

SYSTEMATIC, STRATIGRAPHIC, GEOGRAPHIC AND PALEOECOLOGICAL  
DISTRIBUTION OF THE LATE CRETACEOUS SHARK GENUS *PTYCHODUS*  
WITHIN THE WESTERN INTERIOR SEAWAY

by

Shawn Hamm

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I dedicate this work to my family, Amy, Preston, Hayden and Emily, for all of their love  
and support.

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by

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THESIS

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November, 2008

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This is the first comprehensive review of the Cretaceous elasmobranch family Ptychodontidae and the first 3 dimensional morphometric analyses regarding the variability in each species and tooth position of individual teeth within the dentition. The Ptychodontidae consists of four genera, *Hylaeobatis*, *Heteroptychodus*, *Paraptychodus n. gen.* and *Ptychodus*. *Hylaeobatis*, *Heteroptychodus* and *Paraptychodus n. gen.* are considered successive sister taxa to *Ptychodus*. Based on stratigraphic occurrence, modification in dental morphology within the family illustrates continuous specialization. Dental characteristics indicate that the high crowned species of *Ptychodus* arose repeatedly and separately from low crowned sister species. Skeletal elements associated with *Ptychodus* include, dermal denticles, circular vertebral centra, plesoid pectoral fin and a dorsal fin, suggesting *Ptychodus* has a spindle shaped body. Its co-occurrence with large lamniform

shark taxa in contemporaneous deposits suggests that *Ptychodus* were large bodied predators capable of moving at fast speeds that occupied the apex of the food chain. The use of 3 dimensional morphometric data capture and statistical analysis demonstrates that it is possible to determine the exact placement of an individual tooth specimen within a dentition that can contain up to ten tooth files. Based on this data the systematic position of the family Ptychodontidae should be placed within its own order, the Ptychodontiformes at the base of the SuperOrder Galea.

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## CHAPTER 1

### INTRODUCTION

*Ptychodus* is a Cretaceous shark genus known from early Middle Cenomanian to early Early Campanian marine deposits of North and South America, Europe, Africa, and Asia (Cappetta 1987). The genus is known primarily by its teeth, which are characterized by a massive crown suited for crushing shelled macroinvertebrates (durophagy: e.g., see Kauffman 1978; Stewart 1988a). Based on an articulated specimen (e.g., MacLeod 1982), teeth were arranged in parallel tooth files in both the upper and lower jaws, forming a pavement-like dentition.

Species of *Ptychodus* are differentiated on the basis of variations in dental morphology. In occlusal view the tooth crowns of all *Ptychodus* species are generally square to rectangular, and the central portion of the crown surfaces have several parallel or radial ridges. Surrounding the central portion of the crown is the marginal area, which exhibits various textural patterns (e.g., granular, concentric, radial) formed by numerous small ridges, pits and tubercles. The crown rests on top of a massive tooth root, which may be weakly bilobed. The tooth root is smaller in dimension than the crown and has many foramina located at the crown-root interface. The criteria used to distinguish various species of *Ptychodus* include crown height, the configuration and number of ridges on the tooth crown, and the ornamentation on the marginal area (Hamm and Shimada, 2004).

The first description of *Ptychodus* (Bruckmann, 1752) was based on an isolated tooth specimen and it was considered to be the “palate of an unknown fish”; a view held by other early workers (Parkinson, 1811; Morton, 1822). Agassiz (1843) named the genus *Ptychodus*, and soon thereafter multiple species of *Ptychodus* were described; some included relatively complete tooth associations (Woodward, 1887, 1911; Williston, 1900; Canavari, 1916). These specimens shed new light regarding the variations in dental morphology within the genus; however, they added little information to resolve the ordinal placement of the genus.

Based on tooth morphology alone, *Ptychodus* was considered to be a “cestraciont” because it has a crushing dentition, and was assumed to have a dental arrangement similar to the modern bullhead shark *Heterodontus* (Agassiz, 1839; Owen, 1840; Casier, 1953). Woodward (1887) noted that the dentition of *Ptychodus* does not have small prehensile anterior teeth as in *Heterodontus* and suggested that it was more closely allied to the batoids and subsequently placed the genus within the Myliobatidae (Woodward, 1889a). This view was supported by many paleontologists during the 20<sup>th</sup> century because the dental arrangement and position of the tooth files is pavement-like and very similar to modern rays (Williston, 1900; Leriche, 1902; Dibey, 1911; Canavari 1916; White, 1937; Romer, 1945). *Ptychodus* has also been considered to be a hybodont shark because of the root structure it shares with other hybodontoids (Patterson, 1966; Cappetta, 1987; Welton and Farish, 1993; Brito and Janvier, 2002, and Cuny, 2003). More recently, *Ptychodus* has been theorized to be closely related with the Neoselachii, or modern sharks based on the presence of calcified vertebral centra (Stewart, 1980) and three-layered tooth enameloid (David, 1996; 1999).

## PURPOSE

Most specimens of *Ptychodus* from within the Western Interior Seaway are represented by isolated teeth. Since there is little information regarding the range of intra-specific and inter-specific variation in tooth morphology within the dentition, it has become common practice to “over-split and create new subspecies” (Meyer, 1974; Hermann, 1977) or lump species into general “tooth types.” There are limited reported occurrences of associated or articulated tooth sets of the genus in North America, and of those previously reported (e.g. MacLeod, 1982; Everhart and Caggiano, 2004) there is little information regarding the variation in dental morphology.

In order for researchers to study and fully understand the evolution and taxonomy of any problematic genus, especially *Ptychodus* which is known primarily by its teeth; four basic scientific practices must be made (Hamm et al., 2003). First, unsubstantiated records of the occurrence of a taxon must be substantiated. For example, many of the specimens reported in a well known and widely used publication in elasmobranch descriptions and discussions (Welton and Farish, 1993) are located in private collections and their occurrences and distributions cannot be substantiated. Secondly, detailed and thorough collecting practices are necessary. For

example, Hamm and Shimada (2002) pointed out the probable presence of collecting bias towards larger taxa in the Smoky Hill Chalk Member of the Niobrara Formation in Kansas. This is also likely to occur in other collecting areas as the “largest and best preserved” specimens are the most desired. Third, better-detailed and careful record keeping of locality data and stratigraphic occurrences of collected specimens is required. Without these data, extrapolation of true stratigraphic and geographic occurrences cannot be resolved. Fourth, collected specimens must be properly curated in public museums. *Ptychodus* is poorly represented in North American museum collections and many contain little to no stratigraphic or geographic information. In addition, some previously reported occurrences of associated tooth sets (*i.e.* *P. whipplei* Welton and Farish, 1993, p. 68) could not be located for study in any institutional repository.

## MATERIALS AND METHODS

Building on earlier research and reports conducted by Hamm (2002, 2003, 2004, and 2005), this study focuses on the stratigraphic and geographic distribution of *Ptychodus* within the Western Interior Seaway with comments on systematic relationships. I reviewed material reported in the literature and within museum collections and compared them to the type specimen designated for each species. My identifications of each species are based on the morphology observed within the type specimens.

This study focused on nine associated tooth sets, carefully noting the dental morphology among the tooth files available in each. Specific, quantifiable data were obtained from each tooth within the dentitions incorporating various dental characteristics including: tooth width, length, height, angle of the tooth crown (if applicable), height, and the area occupied by the crown and marginal area. These measurements were acquired from each individual tooth within these dentitions using Imersion Corporations Microscribe 3DX from Southern Methodist University’s imaging lab. The Microscribe is a digital scanner that records 3-dimensional information from specific points of interest, or landmarks, enabling the creation of a 3-D model. The three dimensional model is beyond the scope of this work but the numerical values obtained for each landmark are accurate to 1000th of a millimeter and allowed the creation of a base-line data set showing the amount of variation in each character throughout a single tooth set. The 3-D values were processed using Palaentological Statistics (PAST) version 1.81 (Oyvind Hammer,

D.A.T. Harper and P.D. Ryan, 2008). Measurements taken from isolated tooth specimens and compared to the values obtained from the tooth sets to determine that tooth's possible placement within the dentition. All statistical data was processed using SYSTAT 12 (Cranes Software International).

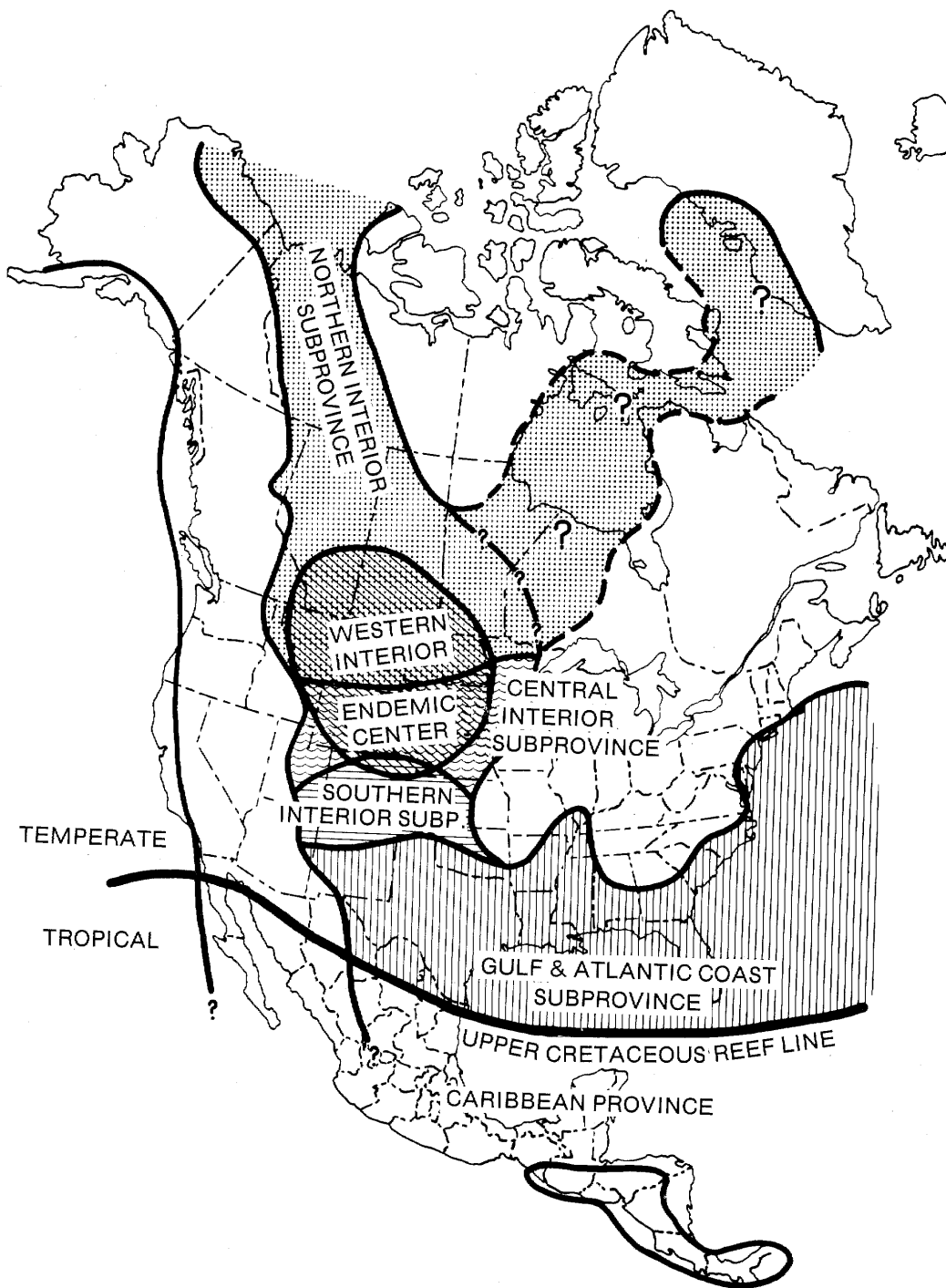
Other elements encountered during this study included jaw elements, vertebrae, calcified cartilage and denticles. Scanning electron microscope (SEM) images of the cartilage and denticles were taken using a JEOL JXA-733 Superprobe at the Geoscience Department at Southern Methodist University. Plate images were taken with an Olympus E-volt 500 digital camera and edited using Photoshop CS3 and Macromedia Freehand. Line drawings were created by making a tracing laying a clear sheet of transparent plastic over an image of the specimen and tracing their outline with a marker. The tracings were scanned and reduced in size and supplementary data such as labeling characters or other features was done digitally within Photoshop.

The paleoecological distributions for each species are based on referable specimens found within specific biohorizons and were correlated throughout the Western Interior Seaway using ammonite, inoceramid and planktonic nannofossil zones.

Material used for this study is located at the American Museum of Natural History, New York, **AMNH**; Booth Museum of Natural History, Brighton, UK, **BMM**; British Museum of Natural History, London, UK, **BMNH**; Columbus State University, Columbus, Georgia, **CSU**; Fort Hays State University Sternberg Museum of Natural History, Hays, Kansas, **FHSM**; University of Kansas Museum of Natural History, Lawrence, KS, **KUVP**; Museum of Northern Arizona, Flagstaff, AZ, **MNA**; Monkton Nature Reserve, Kent England, **MNR**; State Development and Reform Commission, Horizon Scotland, **SDRC**; Saskatchewan Museum of Natural History, Regina, Saskatchewan, Canada **SMNH**; New Mexico Museum of Natural History and Science, **NMMNH**; South Dakota School of Mines and Technology, Rapid City, South Dakota, **SDSM**; Shuler Museum of Paleontology, Southern Methodist University, Dallas, TX, **SMU**; University of Alberta Laboratory for Vertebrate Paleontology, Alberta Canada, **UALVP** and the United States National Museum of Natural History (Smithsonian Institution), Washington, D.C. **USNM**.

## GEOLOGIC SETTING

Three major paleobiogeographic divisions of the western interior represent average expressions of broad climatic zones, representing from north to south cool, mild, and temperate climate zones (Jeltzkey, 1971; Kauffman, 1973; Scott, 1977; Kauffman, 1988) during the Cretaceous (**Fig. 1**). The distribution of the macro and microfauna in the Western Interior basin reflects gradients in physical oceanographic properties (temperature, salinity, and/or dissolved oxygen) from north to south (Kauffman, 1988). These differences are generally attributed to interactions between northern Boreal and southern Tethyan waters. A cool temperature zone existed from the northern Circum-Boreal Sea and progressed southward to the middle arm of the seaway. Here, a mild temperate zone was present between northern Wyoming-South Dakota, north Central Utah, northern Colorado and Kansas. A warm temperate southern zone derived from the Gulf Coast Subprovince during northward invasion of the southern arm of the seaway occurred between south eastern Utah, northeastern Nevada, northern Arizona, New Mexico, northern Texas, central to southern Kansas, and northwestern Oklahoma. These three paleobiogeographic divisions of the seaway comprise Northern, Southern, and Central Interior sub-provinces were characterized by long and broadly defined biozone assemblages that were very dynamic with durations that lasted for millions of years (Kauffman, 1994).



**Figure 1.** Cretaceous climatic Zone Provinces (from Kauffman, 1988).



Correlation between the three provinces resulted in the development of species or genus range zones characterized by single index fossils, mainly from ammonites (Cobban and Scott, 1972; Cobban, 1985; Elder, 1985; Kennedy and Cobban, 1991; Kennedy et al., 1999), inoceramids (Kennedy and Cobban, 1991; Elder, 1991) planktic foraminifera (Eicher and Diner, 1985), dinoflagellates (Dodson, 2000) and calcareous nanofossils (Watkins, 1985; Bralower, 1988) (**Fig. 2**). The occurrence of ammonites in the Western Interior was probably due to the northward flow of warm waters from the Gulf area into the Western Interior Seaway, most of which occurred during the Cenomanian (Cobban, 1993, pg. 437). Inoceramids were widely distributed during the Late Cretaceous and numerous taxa were cosmopolitan. Their rapid and widespread dispersal was probably achieved by long-living planktotrophic larvae and a broad adaptive range of the adult forms. Because of the fast rate of evolution in inoceramids, they have become an important biostratigraphic tool (Voigt, 1995, pg. 343).

			FORAMINIFERA ZONE	AMMONITE ZONE	INOCERAMID ZONE								
Mesozoic	Cretaceous	Late	Campanian	Late									
				Middle									
				Early			<i>Globotruncana/Calculites</i>	<i>Scaphites hippocrepis</i>	<i>Cremnoceramus incostans</i>				
			Santonian	Late									
				Middle									
				Early					<i>Globotruncana bulloides</i>	<i>Clioscapites vermiformis</i>	<i>Inoceramus balticus</i> <i>Cladoceramus undulaticipatus</i>		
			Coniacian	Late									
				Middle									
				Early							<i>Marginotruncan renzi</i>	<i>Scaphites</i>	<i>Inoceramus grandis</i>
		Turonian	Late										
			Middle			<i>Marginotruncana helvetica</i>					<i>Prionocyclus hyatti</i> <i>Collignoceras woolgari</i>	<i>Mylioides</i> <i>Mylioides curvier</i>	
			Early								<i>Sciponoceras gracile</i>	<i>Mylioides labiatus</i>	
		Cenomanian	Late										
			Middle					<i>Rotalipora</i>			<i>Acanthoceras</i>	<i>Inoceramus pictus</i>	
			Early										
		Early	Albian					Late					
								Middle			<i>Hedbergella</i>	<i>Eopachydiscus marcianus</i>	<i>Inoceramus comancheanus</i>
								Early					

**Figure 2.** Invertebrate Biozone Correlation of North American Cretaceous deposits. Modified from Eicher and Diner, 1985; Kennedy et al., 1999; Kennedy and Cobban, 1991.

Marine sedimentation within the Western Interior Seaway is divided into a series of large-scale marine cyclothems. These cyclothems reflect both transgressive and regressive pulses of the seaway in response to variations in rates of tectonic activity and changes in eustatic sea level (McGookey et al., 1972; Kaufmann and Caldwell, 1993). The initial Early Cretaceous inundation of the Western Interior Seaway occurred in the north and proceeded through a series of progressively southward incursions until the early Late Albian (Stelck, 1991). At this time, connection with the southern arm of the seaway was temporarily established across the Trans-Continental Arch during transgression and peak flooding of the Kiowa-Skull Creek Cycle. Prior to this time water from the south was prevented from entering the Western Interior Basin by a series of tectonic barriers, the Ouachita Uplift, and by a relatively low global sea-level (Kauffman and Caldwell, 1993). The isolation of the northern and southern arms of the Western

Interior Seaway ended during the early Late Albian with deposition of the Skull Creek transgressive-regressive couplet of the Kiowa-Skull Creek Cycle (Kauffman, 1977). This cycle records a rapidly rising global sea level along with increased basin subsidence allowing the southern sea to breach the Trans-continental Arch briefly.

The mixing and overturn of the Skull Creek and Mowry seas was primarily the result of the Greenhorn Cyclothem (Early Cenomanian) which initiated rapid southward flooding of the seaway in response to latest Albian and the earliest Cenomanian eustatic sea level rise (Kauffman and Caldwell, 1993). The transgression progressed over the Western Interior Basin from two converging oceans, a southerly transgressing Arctic Ocean to the north and northerly transgressing Atlantic-Tethyan seas to the south from the Gulf of Mexico merging at the midcontinent of the during the early Middle Cenomanian (Kauffman and Caldwell, 1993). The merger caused the alteration of water circulation and the mixing of water masses, resulting in a shift from an oxygen-stratified basin to a normal marine condition (Kauffman and Caldwell, 1993). Data based on calcareous nanofossils (Watkins et al., 1993) suggest that warm water mass from the “pre Gulf of Mexico moved northerly with a rapid lateral expansion as the Western Interior Seaway developed. The majority of specimens in this report are from Cenomanian and Turonian deposits from South Dakota (**Fig. 3**), Kansas, Colorado (**Fig. 4**) and the Eagle Ford Group in Texas (**Fig. 5**). Lithologic units from the Greenhorn consist of interbedded limestones, chalky limestones and shales containing diagnostic ammonites (including baculitids), inoceramids, oysters and cirripeds (Hattin et al., 1987) as well as a vertebrate fauna composed of numerous elasmobranch, osteichthyian, and aquatic reptiles (Shimada et al., 2006) indicative of an offshore shelf environment. A major lowering of sea level after peak transgression of the Greenhorn Cycle took place during the Early to the Late Turonian (Kauffman and Caldwell, 1993). The sea became increasingly brackish and stagnant, which was attributed to greater restriction on current and tidal circulation away from the apertures, coupled with increased internal runoff of fresh water into the basin (Kauffman, 1977).

ERA	SYSTEM	STAGE	FORMATION	MEMBER
Mesozoic	Upper Cretaceous :	Campanian	PIERRE SHALE	Sharon Springs
				Gammon Ferr
		Santonian	NIOBRARA FM.	
		Coniacian	CARLILE SH.	Sage Breaks
				Turner Sandy
		Turonian	CARLILE SHALE	Pool Creek
		Cenomanian	GREENHORN FORMATION	
			BELLE FOURCHE SH.	
			Clay Spur Bent.	
		Albian	MOWRY SHALE	
			NEWCASTLE SS.	
		Albian	SKULL CREEK SHALE	
FALL RIVER FORMATION				

**Figure 3.** Upper Cretaceous Stratigraphy of South Dakota (after Cicimurri, 1998).

PERIOD	STAGE		AGE	FORMATION	MEMBER
Upper Cretaceous	Turonian	Upper	89.3 mya	Eagle Ford Group	Arcadia Park
		Middle	93.5 mya		Kamp Ranch
		Lower			Arcadia Park
	Cenomanian	Upper			Britton
		Middle	Tarrant		
		Lower	99.6 mya		Woodbine

**Figure 4.** Eagle Ford Group Stratigraphy in North Central Texas (after Welton and Farish, 1993).

ERA	SYSTEM	SERIES	STAGE	FORMATION (GROUP)	MEMBER (THICKNESS IN METERS)	
Mesozoic	Upper Cretaceous	Gulfian	Campanian L - U	Pierre Shale	Weskan Shale (52)	
					Sharon Springs Shale (47)	
			Santonian L - U	Niobrara Chalk	Smoky Hill Chalk (171-189)	
						Coniacian L - M - U
			Turonian M - U		(Colorado Group)	
						Blue Hill Shale (51.2-56.4)
				Fairport Chalk (27.5-36)		
				Greenhorn Limestone		Pfeifer Shale (6.4)
						Jetmore Chalk (6.1-6.4)
			Cenomanian L - U	Hartland Shale (8.8-10.7)		
				Lincoln Limestone (6.4-7.6)		
				Graneros Shale (7.6-11)		
			M	Dakota Formation	(15.3+)	

Figure 5. Upper Cretaceous Stratigraphy of Kansas (after Hattin, 1982).

The Niobrara cyclothem occurred in the middle Early Coniacian, Late Coniacian, Santonian and Early Campanian stages of the Late Cretaceous. Transgression occurred once again and continued flooding of the Western Interior Basin during the Early Coniacian resulted in change of lithology from limestones and shales to chalk and marl deposits that were rich in organic carbon (Kauffman and Caldwell, 1993). The majority of specimens observed from the Upper Cretaceous are from the Basal Atco Formation of the Austin Group in Texas, the Niobrara Formation in Kansas and Tombigbee Member of the Eutaw Formation in Alabama (**Fig. 6**).

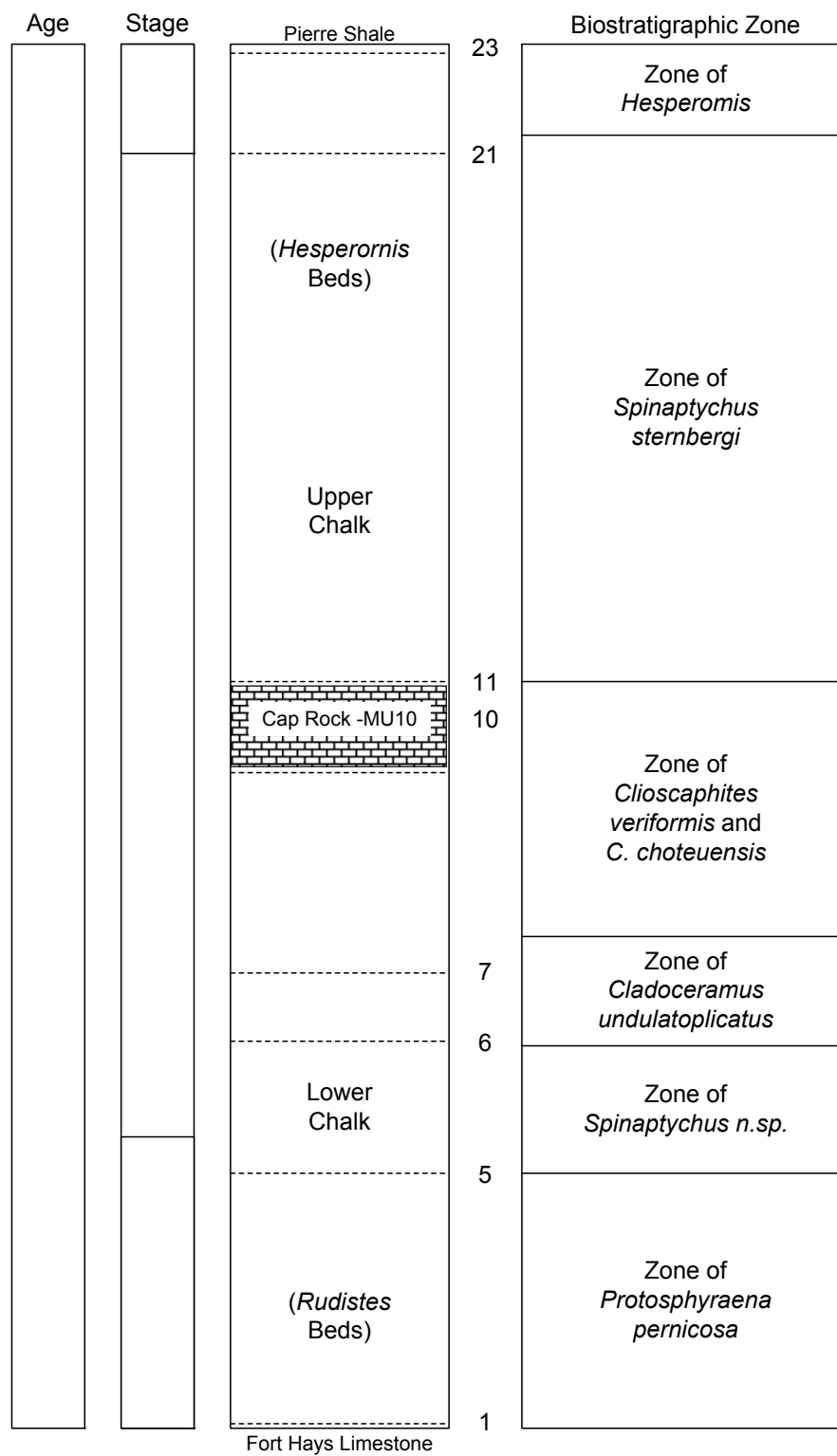
PERIOD	STAGE	AGE MYA	GROUP MEMBER		
			TEXAS	GULF COAST	
Upper Cretaceous	Campanian	70.6	Taylor Group	Pecan Gap Chalk	Demopolis Formation
				Wolfe City	Mooreville Formation
				Ozan	Tombigbee Sand Member
	Santonian	83.5	Austin Group	Gober Chalk	Eutaw Formation
				Brownstown	
				Austin Chalk	X
	Coniacian	85.8	Austin Group	Atco	
				Middle	
				Upper	
	Coniacian	89.3	Austin Group	Atco	X
				Middle	
				Lower	

**Figure 6.** Upper Cretaceous Stratigraphy of Texas and the Gulf Coast (after Cobban and Kennedy, 1993 and Kennedy et al., 1997).

The Austin Group is a deep-water deposit that has a very fine textural composition throughout its range in Texas, except in the Atco Formation, which was deposited in an open, offshore shallow shelf environment (Hovorka and Nance, 1994). Lithologically, the Atco Formation is a coarse-grained facies with alternating beds of chalky marls, chalky limestone and shale stringers with abundant phosphatic nodules (Young, 1985). Planktonic foraminifera data correlate the Atco Formation with the Fort Hays Limestone Member (Early Coniacian, 88 mya) of the Niobrara Formation in western Kansas (Frerichs and Deiss, 1987).

The Smoky Hill Chalk Member of the Niobrara Formation is composed of light-olive gray to olive gray chalky shale containing nearly white spheroidal calcareous coccolith fecal pellets (Hattin, 1975c). The chalk is evenly laminated and scattered throughout the member are thin bentonite seams that have been used to construct stratigraphic composite sections (Hattin, 1982; Hattin and Seimers, 1978). The Smoky Hill Chalk is renowned for its content of marine vertebrate fossils including mosasaurs, plesiosaurs, pterosaurs, turtles, birds, teleosts, and sharks. Stewart (1990) developed a scheme for biostratigraphic zonation of vertebrate remains including stratigraphically significant inoceramids and rudist bivalves while also incorporating Hattin's (1982) Marker Units which are comprised of distinctive bentonite seams (**Fig. 7**).





**Figure 7.** Biostratigraphy of the Smoky Hill Chalk Member Niobrara Chalk (from Hattin 1982 and Stewart 1990).

The Eutaw Formation and the Tombigbee Member were deposited across the eastern Gulf of Mexico Coastal Plain throughout the Santonian with the uppermost Tombigbee Member ranging into the base of the Campanian (**Fig. 6**). The Eutaw Formation contains a variety of lithofacies that reflect a range of nearshore and marine environments developed around a series of barrier island systems (Case et al., 2001). Lithologically it is comprised of clean sandstones, argillaceous, marly, sandstones; and sandy, marly mudstones with the vertebrate fauna being found in nearshore environments (Case et al., 2001).

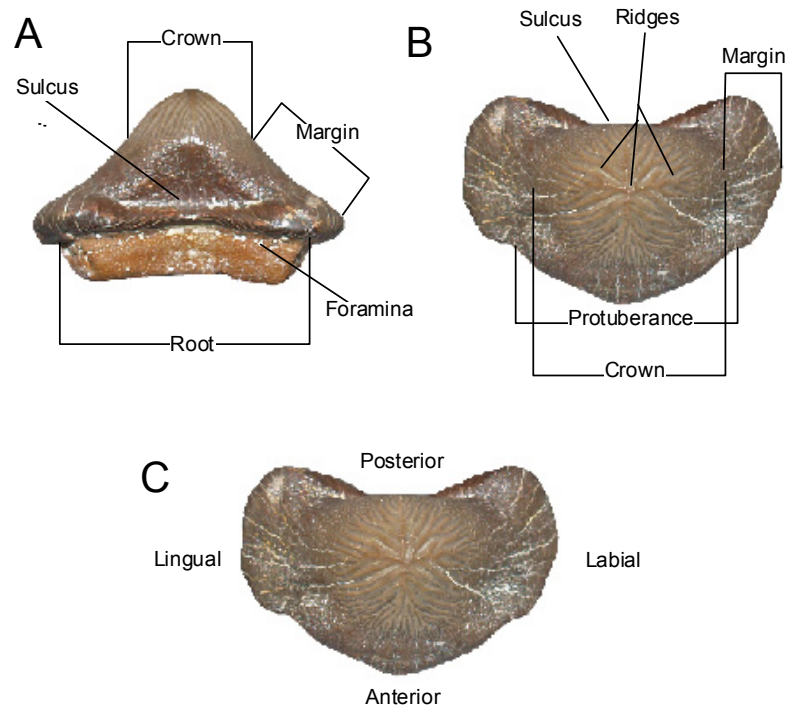
The last of the major marine transgressions during late Early Campanian, the Bearpaw cyclothem, resulted in a change in lithology from the chalks and marls of the Niobrara Seaway to dark gray muds of the Pierre Seaway (McGookey et al., 1972) and was the last of the major marine transgressions (He et al., 2005). Rapid draining of the Western Interior Basin occurred due to tectonic activity, and the seaway withdrew completely by the Late Maastrichtian (Kauffman and Caldwell, 1993).

## CHAPTER 2

### TOOTH CHARACTERISTICS

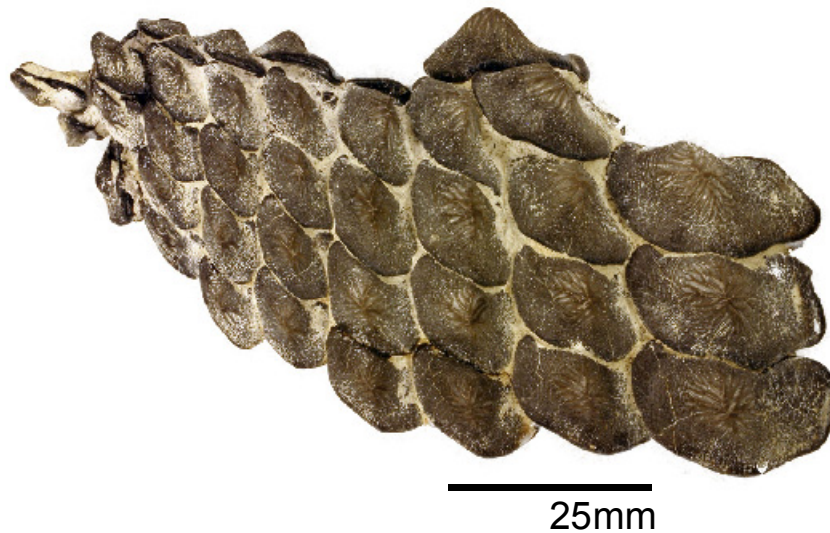
The teeth of *Ptychodus* are unique compared to other elasmobranchs. The **tooth crown** is square to rectangular in shape, having a thick crown that is either elevated or flat depending on species. The apex of the crown possesses a number of sharp **enameloid ridges**. The crown is usually surrounded by a well-developed **marginal area** of varying width that is covered by enameloid wrinkles of varying thicknesses and orientations, although they are typically concentric with the crown. The tooth crown and margin overhangs the tooth root on all sides. The **tooth root** is anaulacorhizous, which is a root that is flattened or tabular, lacking a nutrient groove, with foramina at the top of the root just below the crown all around the tooth. The tooth root is square and bilobed with the center of the root being concave presumably for articulation within the dental cartilage.

Tooth orientation terminology for sharks and rays is different from convention in other vertebrates (**Fig. 8**). In *Ptychodus* the **anterior** or rostral tooth side is convex with a **protuberance** that overhangs the tooth root, whereas the **posterior** or caudal side is concave with a **sulcus** of varying depths and widths. The anterior protuberance fits within the posterior sulcus of the preceding tooth within the tooth file. The **lingual** (mesial) tooth edge is oriented towards the midline of the jaw and may be straight or double angled with the top edge being short with an acute angle and a longer bottom edge with an obtuse and rounded bottom edge. Together they create an edge for interlocking with teeth in adjacent tooth files. The **labial** (lateral or buccal) tooth edge is oriented toward the “cheek side” of the jaw. It can have a rounded, straight or angled edge depending on tooth file position (**Fig. 9**). The terms mesio-distal, mesial-distal or meso-distal all have the same meaning and have been used interchangeably.



**Figure 8.** General *Ptychodus* tooth Characteristics; A, posterior view, B, C apical views.

Individual teeth possess structures specialized for interlocking with adjacent teeth in the same file and with teeth in neighboring tooth files (Macleod, 1982). The posterior tooth side is infolded creating a sulcus or groove, allowing the anterior protuberance of the preceding tooth to fit within; each tooth in a single file is interlocked in the same fashion. Except for the central most teeth, all other files have teeth in which the distal (labial/lingual) tooth edges become progressively angled for interlocking between the mesial edges of two teeth of the previous file. Within the same file, some teeth may have a straight distal tooth edge. Throughout the dentition the mesial tooth edge is tucked underneath the distal tooth edge in the preceding file providing a strong and flexible tooth battery when feeding (**Fig. 9**).



**Figure 9.** Dental Articulation. Apical view of the upper right 3<sup>rd</sup>-10<sup>th</sup> tooth files of *Ptychodus mortoni* (FHSM VP- 2223) illustrating labio-lingual interlocking dental structure.

#### DENTAL MORPHOLOGY

The dentition of *Ptychodus* is confined to the symphyseal region where the teeth are arranged in straight, parallel tooth files forming a crushing pavement dentition. The individual tooth files are closely spaced and directed antero-posteriorly along the ramus of the jaw, with the teeth decreasing in size towards the lateral margins. Teeth within the dentition are interlocking and exhibit dignathic heterodonty (Woodward, 1911; Welton and Farish, 1993).

When describing sharks with pavement dentitions, the terms tooth row and tooth file have been used interchangeably by various authors and can be confusing. The term **tooth row** should be used when referring to teeth in the mesial-distal direction along the dental series. All of the teeth in a tooth row are represented by teeth at the same developmental stage; whereas teeth in an adjacent row may be at slightly different stages of development. The term **tooth file** should be used for describing teeth in the antero-posterior direction. These teeth may be at different developmental stages but are derived from the same tooth bud position within the dental lamina. Four distinct types of teeth and eight to ten tooth files have been recognized within the tooth sets reviewed and each file is located in specific areas along the ramus of the jaw (**Figs. 10, 11**). The number of tooth files varies between species. When examining individual teeth, the characteristics observed can offer clues to the exact position of that tooth within the dentition.

## DENTAL ARRANGEMENT

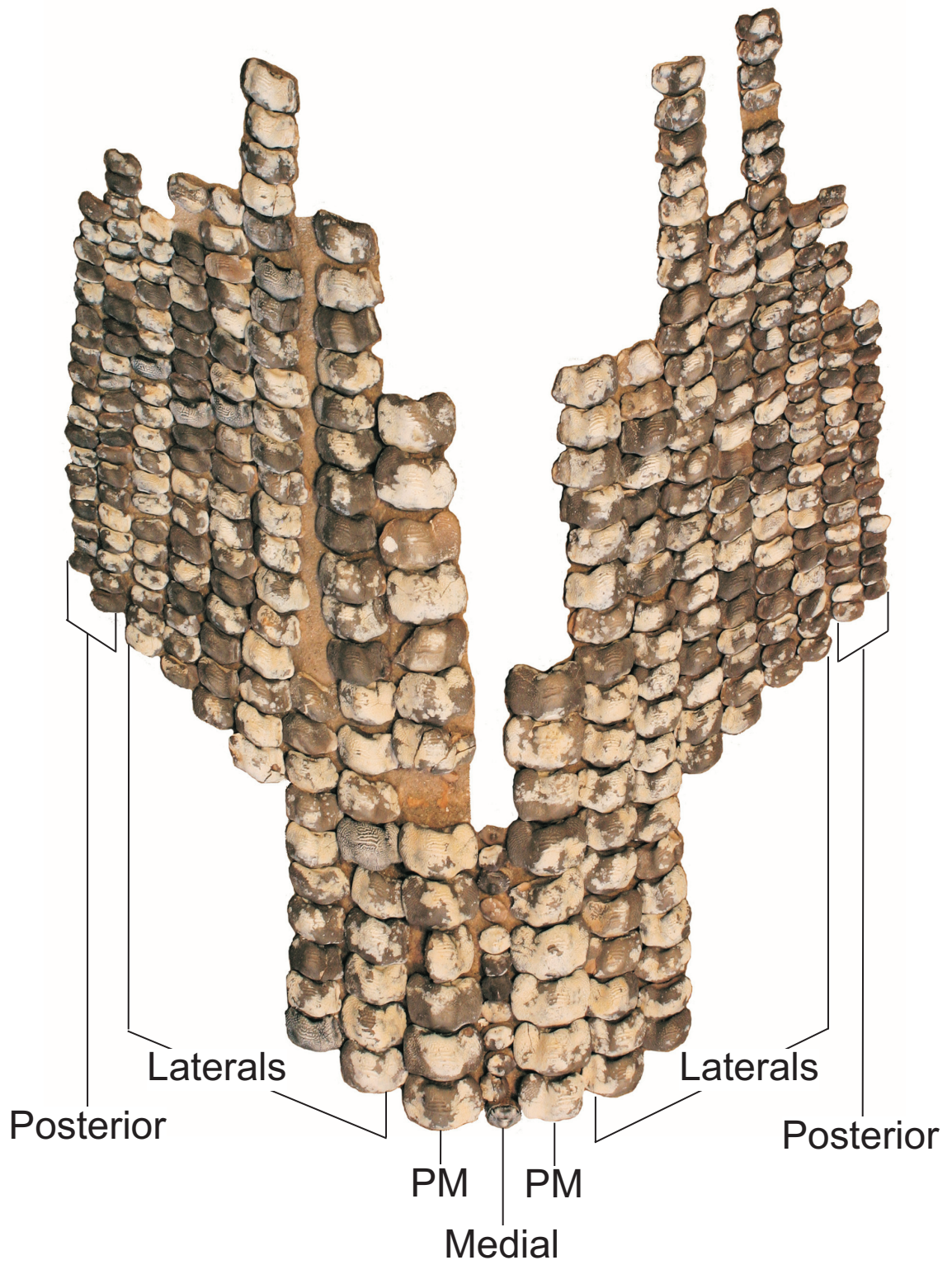
**Medials.** - In the upper dentition the medial file teeth (**Fig. 10**) are located centrally on the midline of the jaw and are much smaller than those in the lower dentition. The tooth crown is square to rectangular in outline having a small occlusal bump on the center of the crown. The marginal area is typically smooth, not possessing the characteristic marginal ornamentation as in other files. The upper medial file is sunk beneath the para-medial files creating a groove for the larger lower medial teeth to fit within, similar to what is seen in the modern Bowmouth Guitar fish *Rhina anclystoma*.

Medial teeth in lower dentition (**Fig. 11**) are the largest and most symmetrical teeth within the dentition, located on the midline of the jaw. In occlusal view the apex of the medial tooth crown is equidistant from the marginal area in the mesial-distal and antero-lateral directions. The medial tooth possesses a deep and distinctive lingual sulcus and extended labial protuberance. The tooth root is massive and symmetrical and is separated into two lobes by a smooth and shallow “groove”.

**Paramedials.** - The para-medial teeth are comprised of two tooth files flanking the medial teeth distally. In the upper dentition (**Fig. 10**) these teeth are more labio-lingually compressed with the cusp inclination being just slightly offset while still retaining a symmetrical tooth root as in teeth of the medial file. In the lower dentition (**Fig. 11**) they are much smaller than the medial file and are similar in morphology to teeth of the lower medial file. They are symmetrical in all dimensions having an upright and centrally located tooth crown and a tooth root that is not displaced. They are differentiated from the upper medial by being narrower and longer.

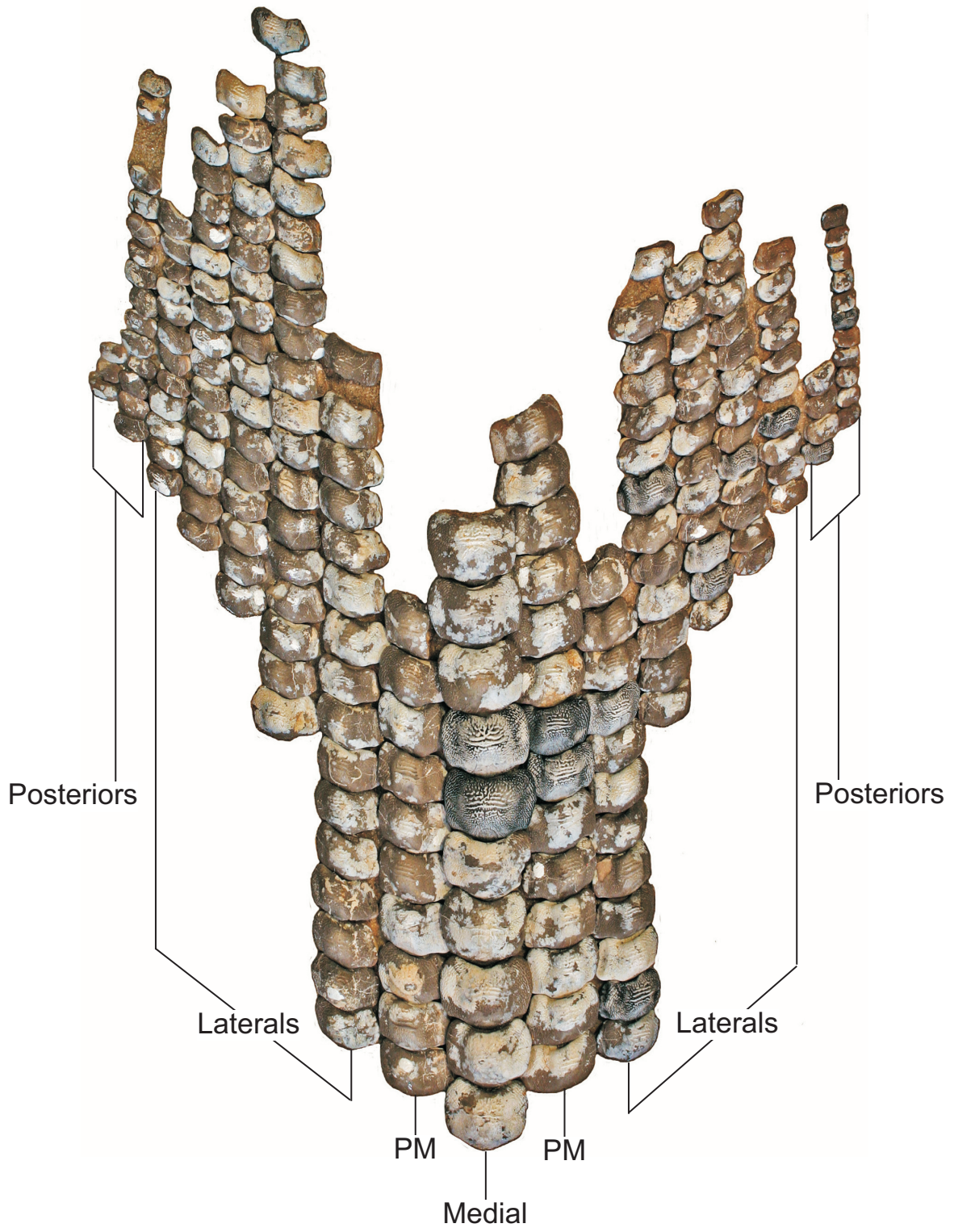
**Laterals.** - The lateral teeth comprise the second through eighth tooth files that decrease in size slightly posteriorly (**Figs. 10, 11**). They become progressively wider laterally with the tooth crown and root being offset from one another. The marginal area on the mesial tooth edge is wider than the distal margin due to the angle of inclination of the tooth cusp. The distal margin becomes smaller in area laterally and is absent in the posterior most files. The mesial tooth edge is either parallel to the tooth crown or greatly angled with a V shape. The distal tooth edge becomes progressively angled and rounded with the left or right (depending on which side of the dentition the tooth is from) lingual tooth edge extending further distally than the labial tooth edge.

***Posteriors.*** - These teeth are the furthest away from the commissure of the jaw and are composed of the 9<sup>th</sup> and 10<sup>th</sup> tooth files (**Figs. 10, 11**). They are the smallest teeth in the dentition, being meso-distally elongate and labio-lingually narrower than teeth from other files. The tooth crowns are greatly off center or completely flat compared to other files depending on the species. These teeth appear to lack functionality, serving as spacers or support in the lateral quadrant of the jaws.



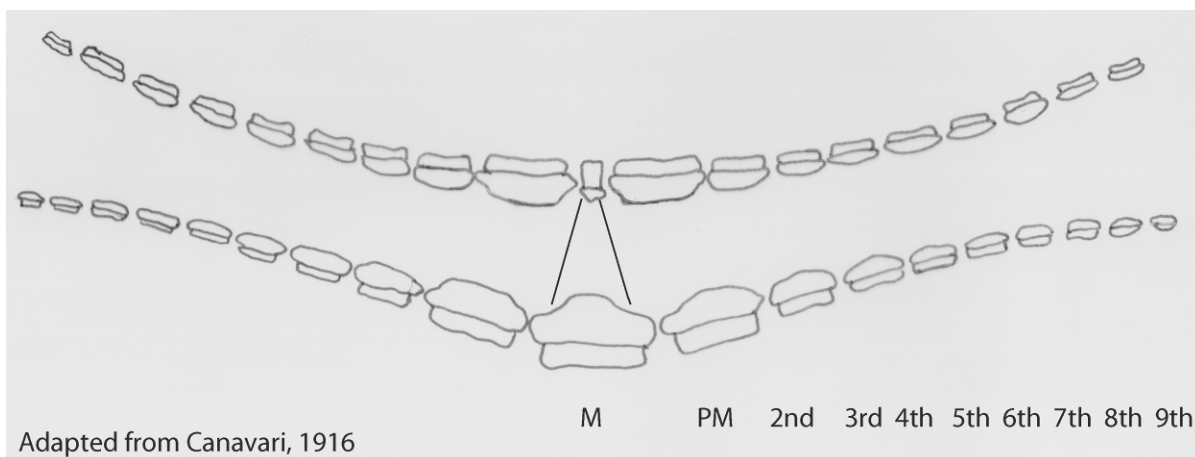
**Figure 10.** Upper Tooth File Designations (based on *P. rugosus* SMU 69002).





**Figure 11.** Lower Tooth File Designations (based on *P. rugosus* SMU 69001).

The teeth in both upper and lower tooth plates do not occlude against each other directly at the apex. Instead, the lingually offset tooth crowns allow the teeth to interlock with one another with the occlusal surfaces fitting in between the labial and lingual margins of two teeth in the opposite jaw (**Fig. 12**).



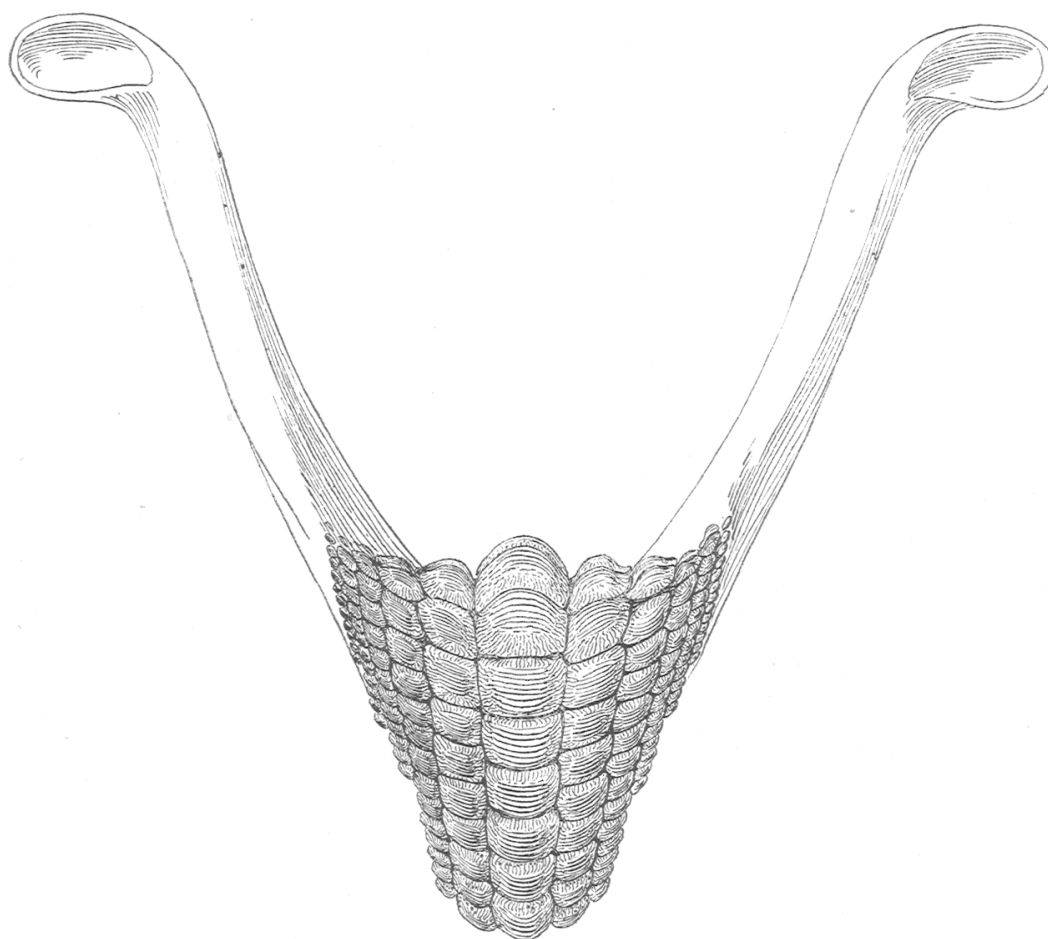
**Figure 12.** Generalized pattern of dental occlusion in anterior (rostral) view (adapted from Canavari, 1916).

Nine tooth sets were observed in this study; 3 consisting of both the upper and lower dentitions and six by single dentitions only. Shimada (2005) defined the types of elasmobranch tooth sets present within the fossil record and discussed the taphonomic processes that influence the interpretations that can be obtained from each. Teeth that are found in association with one another can be defined as being associated, articulated, or disarticulated. An **associated tooth set** is a tooth set composed of a single individual that may or may not exhibit the original tooth arrangement. An **articulated tooth set** is a dental series from one individual shark preserved in life position such that there is no question about their row group order. A **disarticulated tooth set** is an associated tooth set from one individual shark that has undergone postmortem disturbance.

If a large enough sample of isolated teeth from a single species can be collected their positions within the jaw can be determined with reasonable certainty (Cunningham, 2000) when grouped according to the above characters. It is easier to compare tooth shapes when the teeth are arranged in horizontal rows with tooth crowns pointing in the same direction. Examination of the tooth length, width, angle of crown inclination, variation of the displacement of the tooth

root and areas of interstitial wear on the marginal area is necessary to help determine position. Progressing from the midline laterally, the tooth crown generally becomes progressively shorter and the angle of inclination greater, creating a wider mesial marginal area until the posterior most files which have nearly flat to flat occlusal surfaces. When grouped according to these characters it is possible to create an **artificial** or **composite tooth set**, which is a hypothetical dental series reconstructed from the teeth of the same species but from many different individuals.

Several of the tooth sets obtained for this study were disarticulated sets of a single individual. They were reassembled by arranging teeth in vertical files with angle of the tooth crowns pointing in the same direction, left or right. Each tooth was measured according to length, width and angle of crown displacement and grouped according to similar characteristics as those stated above. I followed the dental arrangement of SMU 69001-69002 (**Figs. 10, 11**) regarding the positioning of the individual files as these tooth plates were recovered in their natural position (MacLeod, 1982). This arrangement parallels Woodward's (1911) reconstruction (**Fig. 13**) which has teeth adhered to the dental lamina in their natural order (**Fig. 16**).



**Figure 13.** Dental reconstruction of *P. decurrens* (BMM-8524) showing arrangement of lower dentition with Meckel's cartilage (occlusal view). After Woodward (1911).

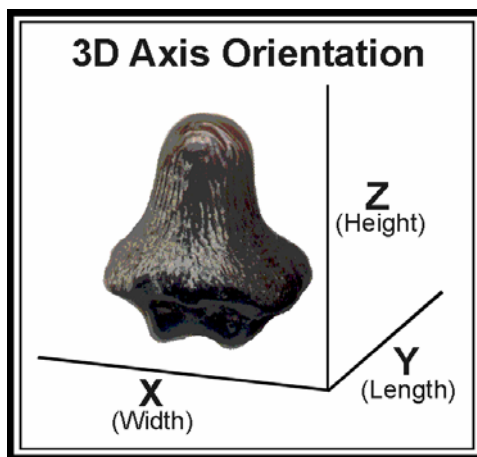
## CHAPTER 3

### STATISTICAL ANALYSIS

Statistical analyses were performed 1) To define the variation in tooth morphology within the dentition of *Ptychodus*, 2) to quantifiably define dental characters using landmark 3-D morphometric analysis; 3); to use those characters in phylogenetic analyses for use in species identification and 4) to determine possible tooth file placement of isolated tooth specimens (i.e. non-articulated teeth) from the fossil record.

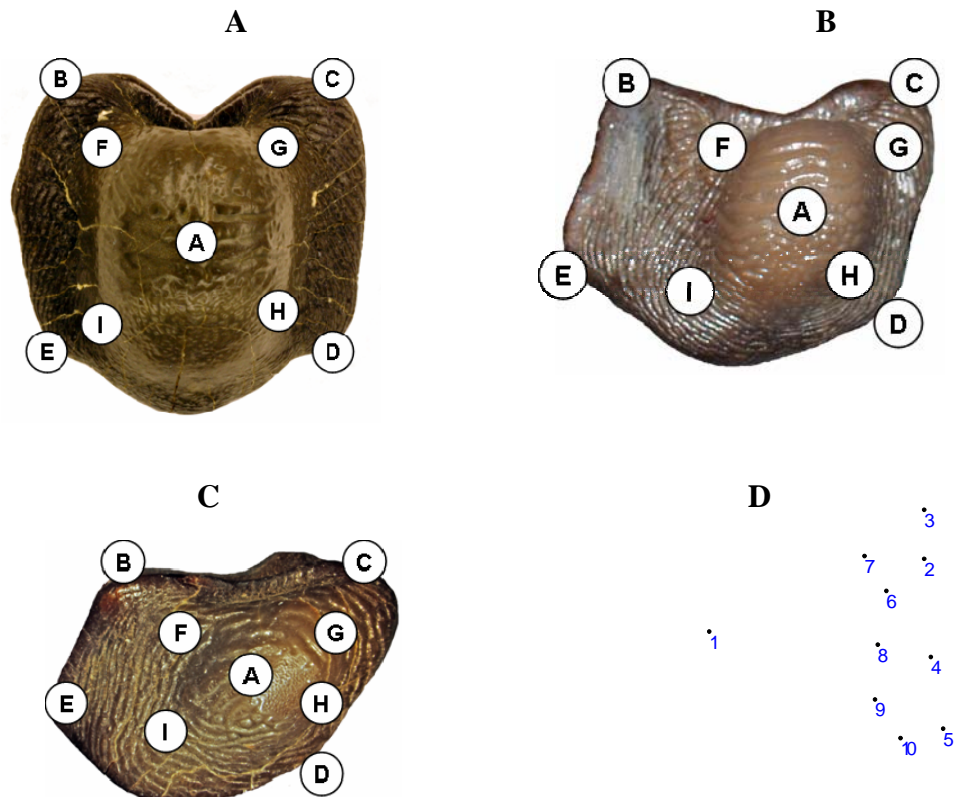
#### METHODS

Individual specimens are described by groupings of landmark coordinates expressed in terms of the standard 3D coordinate system containing X, Y and Z axes. The orientation of these axes and the arbitrary terms of width, length and height, and the relationships of these terms to the specific axes are described in Figure 14.



**Figure 14.** 3D Axis Orientation

Each tooth specimen was measured and described based on 9 individual landmark data points. The landmarks used for the purpose of this analysis (**Fig. 15**) include the top of the tooth crown (A), the four lateral most tooth edges (B-E), and the four quadrants of the tooth crown where it meets at the margin (F-H).



**Figure 15.** Landmark data points used in analysis as taken on medial (A), lateral (B) and posterior (C) tooth files; D, 3-D model of plotted data points with the tooth turned sideways showing planar relationships; 1= point A; 7, 8, 9, 10= points F, G, H, I; 2, 3, 4, 5= points B, C, D, E.

Figure 15 D demonstrates the planar relationships in 3-D between each of the landmark data points. The figure is rotated 90° counterclockwise to demonstrate the planar relationships between each point. It is the base line or zero point where each measurement is taken from. Landmark point A, (represented by # 1) is a single point that represents the top of the tooth crown, the highest level, or uppermost horizontal plane. The grouping of landmarks F, G, H, I

(#'s 7, 8, 9, and 10) create another plane lying below the level of point **A**. The distance between this group of landmarks define the length and width of the tooth crown. The distance between plane **A** and **F, G, H, and I** define the height of the tooth crown. The landmark points **B, C, D,** and **E** (#'s 2, 3, 4, and 5) represents the lateral tooth edges and creates the lowest plane measured on the tooth. The distances between these landmark points define the tooth length and width.

### TOOLS

Each tooth specimen was measured using Immersion Corporations Microscribe 3DX (**Fig. 16**). The Microscribe is a type of 3-D scanner that works by recording x-y-z coordinate axes at the location of the tip of its stylus on the entire series of landmark data points figured above. All of the 3D data gathered was processed using the Paleontological statistics tool PAST ver. 1.81 (Hammer et al., 2008). The PAST program is a free-ware software program that utilizes many of the mathematical functions used in quantitative paleontology and can be downloaded at <http://folk.uio.no/ohammer/past/index.html>. All data was organized using Microsoft Excel.



**Figure 16.** Microscribe 3DX digital scanner.

## ANALYSIS

The following formulas were utilized to produce the analysis results:

- Euclidean Landmark Distance Formula:

$$P = (p_x, p_y, p_z) \text{ and } Q = (q_x, q_y, q_z).$$

- The distances between landmarks were computed as:

$$\sqrt{(p_x - q_x)^2 + (p_y - q_y)^2 + (p_z - q_z)^2}$$

- Distance from Plane 1, (point A) to Plane 2 (F, G, H, I) and Plane 3 (B, C, D, E) were computed as:

$$D = (n_x \cdot (a_x - x_1) + n_y \cdot (a_y - y_1) + n_z \cdot (a_z - z_1)) / n_{\text{norm}}$$

Processing the 3-D data within the PAST program utilized these formulas and was not Procrustes fitted or normalized. Some individual tooth specimens were omitted from analyses based on tooth preservation which produced unreliable data. The values obtained from the teeth within each tooth set and isolated tooth specimens of each species were used to establish a quantifiable definition of the arbitrary terms that have been used to describe ptychodontid teeth including, “low, intermediate, high, and narrow and wide crowned” (**Fig. 17**).

## CHARACTER RATIO DEFINITIONS

In order to use the data gathered effectively for species identification, it is necessary to know the specific geographic and stratigraphic locality data of the specimen in question. Having this fundamental information will help greatly in narrowing down the number of species to compare and diagnose from.

The statistical data listed in **Appendix III** includes all landmark distances, which are defined as: **A-B**, apex of the crown to the left posterior tooth edge; **A-C**, apex of the crown to the right posterior tooth edge; **A-F**, apex of crown to posterior left crown edge; **A-G**, apex of crown



to right crown edge; **B-C**, left to right posterior tooth edges (tooth width); **E-D**, left to right anterior tooth edges (tooth width); **F-G**, left to right posterior crown width; **B-E**, labial tooth length; **C-D**, lingual tooth length; **F-I**, labial crown length; **G-H**, lingual crown length, as are the number of crown ridges. For each of the associated tooth sets studied, all of the data from each individual tooth file is summarized using descriptive statistics which includes the minimum and maximum values, mean, standard deviation, tooth height to crown height and the tooth width to crown width ratios. For all other species represented by isolated teeth only the landmark distances are given. Given this, the following characters can be determined and are defined as:

- **Character 1**
  - Tooth Height to Crown Height Ratio is approximated by the orthogonal distances:  $(A-F) / (A-B)$ .
  - Defines low, moderate or high crown tooth heights.
  - Value used for species identification in phylogenetic analysis.
- **Character 2**
  - Left/Right Tooth Height Ratio:  $X = (A-B / A-C)$ .
  - Defines amount of crown offset. Values  $>1$  are defined as being from the right tooth series. Values  $<1$  are defined as belonging to the left tooth series.
- **Character 3**
  - Ratio of Crown Width to Tooth Width:  $X = (F-G / B-C)$ .
  - Designates the amount of area the tooth crown occupies compared to the total tooth width.
  - The values for this character are species dependant. When used to compare specimens within a single species and a given sample, the values are a clear determination of age.
- **Character 4**
  - Ratio of Areas:  $L \times W$  of the tooth perimeter  $(B-C * B-E) / L \times W$  of the crown perimeter  $(F-G * F-I)$ . Species dependant values. When used to compare specimens within a single species and a given sample, the values are a clear determination of age.

The ratio summaries gathered from three species of *Ptychodus* known by associated tooth sets in North America including *P. mortoni*, *P. martini*, *P. rugosus* and composite tooth sets of *P. whipplei* quantify the heretofore unknown variation in dental morphology within the genus. The same ratio values were also obtained from all other species based on individual teeth representing multiple tooth file positions from medial through posterior tooth files. Upon diagnosing the physical characteristics of an isolated tooth to a particular species, it is possible to determine its placement within the dentition by comparing the ratio values obtained from that specimen to the values for that species in Appendix III.

Character 1: Crown height to tooth height ratio	<b>FLAT</b> 0-0.1999	<b>LOW</b> 0.20-0.3999	<b>INTERMEDIATE</b> 0.40-0.5999	<b>HIGH</b> 0.60-0.7999	<b>VERY HIGH</b> 0.80-1.0
Character 2: Left-Right tooth height ratio	<b>LEFT SERIES</b> Files 6+ Ambiguous	<b>LEFT SERIES</b> Files 1-5 <1.0	<b>MEDIAL</b> File 1.0	<b>RIGHT SERIES</b> Files 1-5 >1.0	<b>RIGHT SERIES</b> Files 6+ Ambiguous
Character 3: Crown width to tooth width ratio	<b>NARROW</b> <.60	<b>WIDE</b> >.60			
Character 4: Ratio of areas (length x width)	<b>SPECIES SPECIFIC</b>  <b>Best used in combination with Characters 1-3 to determine tooth file placement within the species.</b>				

**Figure 17.** Character ratio summary.

These data are discussed in more detail with each species diagnosis, description and phylogenetic analysis. All physical characteristics are presented in Appendix I.

**Specimens studied include:**

- *Paraptychodus washitaensis*: Type specimen, SMU 61362; and SMU 76442-76444.
- *Ptychodus anonymus*: Type specimen, KUVVP 55352; isolated teeth, SMU 76420, SMU 63280, SMU 63282, SMU 76422, 62772-62776, and SMU 76421.
- *Ptychodus mammillaris*: Isolated teeth, SMU 62808, SMU 63309, SMU 63310, SMU 75593, KUVVP 32450, KUVVP 32480, KUVVP 55243, KUVVP 85019, KUVVP 55241, KUVVP 25282, KUVVP 55240 and KUVVP 65056.
- *Ptychodus atcoensis*: Type specimen SMU 75598; isolated teeth SMU 75599, SMU 63302 and SMU 76433-76437.
- *Ptychodus occidentalis*: Type specimens ANSP 1460-1464, 1466; isolated teeth, FHSM VP 13200 and SMU 62764-62766.
- *Ptychodus whipplei* composite tooth sets: SMU 76416 and SMU 63290; isolated teeth from the Kamp Ranch Formation (SMU 76424) and Arcadia Park Member (SMU 76409-76412) of the Eagle Ford Group of Texas.
- *Ptychodus rugosus* upper dentitions: AMNH 19553, FHSM VP 2222 and SMU 69002.
- *Ptychodus rugosus* lower dentitions: AMNH 19553, FHSM VP 2223, FHSM VP 2073 and SMU 69001.
- *Ptychodus marginalis*: SMU 76430, KUVVP 55255 A-D, KUVVP 55257 and KUVVP 55263.
- *Ptychodus martini*: Type specimen, KUVVP 55271 and isolated teeth KUVVP 55237, KUVVP 55245, SMU 76427-76429, SMU 76250, SMU 76264 and SMU 76265.
- *Ptychodus latissimus*: SMU 62807, SMU 63286, SMU 75590, SMU 75591, SMU 75592, SMU 76251 SMU 76431 and SMU 76432.
- *Ptychodus mortoni* upper dentitions: FHSM VP 335, FHSM VP 2238 and FHSM VP 16684.
- *Ptychodus mortoni* lower dentitions: KUVVP 55269, FHSM VP 15532, FHSM VP 335, FHSM VP 336, SMU 76278 and SMU 76359.

**CHAPTER 4**  
**SYSTEMATIC PALEONTOLOGY**

Class CHONDRICHTHYES Huxley, 1880  
Subclass ELASMOBRANCHII Bonaparte, 1838  
Cohort EUSELACHII Hay, 1902  
Subcohort NEOSELACHII Compagno, 1977  
New Order PTYCHODONTIFORMES  
Family PTYCHODONTIDAE Jaekel, 1898

*Diagnosis for family.* Sharks with crushing type dentitions with teeth arranged in no less than eight straight, antero-posterior, parallel tooth files. The largest and most diagnostic teeth are located medially with tooth size decreasing laterally along the jaw ramus. Dentitions exhibit dignathic heterodonty, with teeth shaped from low and wide to high and narrow. Teeth of each species have a well developed occlusal surface ornamented with a pattern of raised cutting ridges or numerous reticulate enamel folds and lack lateral cusplets. Each tooth possesses antero-posterior and labio-lingual interlocking structures for articulation with other teeth in the dentition, including a well developed lingual sulcus, labial protuberance and multi-angled mesial and lateral tooth edges. The tooth crown overhangs a narrow and bilobed tooth root that contains numerous irregularly spaced foramina; tooth histology osteodont.

*HYLAEOBATIS PROBLEMATICA* (Woodward 1916)

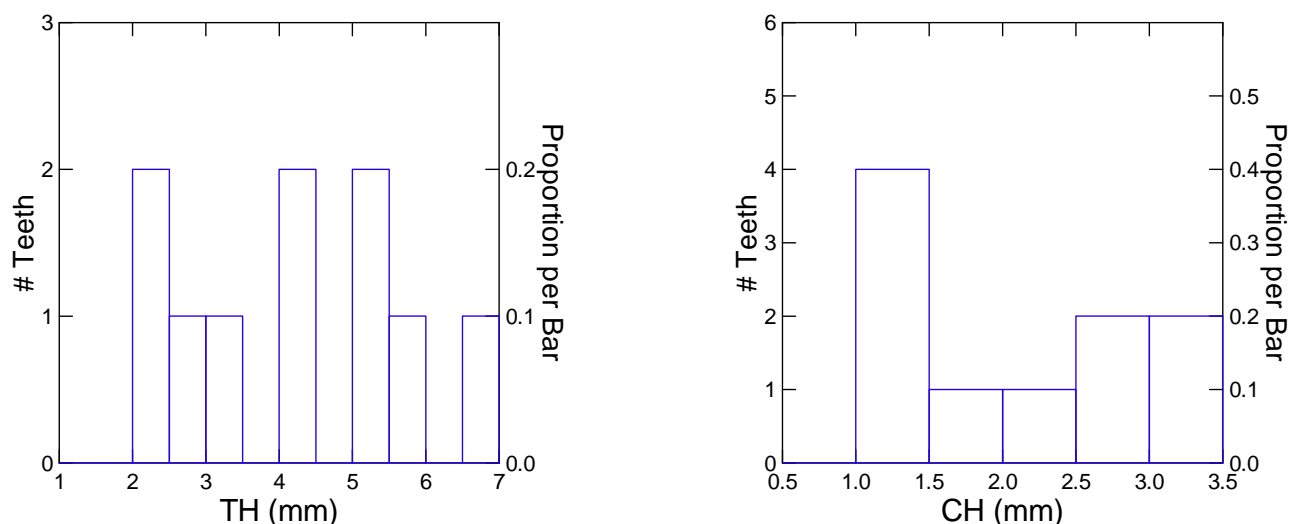
(Plates 1A-1B)

*Hylaeobatis problematica* Woodward, 1916: p. 19, pl. 5 figs. 1-5, text fig. 10.*Hylaeobatis ornatus* Patterson, 1966: p. 333, pl. 4 figs, 1-4, text fig. 28.*Hylaeobatis problematica* Batchler and Ward, 1990: p. 190, pl. 1, figs. 4, 5.*Hylaeobatis problematica* Rees and Underwood, 2002: p. 476.

**Diagnosis.** Teeth transversely elongated, being wider than long and oval to rectangular in occlusal view. The occlusal surface of medial and lateral teeth is wide and flat, ornamented with reticulate enamel folds and lacking lateral cusplets. Posterior teeth have a single, mesio-distal raised crest from which the crown ornamentation radiates from also lacking lateral cusplets. The tooth crown overhangs the tooth root, which is massive with well-developed foramina on lingual face. In all files, the labial protuberance and lingual sulcus are features of the tooth root, not the crown. Dentition type is crushing, exhibiting weak heterodonty. Tooth histology osteodont.

**Type specimen.** BMNH P. 5275, posterior tooth from the Wealden Shales (Barremian) Brixton, Isle of Wight.

**Referred specimens.** BMNH P. 47211-47214.



**Figure 18.** Tooth Height-Crown Height values for BMNH P. 47211-47214.

**Description.** Teeth are bilaterally symmetrical, transversely elongate, and rectangular to square in outline. The crown is greater in length, width and height compared to the crown height in all files (**Fig. 18**). The crown surface is flat ornamented with numerous reticulating enameloid folds which meet and form a straight ridge at the lingual tooth edge. From there, the ridges bifurcate and extend down and terminate at the top half of the cusp. The lower half is completely smooth and terminates sharply at the root. The labial tooth edge is straight with a short protuberance. The enamel folds terminate at the leading tooth edge and do not form a pronounced ridge. The crown is sharply indented and covered with weakly crenulate enamel that makes contact with the top of the root. The occlusal ridges in the posterior teeth merge at the center of the crown forming a distinctly raised ridge that curves lingually at both edges of the crown. The tooth root is well defined; it is narrower than the crown and almost just as long. It is porous with numerous circular foramina at the crown root interface on the lingual edge and at the center of the root on the labial edge. The lingual edge is concave and separated from the basal surface of the root which is inclined labially, creating a sharp edge. The labial root edge is slightly curved, extending anteriorly for articulation within the lingual sulcus of the next tooth in line.

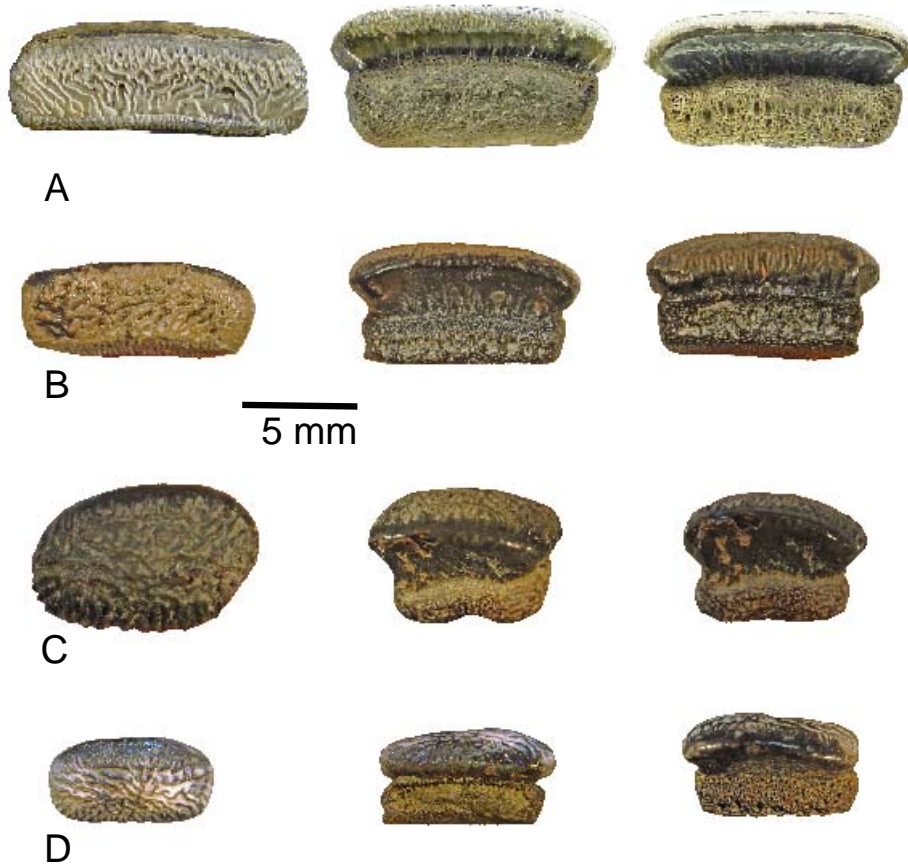
**Discussion.** *Hylaeobatis* is known by isolated tooth specimens from the Lower Cretaceous (Barremian) in England (Woodward, 1916; Casier, 1953; Patterson, 1966) from near shore and estuarine deposits (Batchler and Ward, 1990; Rees and Underwood, 2002). *Hylaeobatis* is considered to be closely related to *Ptychodus* (Patterson, 1966) and to the hybodont genus *Lonchidion* (Stewart, 1988; Rees and Underwood, 2002) and is enigmatic as it possesses tooth characters intermediate between both.

In the anterior and lateral teeth observed, the crown surface is wide and flat with well developed crown ornamentation which is typical of a crushing-type dentition rather than a clutching-type dentition as in *Lonchidion*. Apomorphic characters include a crown surface that is much wider than *Lonchidion* with a greater amount of surface area, lacking lateral cusplets and a tooth crown that overhangs a narrow tooth root. There is a pattern and arrangement of enamel folds and ridges in *Hylaeobatis* which is similar to *Ptychodus*. The tooth root of *Hylaeobatis* is narrow and not divided or bilobed, but is similar to *Ptychodus* as it does have numerous large foramina at the crown root junction. The overall tooth morphology suggests a dental arrangement similar to *Ptychodus* as each tooth exhibit labial protuberance and lingual sulcus and mesial-distal interlocking tooth mechanisms. However, the posterior teeth exhibit different

crown morphology as there is a single, slightly raised cutting edge on the midline of the crown, retaining the primitive hybodont morphology. Because of these features, I consider *Hylaeobatis* to be closely related to *Ptychodus* and place it within the Ptychodontidae. Unfortunately no other postcranial remains such as vertebrae or cephalic fin spines that would confirm its familial placement have been reported to date.

Patterson (1966) illustrated a probable dental arrangement for *Hylaeobatis* based on ten isolated teeth. Although the complete dental series is not known, two of Patterson's the tooth positions are questionable. Two teeth (P. 47213 and P. 47217, Plate 1a, Fig. C; Plate 1b, fig. F) have the same tooth shape and weakly developed occlusal ornamentation as in the upper medial file of *Ptychodus* suggesting that the dentition of *Hylaeobatis* was dignathic heterodonty with differentiated upper and lower dentitions.

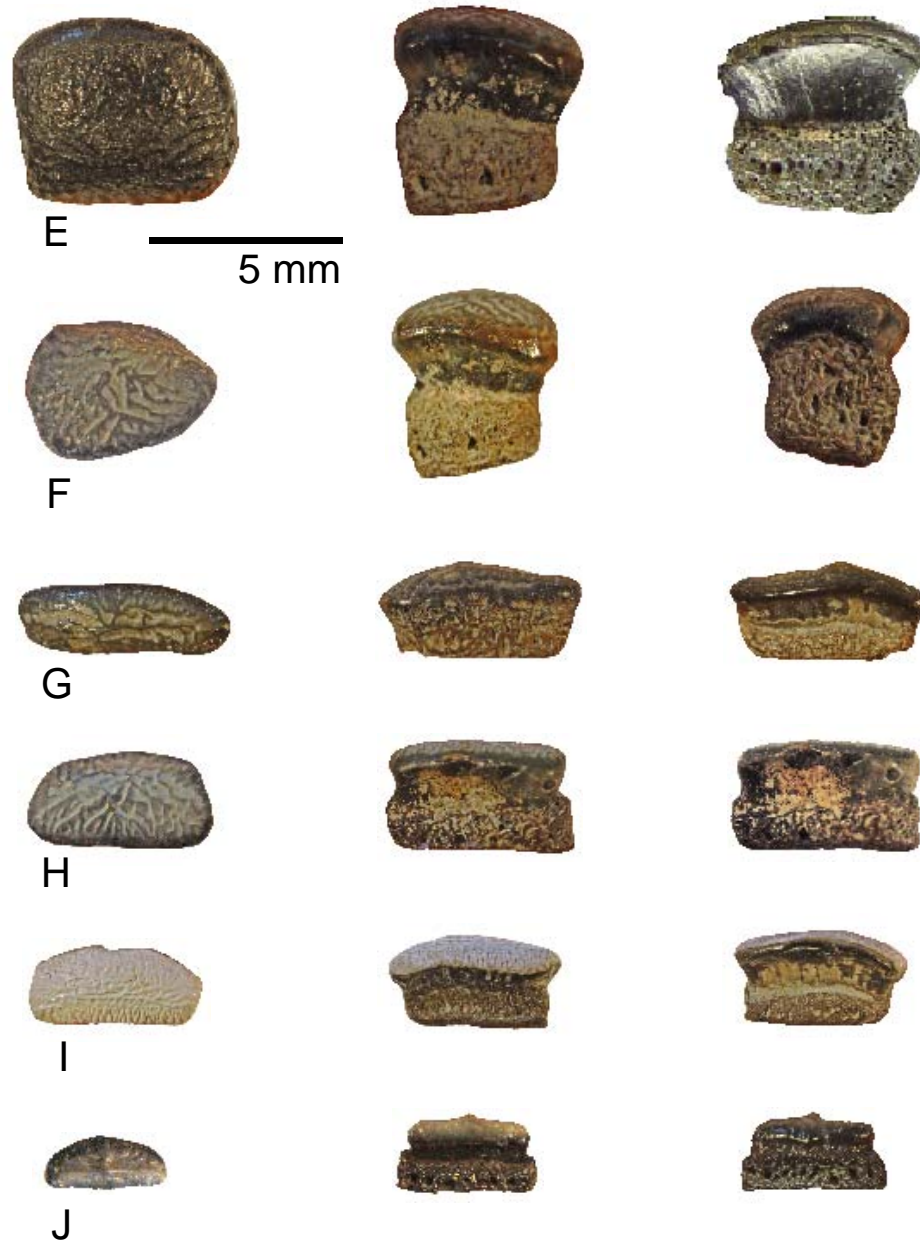
## PLATE 1A

*Hylaeobatis problematica*

**Figure A**, BMNH-47211, lower? medial tooth; **Figure B**, BMNH-47212, para-medial; **Figure C**, BMNH-42213, upper? medial; **Figure D**, BMNM-42214, anterolateral. All in occlusal (left), labial (middle) and lingual (right) views.



## PLATE 1B

*Hylaeobatis problematica*

**Figure E**, BMNH-42215, anterolateral (6-7<sup>th</sup> file); **Figure F**, BMNH-42216, posterior/juvenile tooth; **Figure G**, BMNH-42217, (3<sup>rd</sup>-4<sup>th</sup> anterolateral); **Figure H**, BMNH-42218, (2<sup>nd</sup>-3<sup>rd</sup> anterolateral); **Figure I**, BMNH-42219, (? anterolateral); **Figure J**, BMNH-42220, posterior-most file. All in occlusal (left), labial (middle) and lingual (right) views.

*HETEROPTYCHODUS STEINMANNI* (Yabe and Obata 1930)

(Plate 2)

*Heteroptychodus steinmanni* Yabe and Obata 1930: p. 6, pl. 1, figs. 6-8.*Heteroptychodus steinmanni*, Cuny et al., 2003: pp. 52, 59, fig. 1 G-K*Heteroptychodus steinmanni*, Cuny et al., 2004: p. 17, 1 G-K, pp. 18, 20, fig. 2 E-F.*Heteroptychodus steinmanni*, Cuny, 2006: p. 7, fig. 4, A-H.*Heteroptychodus steinmanni*, Cappetta et al., 2006: p. 550, fig. 6, A-M.

**Diagnosis.** Teeth wider than long, parallelogram-shaped with a slightly sigmoidal outline. The tooth crown is well developed with a raised crest in the anterior and lateral files, lacking lateral cusplets. There are between eight and fifteen parallel meso-distal transverse ridges that have cross striae between the ridges and extend fully to the lateral tooth edges. A distinctive marginal area is absent. The labial and lingual crown edges are ornamented with fine branching and radiating ridges. The tooth root is anaulachorizous with very few foramina located at the base of root (Cuny pers. comm., 2007).

**Type specimen.** Tohoku Imperial University, Sendai, No. 37741; from the *Cyrena naumani* Bed (Albian, Lower Cretaceous) Ryoseki Series; Yanagidani, Takahoko-mura, Katsura-gun, Awa Province, Shikoku, Japan.

**Referred specimens.** SDRC 9-16.

**Description.** The occlusal surface possesses eight to fifteen parallel transverse enameloid ridges that extend fully to the mesial and distal tooth margins. The ridges are prominent, having an inverted V shape as they cross the bulge on the tooth surface. The labial margin is oblique and smooth, being slightly convex with a protuberance overhanging the tooth root. The protuberance is in line with the occlusal bulge. The lingual tooth edge is oblique with labio-lingually directed enameloid ridges oriented perpendicular to the occlusal crest. The ridges at the mesial tooth edge bifurcate and branch, becoming faint. On the distal edge the enameloid folds bend, terminating at a boundary where the bifurcating ridges begin and fold over the sides of the crown towards the root. The mesial and distal tooth edges are mutli-angled for interlocking with teeth in other tooth files.

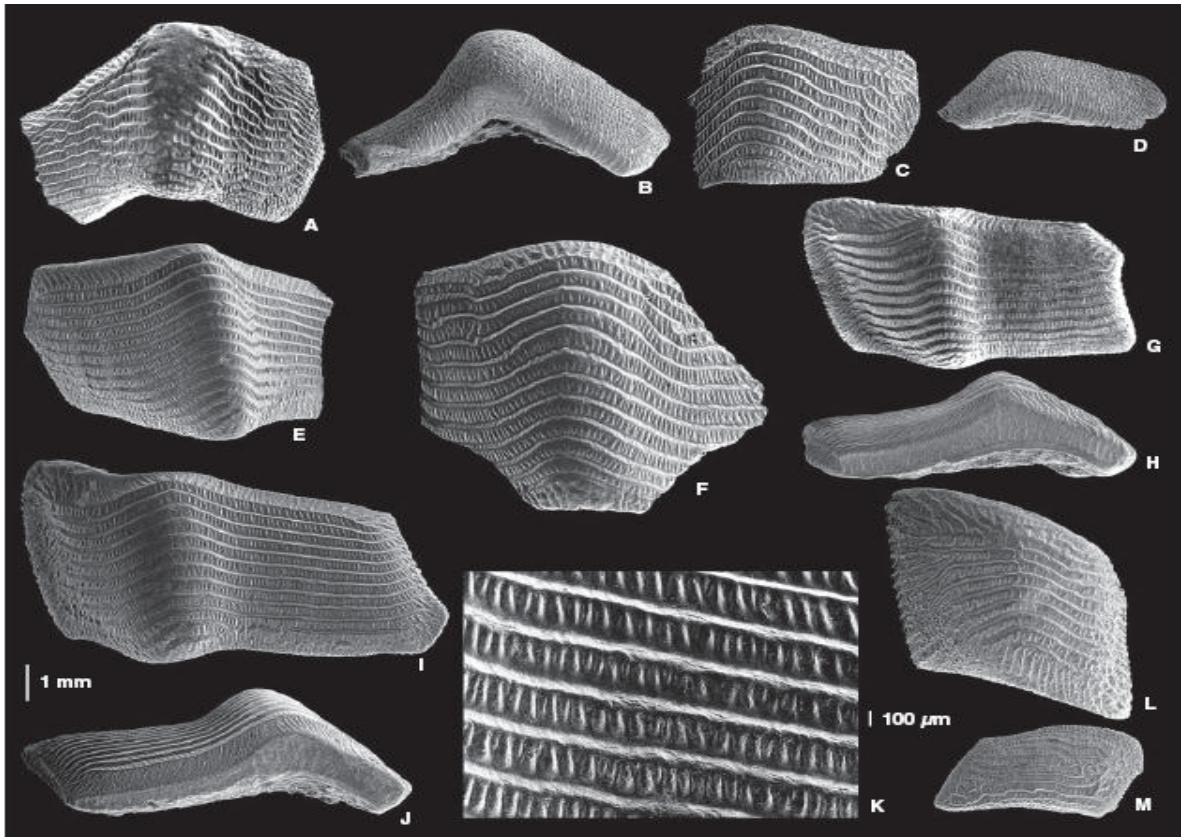
Until recently, *Heteroptychodus* was known only from a handful of teeth from the Lower Cretaceous of Japan (Yabe & Obata, 1930; Tanimoto & Tanaka, 1998). Additional tooth

specimens from the Aptian/Albian Khok Kruat Formation in Thailand were reported by Cuny et al. (2003, 2004) and Cappetta et al., (2006). In this sample of about 20 teeth (**Plate 2**), the presumed medial or anterior teeth (SDRC- 9, 10, 12) possess a well developed, centrally located occlusal crest, while anterolateral teeth (SDRC- 11, 13, 14, 15) have a moderately developed crest offset distally. Small flattened teeth (SDRC- 16) are interpreted to be from the posterior-most files.

**Stratigraphic and Geographic occurrence.** *Heteroptychodus* is only been recovered from Asian deposits including the Phu Kradung Formation (latest Jurassic- earliest Cretaceous) in Thailand (Cuny, 2008); Aptian/Albian Khok Kruat Formation in Thailand (Cuny et al., 2003 and Albian deposits in the Awa Province, Shikoku, Japan (Yabe and Obata, 1930).

**Discussion.** Cuny (2006) noted that *Heteroptychodus* shares a similar pattern, crown ornamentation and overall shape of posterior teeth with the lonchidiid genus *Isanodus paladeji* from the Lower Cretaceous of Thailand. *Heteroptychodus* also shares several affinities with *Ptychodus* including a well-developed occlusal bulge in anterior teeth, a similar pattern of occlusal ornamentation, mesio-distal tooth shape and a massive anaulacorhizous tooth root. It differs from *Ptychodus* in having a reduced marginal area and denser pattern of transverse ridges with numerous small ridges oriented perpendicular to the main ridges. In teeth with well preserved tooth roots, foramina are few, numbering 3-4, and are located at the base of the root instead of at the crown root junction as in *Ptychodus* (Cuny, pers. comm., 2007). Cuny (2008, p. 213) states that the tooth root structure of *Heteroptychodus* “confirms its hybodont status”. However, later in the same paragraph and in previous papers (Cuny, 2003; 2006, Cappetta et al., 2006) he also states that *Heteroptychodus* should be placed within the Ptychodontidae, a view supported here. The similarities in tooth crown morphology indicate a close relationship to the low crowned species of *Ptychodus*.

## PLATE 2

*Heteroptychodus steinmanni*

**Figures. A–B**, SDRC 9, anterior tooth in A, occlusal and B, lingual views. **Figures C–D**, SDRC 10, anterior tooth in C, occlusal and D, lingual views. **Figure E**, SDRC 11, anterolateral tooth in occlusal view. **Figure F**, SDRC 12, anterior tooth in occlusal view. **Figure G–H**, SDRC 13, anterolateral tooth in G, occlusal and H, lingual views. **Figure I–K**, SDRC 14, anterolateral tooth in I, occlusal and J, lingual views. K, detail of the occlusal surface. **Figure L**, SDRC 15, anterolateral tooth in occlusal view. **Figure M**, SDRC 16, very lateral tooth in occlusal view. (Used with permission Gilles Cuny, 2008)

*PARAPTYCHODUS WASHITAENSIS* gen. et sp. nov.

(Plate 3)

**Diagnosis.** Tooth crown of medial file high and rounded; crown is crossed by five to six distinctly raised, and closely spaced parallel transverse ridges. Lateral file teeth have low, rounded and broad crowns with four to five transverse ridges; posterior files triangular with a raised and pointed crown and one to three ridges. In all files the transverse ridges cover the entire crown surface, anatomize and bifurcate to the lateral edges; the marginal area is lacking with mesial and distal angled tooth edges. The tooth root hybodontid with labial protuberance and lingual sulcus being features of the tooth root.

**Etymology for genus:** *Para* (near) *Ptychodus*; the specific name is after the Washita Group of Texas, the only stratigraphic units it is found.

**Type specimen.** SMU 61362 from the Duck Creek Formation (Late middle Albian) of Texas.

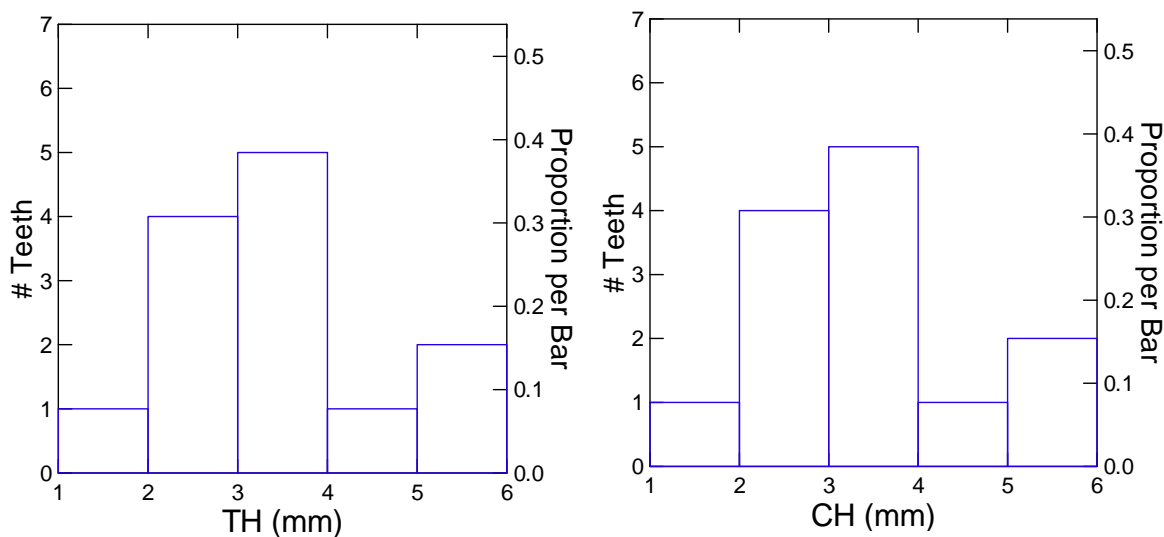
**Referred specimens.** SMU 61362 (1 tooth); SMU 76442 (1 tooth); SMU 76443 (9 teeth); SMU 76444 (2 teeth). **Plate 3, figs. A-N.**

**Description.** The type specimen (SMU 61362) is represented by a single medial file tooth. The crown is meso-distally elongate, evenly convex with a 1:1 tooth height (TH)/crown height (CH) ratio (**Fig. 19**). The crown is gently raised, rounded and wide, covered by six parallel transverse ridges that extend fully to the mesial and distal tooth edges. At the margin, the ridges bifurcate and branch into numerous, finer anatomizing ridges that extend to the edge of the crown; there is not a distinct tooth margin. The anterior and posterior tooth margins bear fine bifurcating ridges oriented perpendicular to the crown.

Other specimens of *Paraptychodus* are represented by anterolateral teeth (SMU 76442, 76443) which are elongate meso-distally, with crowns that are slightly offset crossed by three to four transverse ridges and posterior teeth (SMU 76444) which are triangular in shape with a well developed, raised and anteriorly pointed tooth crown with two to three parallel ridges. In all files the crown overhangs a square root that is weakly bilobed.

**Stratigraphic and Geographic occurrence.** *Paraptychodus* has only been recovered from deposits within the Washita Group including the Duck Creek Formation (Middle Albian) and the Del Rio Formation (Early Cenomanian) in Texas.

**Discussion.** Defined as a new genus, *Paratyichodus* is more derived than *Lissodus* and *Lonchidion* possessing apomorphic characters including a broad tooth crown with multiple raised cutting ridges, multi-angled mesial and distal tooth edges and lacking lateral cusplets in all tooth files. *Paratyichodus* is still more primitive than *Ptychodus* in regards to tooth root development (**Fig. 69**). The labial protuberance and lingual sulcus of *Paratyichodus* is distinctly hybodontid, being features of the tooth root, not the crown. The most distinctive character of *Paratyichodus* is present within the posterior teeth, which have a sharply raised and pointed tooth crown devoid of transverse ridges or marginal ornamentation. These features are present within the *Lonchididae* and their presence within *P. washitaensis* is likely due to retention of those primitive characters (**Fig. 15**).



**Figure 19.** Tooth Height-Crown Height values for all *Paratyichodus* teeth observed.

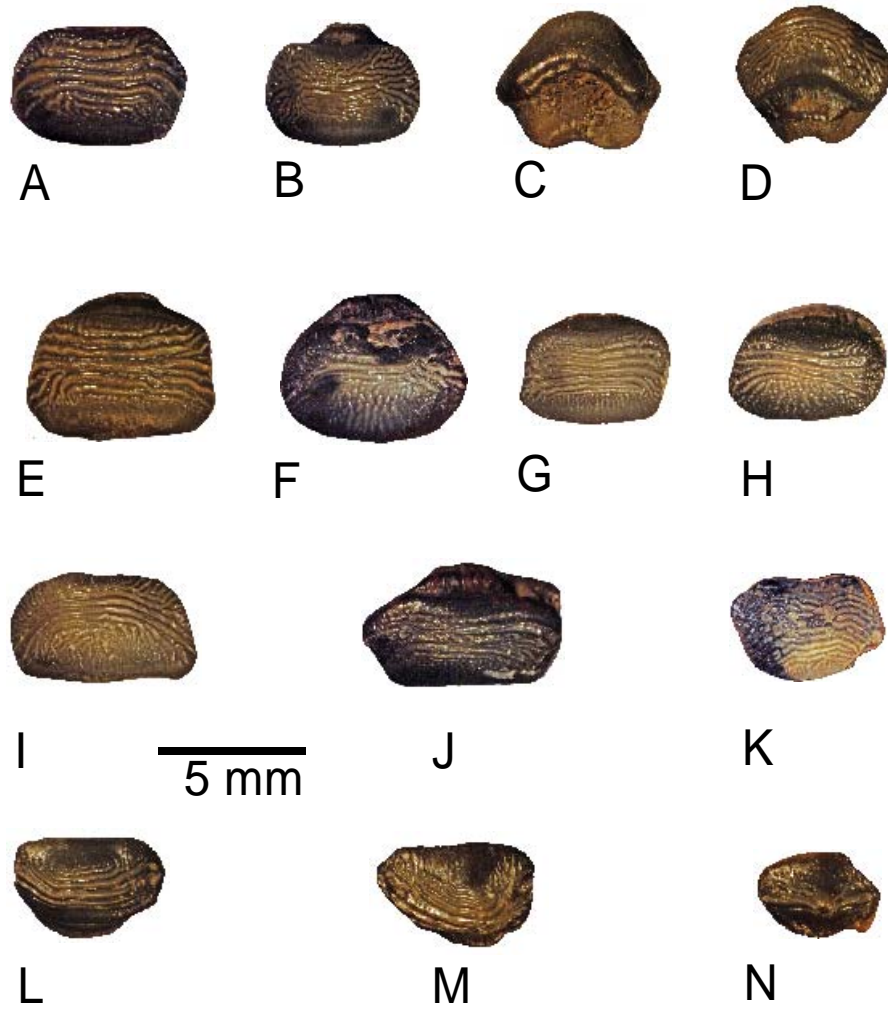
**List of characters comparing members of Lonchidiidae with members of the Ptychodontidae**

Modified from Rees and Underwood (2002)

Character	<i>Lissodus</i>	<i>Lonchidion</i>	<i>Hylaeobatis</i>	<i>Heteroptychodus</i>	<i>Paraptychodus</i>	<i>Ptychodus</i>
Heterodonty	strongly monognathic	moderately monognathic	monognathic	dignathic	dignathic	dignathic
Dentition type	grasping-crushing	cutting-crushing	crushing	crushing	crushing	crushing
Crown shape	low and wide	gracile	low and wide	low and wide	low and wide	low and wide to high and narrow
Occlusal crest	low to moderate	low to moderate	lacking	moderate	well developed	well developed
Crown ornamentation	weakly ridged	single ridge	strongly reticulate	strongly ridged	strongly ridged	strongly ridged
Labial protuberance	strong	strong	short	short	well developed	well developed
Lingual sulcus	weak	weak	shallow	shallow	well developed	well developed
Marginal ornamentation	weak	absent	numerous reticulating folds	absent	absent	numerous reticulating folds
Crown root junction	crown larger	crown larger	crown larger	crown larger	crown larger	crown larger
Root shape	square and low	rectangular	rectangular and flat	rectangular and flat	rectangular and bilobed	rectangular and bilobed
Foramina at crown root junction	single row	single row	singularly spaced, single row	at base of root	irregularly spaced, single row	irregularly spaced, single row
Calcified vertebrae	no	no	?	?	?	yes
Cephalic spines	yes	yes	?	?	?	no

**Figure 20.** Table of Characters Comparing Lonchidiidae and Ptychodontidae (modified from Rees and Underwood, 2002).

## PLATE 3

*Parapytychodus washitaensis*

**Figure A**, Type specimen, SMU 61362, medial tooth; **Figures B-J**, SMU 76443; **B-D**, medial tooth in B, apical, C, posterior and D, anterior views; **Figures E-F** medial files; **Figures I-K**, anterolateral files; **Figures K**, SMU 76442; **Figures L-N**, SMU 76444 posterior files. All in occlusal view.



*PTYCHODUS* (Agassiz 1835)

**Diagnosis:** Apomorphic characters include: teeth arranged antero-posteriorly in no less than eight parallel tooth files with tooth size decreasing laterally along the jaw margins; Meckel's cartilage and palatoquadrates narrow, elongate and fused at the symphysis. The dentition exhibits dignathic heterodonty as the medial file teeth in the upper dentition comprise small symmetrical teeth located between much larger para-medial file teeth, whereas the medial file teeth in the lower dentition are the largest and most diagnostic teeth within the dentition. Teeth characterized by being square to rectangular in shape, with a thick crown traversed by a number of enameloid ridges on the apical surface, with a tooth crown that overhangs the tooth root. Tooth crown exhibits differing morphologies, from a flat surface to high and narrow; ridges on the crown can be transverse (in the meso-distal plane) or radiating in all directions from the apex that bifurcate or unite at the lateral tooth edges. The crown has a distinct labial protuberance and lingual sulcus surrounded by a well-developed marginal area that varies in width and covered by enameloid wrinkles. The tooth root is square and bilobed (anulacorhizous), lacking a nutrient groove, with numerous foramina located at the crown-root junction. Tooth histology osteodont. Skeletal elements include well calcified, circular vertebral centra, differentiated dermal denticles, plesodic pectoral and dorsal fins lacking spines.

**Etymology for genus:** "ptyche", Greek for fold and "odus" Greek for tooth; folded tooth.

**Type species for genus:** *Ptychodus mammillaris* Agassiz 1835.

*PTYCHODUS MAMMILLARIS* (Agassiz 1835)

(Plates 4A-4C)

- Ptychodus mammillaris* Agassiz, 1835-39: p. 54 (name only), and vol. iii, p. 151, pl. xxv b, figs. 12-20.
- Ptychodus altior* Agassiz, 1835-39: p. 54 (name only), and vol. iii, p. 155, pl. xxv b, figs. 9, 10.
- Ptychodus decurrens* Agassiz: 1835-39, p. 154, pl. xxv b, figs. 3, 5.
- Ptychodus mammillaris* Reuss: 1845, p. 2, pl. 2, figs. 11, 13.
- Ptychodus mammillaris* Dixon, 1850: p. 361, pl. xxx, fig. 6, pl. xxxi, fig. 4.
- Ptychodus mammillaris* Kiprijanoff: 1852, 487, pl. 12, fig. 3, pl. 13, fig. 34.
- Ptychodus mammillaris* Pictet, 1854: p. 265, pl. 38, fig. 27.
- Ptychodus mammillaris* Fischer, 1856: p. 139.
- Ptychodus mammillaris* Roemer, 1870: p. 324, pl. 36, fig. 8.
- Ptychodus mammillaris* Sauvage, 1872: p. 16, pl. 2, fig. 86, 89.
- Ptychodus mammillaris* Geinitz, 1875: p. 297, pl. 54, fig. 26.
- Ptychodus mammillaris* Fritsch, 1878: p. 14, fig. 33.
- Ptychodus mammillaris* Quenstedt, 1885: p. 282, pl. 21, fig. 61, 62.
- Ptychodus mammillaris* Woodward, 1889: p. 133.
- Ptychodus mammillaris* Woodward, 1889: p. 38, pl. 1, figs. 3, 14.
- Ptychodus janewayii* Williston, 1900: p. 244, pl. 30, figs. 9, 10, 11.
- Ptychodus mammillaris* Leriche, 1902: 93, pl. 2, figs. 8, 12.
- Ptychodus mammillaris* Leriche, 1906: pp. 55, 67, 75.
- Ptychodus mammillaris* Dibley, 1911: p. 271, pl. 22, figs. 3-5.
- Ptychodus mammillaris* Woodward, 1912: p. 230, fig. 72, pl. 48.
- Ptychodus mammillaris* d'Erasmus, 1922: pp. 18, 19, pl. 2, figs., 13, 27.
- Ptychodus mammillaris* Leriche, 1929: pp. 210, 211.
- Ptychodus mammillaris* Dalinkevicius, 1935: p. 263, pl. 3, fig. 62.
- Ptychodus chappelli* Reinhart, 1951: pp. 195, 201, pl. 6, figs. 1, 3.
- Ptychodus mammillaris* Casier, 1953: p. 10, pl. 1, fig. 1, 1a, 1d.
- Ptychodus mammillaris* Meyer, 1974: pp. 62-65, fig. 15.
- Ptychodus mammillaris* Herman, 1977: pp. 59-62, figs. 4, 5.
- Ptychodus mammillaris* Evetts, 1979: pp. 59-66, Vol. 16 (2).

*Ptychodus mammillaris* Welton and Farish, 1993: p. 61.

*Ptychodus mammillaris* Cicimurri and Bell, 1996: Vol. 16, supp. to No 3, 28A

*Ptychodus mammillaris* Cicimurri, 1998: pp. 54, 55, pl. 4, 1-3.

*Ptychodus mammillaris* Cappetta and Case, 1999: pp. 9, 10, pl. 2 figs. 1-3.

*Ptychodus mammillaris* Everhart and Darnell, 2003: pp. 171-173, fig. 2 A, B.

*Ptychodus mammillaris* Hamm, 2005: Vol. 25, supp. to No 3, 67A

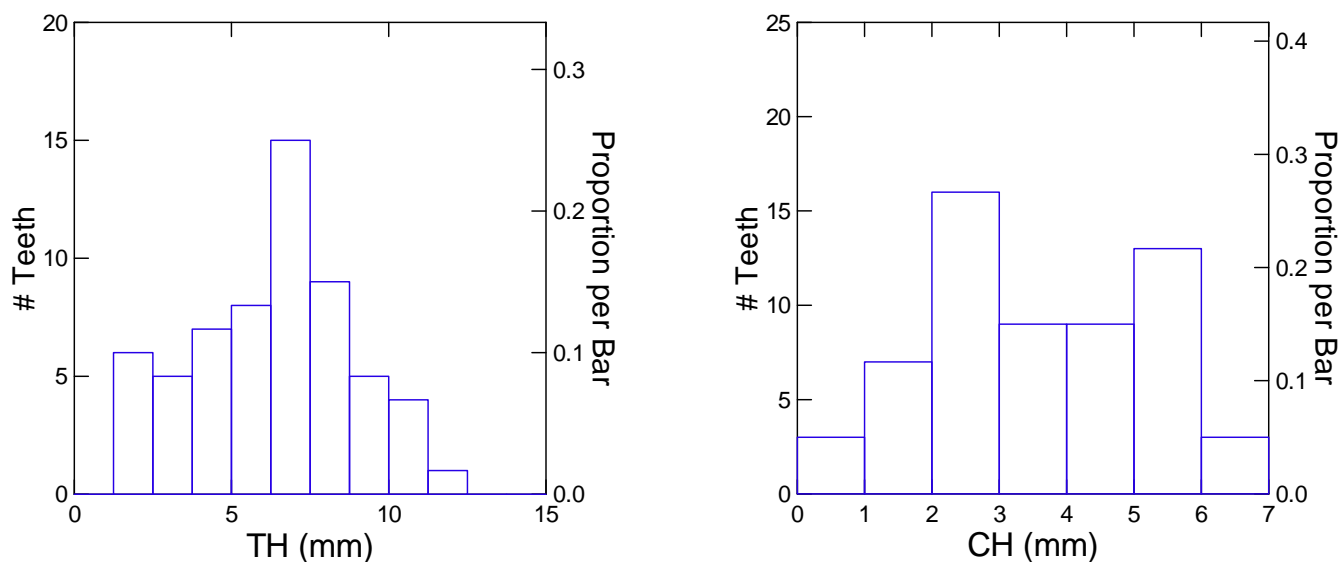
**Diagnosis.** Medial tooth crown moderately high and knob like; tooth crown perpendicular ( $90^\circ$ ) to tooth margin; seven to ten parallel, transverse ridges cover the apex of the crown in medial files; five to seven ridges in lateral files with three to five ridges in posterior files; differs from other species by having parallel, thick and clearly delineated transverse ridges with a wide marginal area covered with coarse and concentric marginal ornamentation.

**Type specimen.** BMNH 4396.

**Syntype** BMNH 4462 (**Plate 4A, figs. B, C**).

From the *Terebratulina gracilis* zone (Turonian)/ *Micraster cortestudinarium* (Coniacian) of the English Chalk.

**Referred specimens.** BMNH 39127 (31teeth); FHSM VP 12354 (53 teeth); FHSM VP 14022 (single tooth); SDSM V9414, 34948 (two teeth); SMU 63309 (18 teeth), SMU 63282 (6 teeth), SMU 63310 (10 teeth), SMU 76423 (12 teeth).



**Figure 21.** Tooth Height-Crown Height values for all *Ptychodus mammillaris* teeth observed.

**Description.** An associated set of teeth from the English Chalk, BMNH 39127 (**Plate 4, fig. A**) demonstrates that teeth from varying positions possess highly inflated crowns with the apex of the crown being flat instead of rounded in the anterior files, but the apex becomes increasingly rounded laterally. In the anterior teeth, the apex of the crown is crossed by seven to eight thick and robust transverse ridges that extend down the sides of the cusp terminating sharply at the margin. In the antero-lateral files, the crowns have five to six ridges, with four ridges in the posterior teeth.

The ridges on the crown surface are thick at the base and thin upwards creating a sharp edge. Because the ridges are thicker at the base of the ridge, they are clearly delineated and spaced apart from one another. The ridges cross the entire crown surface and extend down the sides of the crown mesio-distally and terminate sharply at the base of the crown. The crown-root junction is sharp, creating a 90° angle in the medial files. In the lateral files, the crown- root junction is more oblique and flattens distally. In all files, the marginal area is clearly separated from the crown and is wide, ornamented with coarse, granular and concentric enameloid ridges.

**Stratigraphic and Geographic occurrence.** Teeth of this morphology are present in the Blue Hill Shale Member (Turonian) of the Carlile Shale in Kansas (Williston, 1900[*P. janewayii*]; Shimada, 1993, 2006); the Eagle Ford Group (Late Turonian) of Texas (Meyer, 1974); the Pool Creek and Turner Sandy Members of the Carlile Shale (early Late Turonian) in Wyoming (Evetts, 1979) and South Dakota (Cicimurri, 1998); Fort Hays Limestone (Early Coniacian) in Kansas (Everhart and Darnell, 2003) and the basal Atco Formation (Early Coniacian) in Texas (Welton and Farish, 1993; Hamm, 2005).

**Discussion.** Herman (1977) considered *P. anonymus* from the Western Interior to be synonymous with *P. mammillaris* from the English Chalk Formation and attempted to create several subspecies based on isolated teeth that exhibit only minor variations in morphology. Herman's subspecies (*P. mammillaris-mammillaris*, *P. mammillaris anonymus*) are based on a very few isolated teeth and with my larger tooth sample indicates his conclusions are weakly founded and are now here considered invalid.

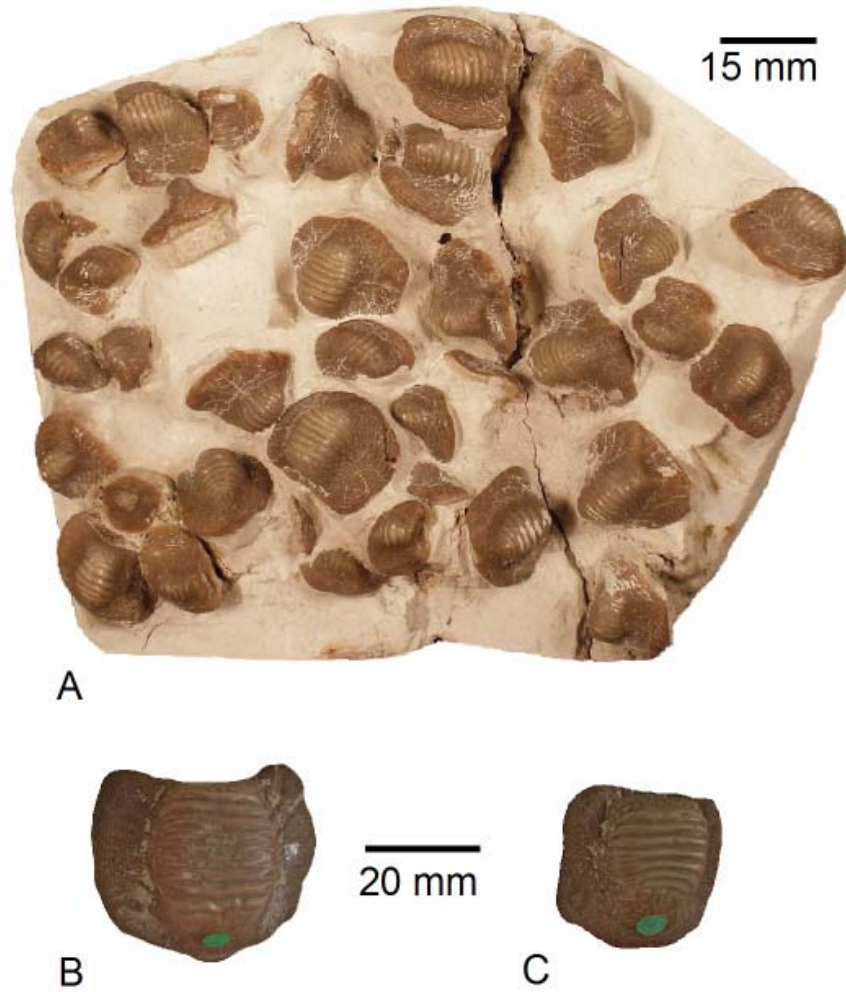
The tooth morphology of *P. mammillaris* differs from *P. anonymus* in regards to TH-CH and TW-CW ratios, and thickness of the transverse ridges (**Appendix III**). The crown of *P. mammillaris* is almost twice (21mm) as high as *P. anonymus* (10mm) and twice as wide (11 mm compared to 8mm) with an average of six transverse ridges. The transition from the crown to the

marginal area in *P. mammillaris* is sharp compared to *P. anonymus* which is gently sloping. The marginal ornamentation in *P. mammillaris* is coarser and more granular than that of *P. anonymus*.

I consider *P. mammillaris* to be separate from, but closely related to *P. anonymus* based on the shape of the crown, similarity in the transition of the ridges to the marginal area, and the similarity in marginal ornamentation. *Ptychodus anonymus* and *P. mammillaris* share a common ancestor with *Paraptychodus* (**Fig. 69**) and demonstrate a lineage of constant increase in tooth size, the loss and thickening of the transverse ridges and a wider marginal area with and thicker ornamentation.

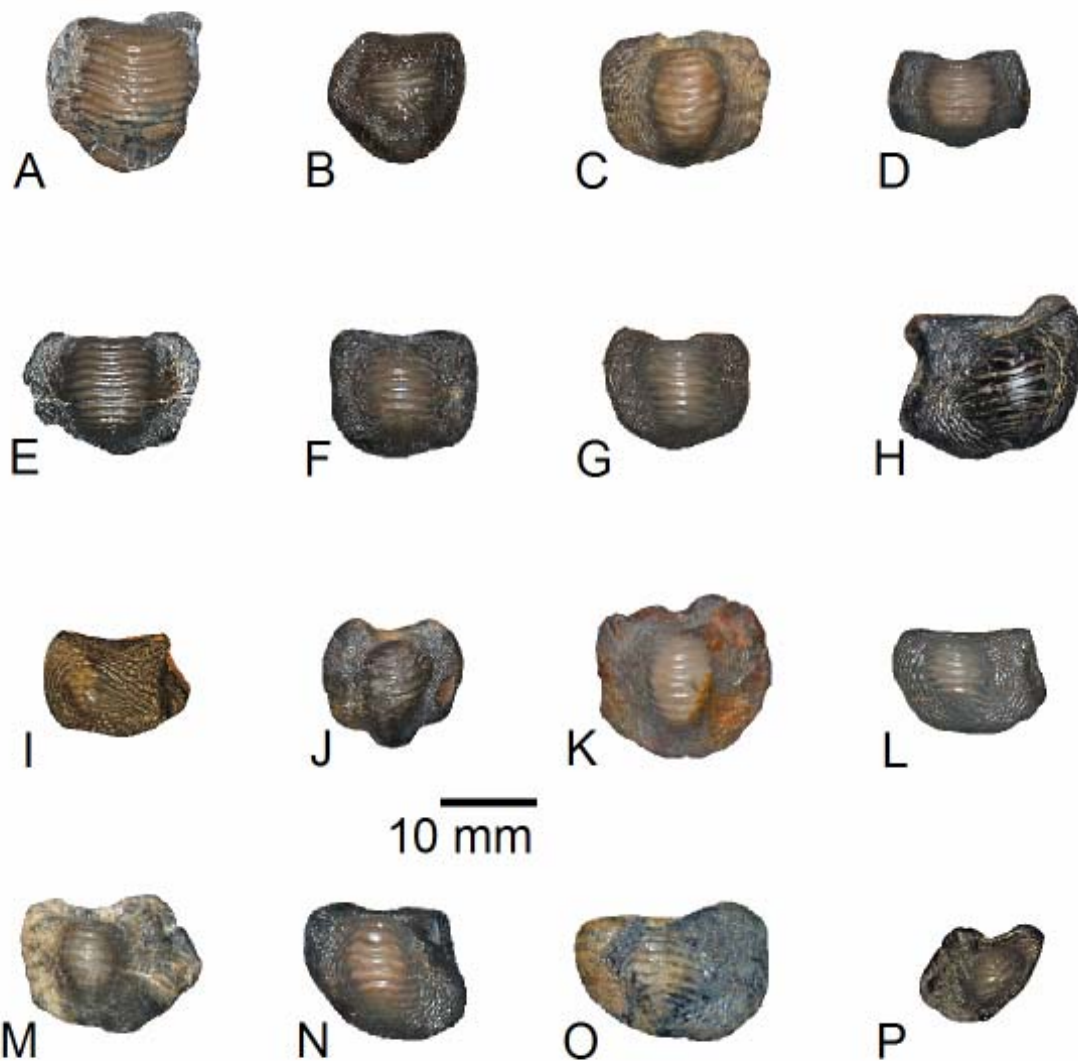
Williston (1900) described four isolated tooth specimens (KUV 55265) as being a new species, *P. janewayii*. A closer examination indicates this material is identical in morphology to the *P. mammillaris*. Williamson et al. (1993) tentatively assigned teeth from the Dakota Formation and Mancos Shale (Cenomanian-Turonian) of Arizona to *P. mammillaris*; however they only figured a single tooth (p. 449, figs. 8-10) which is more similar in morphology to *P. marginalis*. Cicimurri (1998) notes that a tooth referred to *P. mammillaris* from the Boquillas Formation of Texas may also be referable to *P. polygyrus* (*P. marginalis*). The only material I have observed within the Western Interior that have the same characters as the teeth seen within the type specimen of *P. mammillaris* are from Late Turonian-Early Coniacian deposits, which also correlates with its European distribution.

## PLATE 4A

*Ptychodus mammillaris*

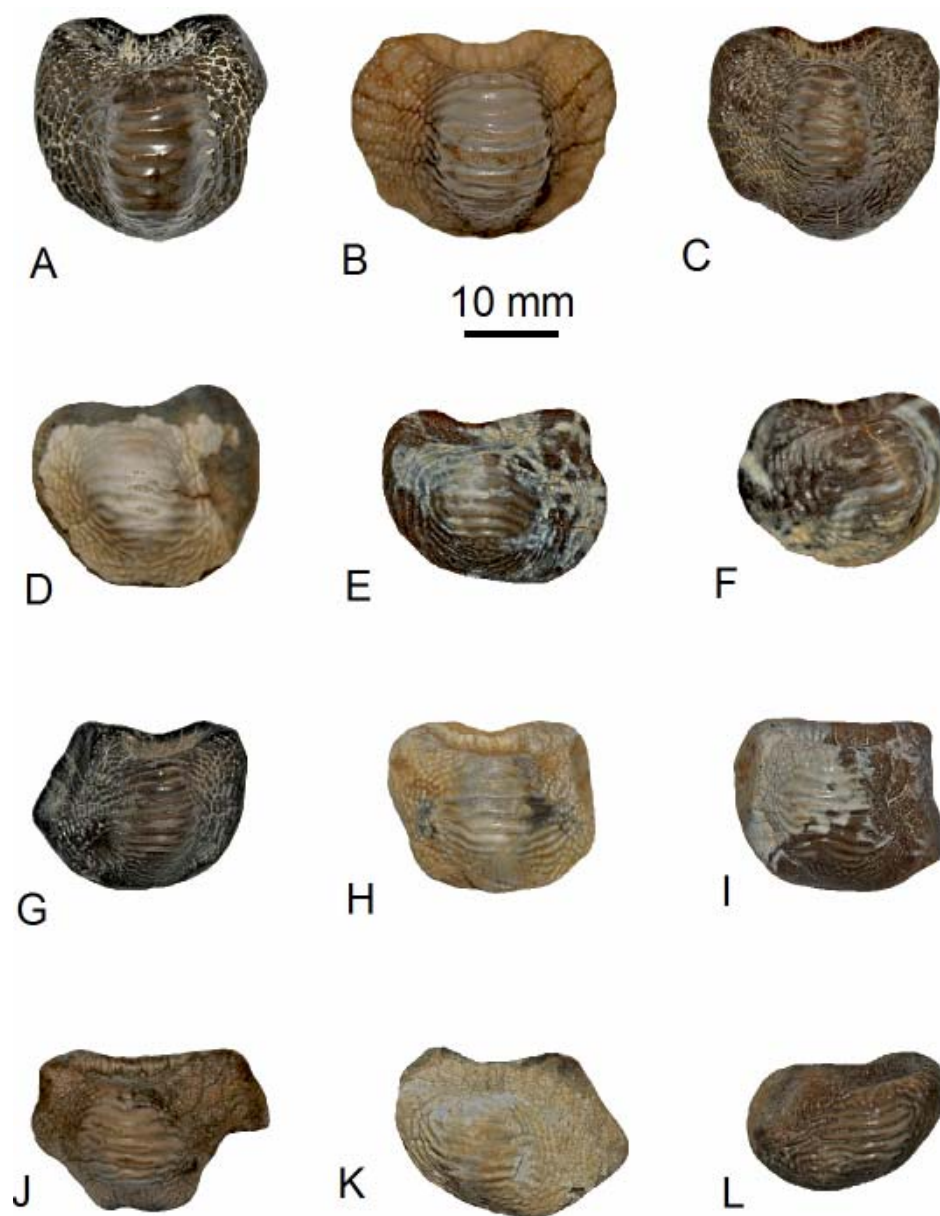
**Figure A**, BMNH 39127, associated set, occlusal view. **Figure B-C**, BMNH 4396, BMNH 4402 (syntypes), occlusal view.

## PLATE 4B

*Ptychodus mammillaris*

**Figure A**, SMU 62767, lower medial; **Figure B**, SMU 63282, upper medial; **Figures C-P**, SMU 76423; **Figures C, D, E, K**, lower medials; **Figures F, G, J, K**, para-medial-2<sup>nd</sup> file; **Figures H, I, L, N, O** lateral files; **Figure P**, posterior tooth. All in occlusal view.

## PLATE 4C

*Ptychodus mammillaris*

**Figures A-B**, KUVP 32450, lower medials; **Figure C**, KUVP 5524, para-medial; **Figure D-K**, KUVP 32480, lateral file teeth; **Figure L**, KUVP 25282, posterior tooth? All in occlusal view.



*PTYCHODUS DECURRENS* (Agassiz 1835)  
(Plates 5A-5C)

Dens piscis Ostracionis Bruckman, 1752: p. 116, pl. 5, fig. 4.

Palate of unknown fish, Parkison, 1811: pl. 18, fig. 12.

*Ptychodus decurrens* Agassiz, 1835: p. 54.

*Ptychodus decurrens* Agassiz, 1839: p. 154, pl. 25b, fig. 1, 2, 4, 6, 8.

*Ptychodus decurrens* Owen, 1845: pl. 18, 19.

*Ptychodus decurrens* Dixon, 1850: p. 362, pl. 30, fig. 7, 8, pl. 31, fig. 1, pl. 32, fig. 5.

*Ptychodus depressus* Dixon 1850: p. 363, pl. 31, fig. 9.

*Ptychodus oweni* Dixon 1850: p. 138, pl. 5, fig. 8.

*Ptychodus decurrens* Woodward, 1889: p. 138.

*Ptychodus multistriatus* Woodward, 1889: p. 146, pl. 5, figs. 4, 6.

*Ptychodus decurrens* Leriche, 1902: p. 95, pl.2, fig. 19.

*Ptychodus decurrens* Leriche, 1906: p. 55, 68, 72.

*Ptychodus decurrens* Dibley, 1911: p. 254, p. 274, pl. 17, figs. 1a, 1b, 2; pl. 18, figs. 1-13; pl. 19, figs. 1-26.

*Ptychodus decurrens* Woodward, 1912: pp. 239, 244, pl. 52, fig. 1, 6, 12, 16.

*Ptychodus decurrens* Casier, 1953: pp. 6, 10, 12, 13, 23, 31.

*Ptychodus decurrens* Herman, 1977: pp. 49-52, pl. 2, fig. 1.

*Ptychodus decurrens* Williamson et al., 1991: pp. 595-599, fig. 2, pl. 1, figs. 1-14.

*Ptychodus decurrens* Welton and Farish, 1993: p. 59.

*Ptychodus decurrens* Johnson et al., 2002: No. 187-12.

*Ptychodus decurrens* Antunes and Cappetta, 2002: p. 103, pl.1, figs. 1, 2.

*Ptychodus decurrens* Shimada et al., 2006: p. 6, fig. 6, 3, 4.

*Ptychodus decurrens* Mueller, 2008: pp. 55-63.

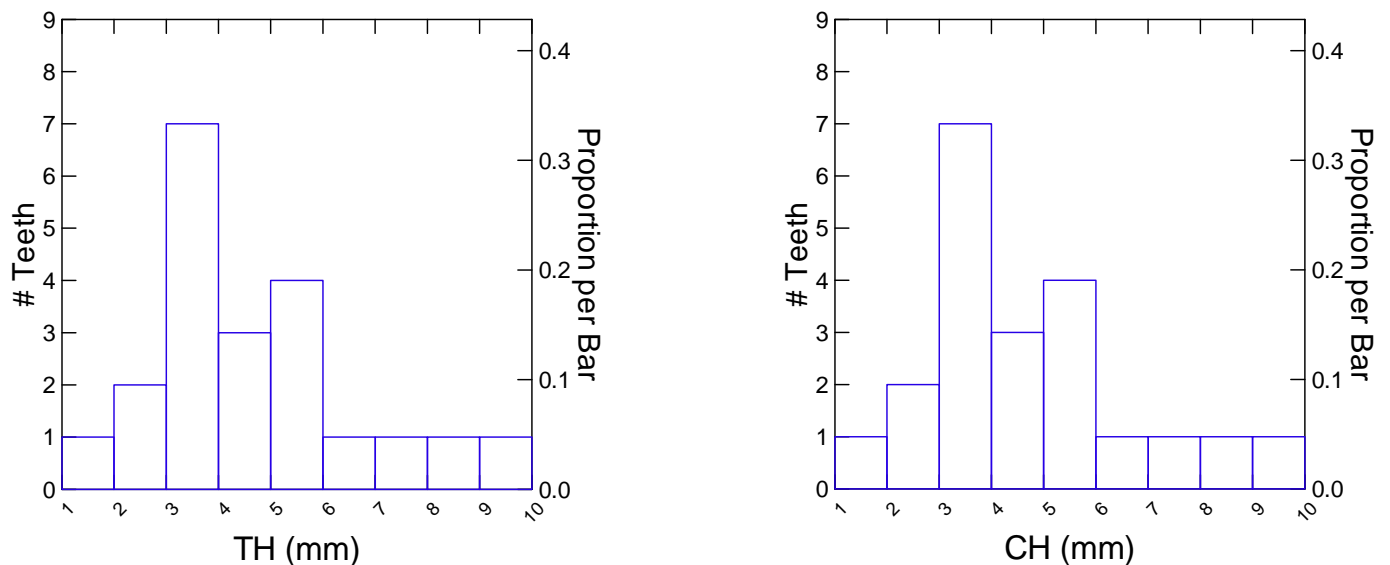
**Diagnosis.** Teeth with flat to gently rounded tooth crowns and tooth edges, short labial protuberance and shallow lingual sulcus. Medial files square in outline with ten to twelve transverse ridges; anterolateral teeth rectangular with multi-angled mesial and distal tooth edges with seven to ten ridges; posterior teeth have five to seven ridges; differs from other species by

having ridges that extend and bifurcate completely at the lateral tooth edges. There are numerous fine ridges on the labial and lingual tooth edges perpendicular to the transverse ridges.

**Type specimen.** P. 12830, from the Zone of *Holaster subglobosus* (Late Cenomanian) of the English Chalk.

**Referred specimens.** SMU- 62767-62771 (5 teeth); SMU 76243 (17 teeth); USNM- 88300 (20 teeth).

**Description.** The description here is based on an associated tooth set of *P. decurrens* (BMNH-12846) from the English Chalk Formation (**Plate 5**). Tooth shape square in anterior files with low, rounded and broad crowns with that gently slope and taper into the margin. The labial edge is rounded while the lingual tooth edge is weakly indented. The tooth crown overhangs a square root that is weakly bilobed. The lower medial file is mesio-distally elongate with between eight and ten straight to sinuous transverse ridges. At the margin, the ridges bifurcate and branch into numerous, finer anatomizing ridges that extend to the edge of the crown. The marginal area is ornamented with the thin anatomized ends of the transverse ridges. The anterior and posterior tooth margins bear fine bifurcating ridges oriented perpendicular to the crown. Anterolateral and posterior teeth are smaller and rectangular with crowns that are slightly inflated to flat.



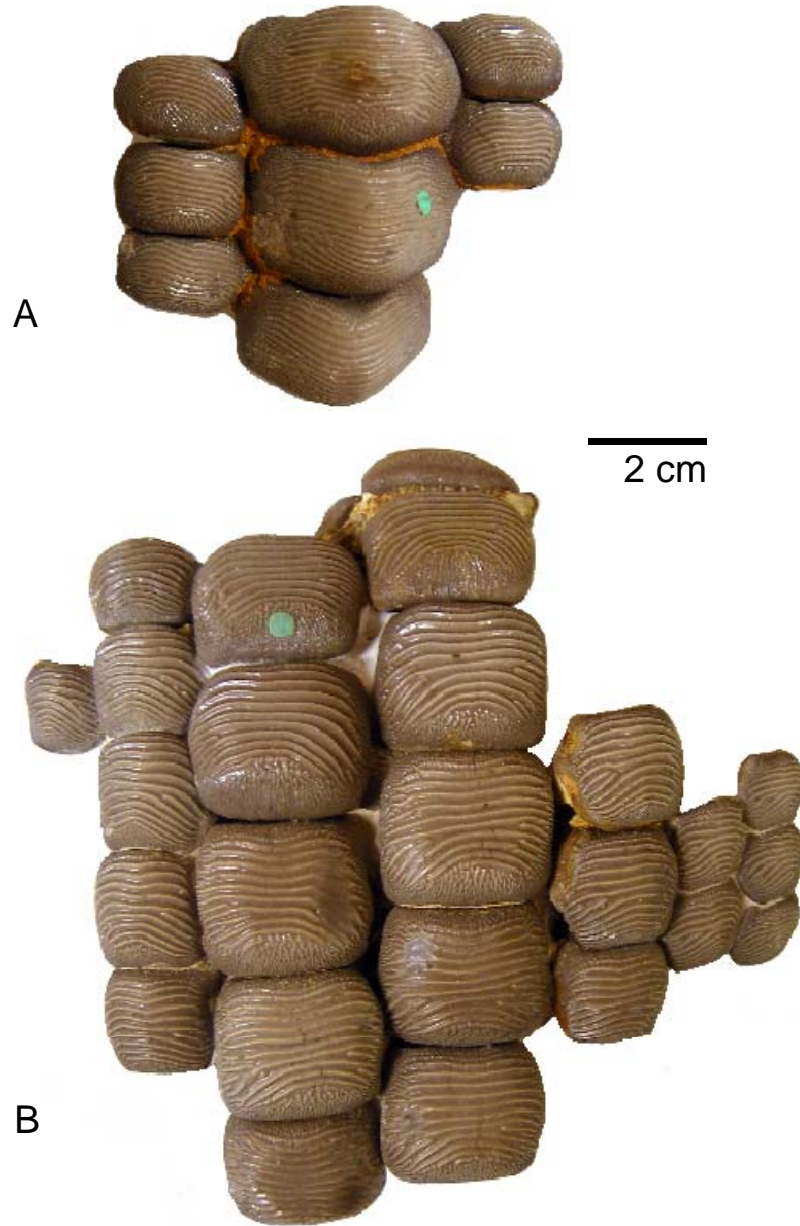
**Figure 22.** Tooth Height-Crown Height values for Texas *Ptychodus decurrens* sample.

**Stratigraphic and Geographic occurrence.** *Ptychodus decurrens* occurs commonly in Cenomanian deposits in Europe, North America and Australia (Cappetta, 1987; Williamson et al., 1991, 1993; Siverson, 1999; Cicimurri, 2001a; Shimada et al., 2006) and Turonian deposits (Hoch, 1992; Antunes and Cappetta, 2002). Within the Western Interior Seaway it has been reported from the Dakota Formation (Middle Cenomanian) and the Lincoln Limestone (Late Cenomanian) of Kansas; the Late Cenomanian of the Mancos Shale (Kirkland, 1983; Williamson and Lucas, 1989); and the Greenhorn Limestone (Cenomanian-Early Turonian) in Arizona (Kirkland, 1989), South Dakota (Cicimurri, 1998) and Colorado (Shimada et al., 2006); and the Kamp Ranch Formation (Middle Turonian) of the Eagle Ford Group in Texas (Meyer, 1974; Welton and Farish, 1993; Hamm, 2003).

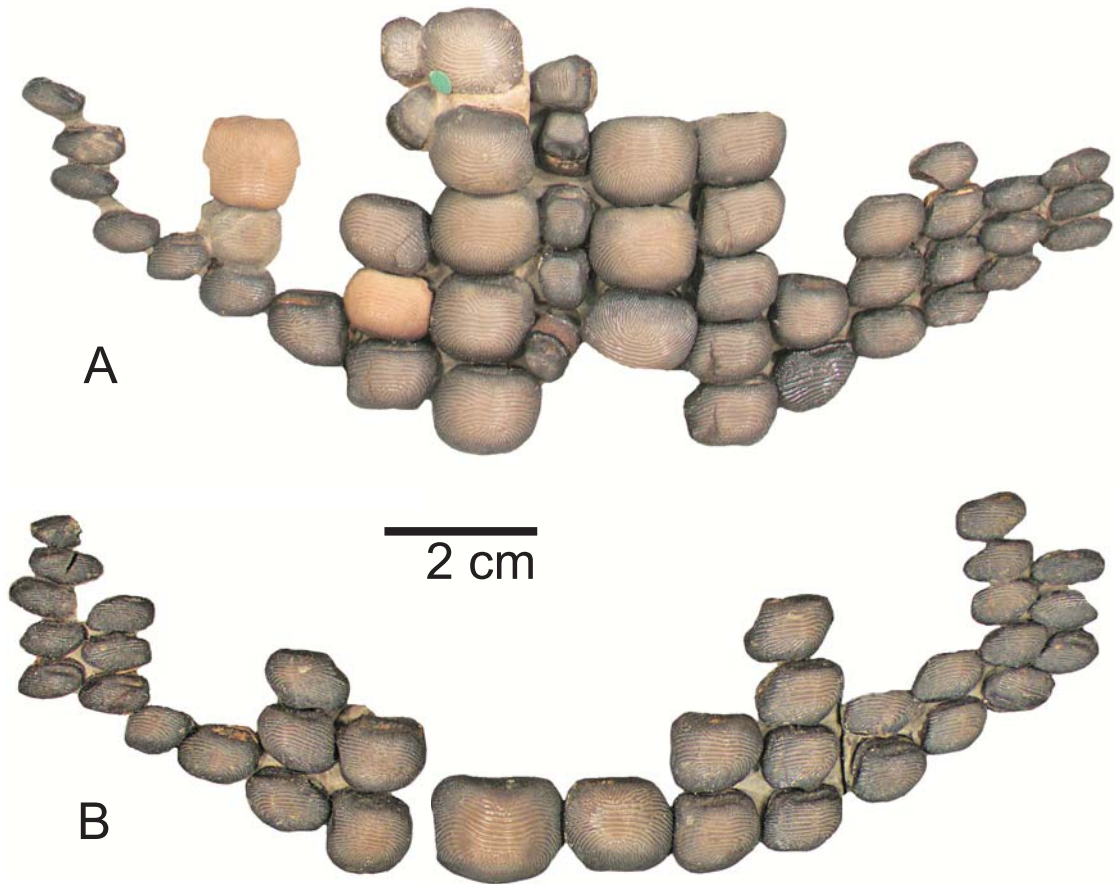
**Discussion.** The presence of *P. decurrens* within the Western Interior Seaway coincides with the beginning of the Greenhorn cyclothem. The greatest concentrations of teeth are reported from the southern end of the seaway (Williamson et al., 2003; Shimada et al., 2006) and Texas (**Plate 4C**). Its abundance within the southern part of the seaway is probably due to its expansion into the Western Interior from Europe. Williamson et al. (2001) reported an associated tooth set (USNM 88300) from Greenhorn Formation in Nebraska, but it could not be located for study. In European deposits *P. decurrens* is known by reasonably complete tooth sets, however within the Western Interior Seaway UNSM 88300 is the only tooth set that I recognized in the literature or museum collections.

A wide range of tooth morphologies present within this large sample of teeth indicates that the typical *P. decurrens* is a sister taxa to *Hylaeobatis*. A larger sample of material from the English Chalk Formation indicates that *P. decurrens* possesses apomorphic characters from *Hylaeobatis* and *Paraptychodus* (**Fig. 69**) including a much larger and wider occlusal surface, more transverse ridges, well developed tooth margin, larger labial protuberance and deeper lingual sulcus. The posterior teeth of *P. decurrens* are not raised or pointed as in *Hylaeobatis* and *Paraptychodus*, but instead are flat with a well developed ridge pattern as in the other tooth files. However, the labial protuberance and lingual sulcus of *P. decurrens* are weakly developed as in *Hylaeobatis* and may represent a primitive condition.

## PLATE 5A

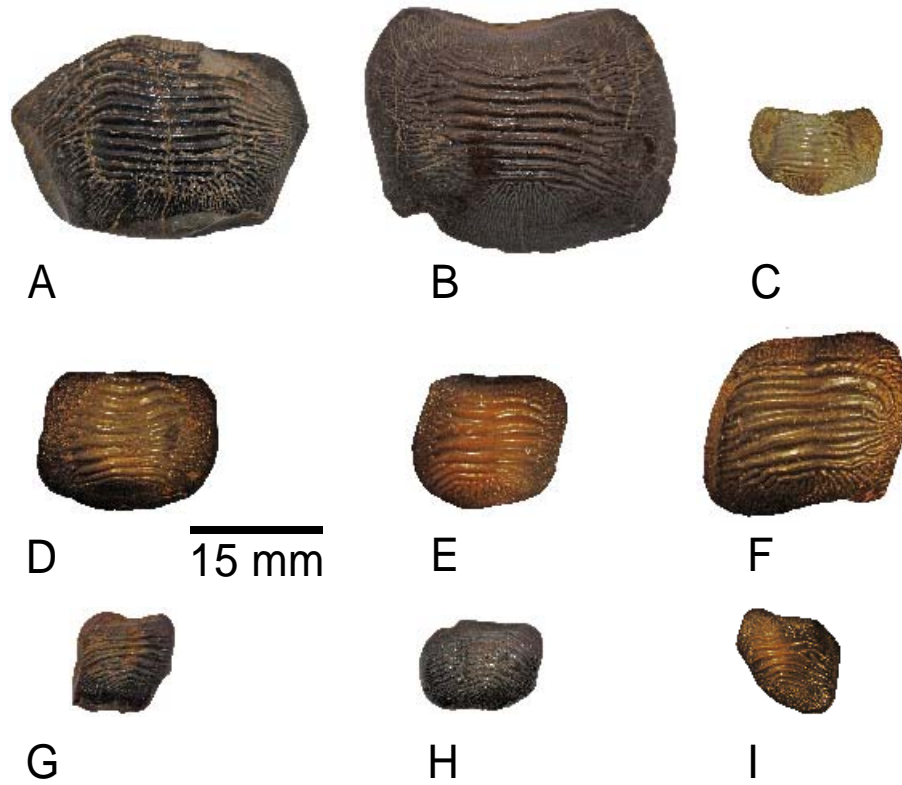
*Ptychodus decurrens*

**Figure A**, BMNH P. 12830, articulated lower medial files, occlusal view. **Figure B**, BMNH P. 10336, lateral files, occlusal view.

**PLATE 5B***Ptychodus decurrens*

**Figure A**, BMNH P. 12846, upper dentition, occlusal view. **Figure B**, BMNH P. 12846, lower dentition, occlusal view.

## PLATE 5C

*Ptychodus decurrens*

**Figure A**, SMU 62771, anterior tooth; **Figure B**, SMU 76243 anterior tooth; **Figures C-D**, SMU 67268, anterolateral files; **Figure E-F**, SMU 76243. All in occlusal view.

*PTYCHODUS ANONYMUS* (Williston, 1900a)

(Plates 6A-6B)

*Ptychodus anonymus* Williston, 1900a: p. 241, pl. 29, figs. 5-8, 16-18, 20-22, 24.*Ptychodus anonymus* Meyer, 1974: pp. 45-55, figs. 12, 13.*Ptychodus anonymus* Evetts, 1979: p. 61, figs. 2-4.*Ptychodus anonymus* Wolberg, 1985a: p. 2, fig. 3, c, d.*Ptychodus anonymus* Lucas et al., 1988: pp. 122:49-60*Ptychodus anonymus* Welton and Farish, 1993: p. 57.*Ptychodus anonymus* Shimada and Martin, 1993: p. 78.*Ptychodus anonymus* Cicimurri and Bell, 1996: 28A.*Ptychodus anonymus* Cicimurri, 1998: p. 47, pl. 2, figs. 1-6.*Ptychodus mammillaris* Cappetta and Case 1999: p. 9, pl. 2, figs. 1-3.*Ptychodus anonymus* Cicimurri, 2001a: 4, fig. 6, A, B.*Ptychodus anonymus* Hanks and Shimada, 2002: 62A.*Ptychodus anonymus* Johnson et al., 2002b: 72A*Ptychodus anonymus* Cicimurri, 2003: p. 5*Ptychodus anonymus* Hamm, 2003: 62A.*Ptychodus anonymus* Hamm, 2004: 67A.*Ptychodus anonymus* Friedman, 2004: p. 98.*Ptychodus* cf. *P. anonymus* Shimada et al., 2006: p. 6, fig. 6, 1, 2.*Ptychodus anonymus* Murphy et al., 2007: 122A.*Ptychodus anonymus* Shimada et al., 2007: 145A.

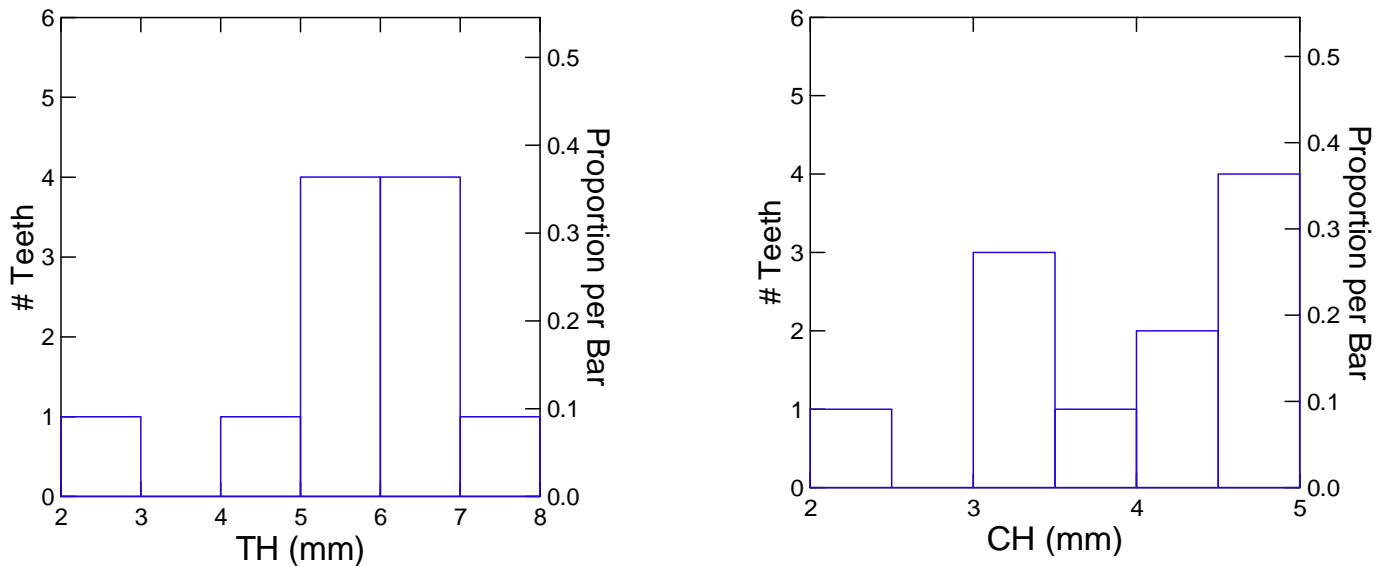
**Diagnosis.** Tooth cusp elevated and rounded; medial teeth square, crossed by ten to twelve thin and closely spaced transverse ridges that terminate at the crown margin. Lateral and posterior teeth are rectangular with multi-angled mesial and distal tooth edges; lateral teeth have eight to ten ridges; posterior teeth have three to five ridges. Marginal area is differs from other species as it is covered with very fine and concentric enameloid ridges that are distinctly differentiated from the crown.

**Type specimen.** Williston (1900, p. 241) did not assign a holotype for *P. anonymus*; however, he did describe “seven teeth, four of them united in the matrix from Walnut Creek” (KUVP 55352) **Plate 6, figs. A-D**) which is here considered syntypes. Williston notes the horizon of this material as being from the Benton Formation, which is now considered to be an obsolete term that originally included the Graneros Shale (Middle Cenomanian), Greenhorn Limestone and Carlile Shale (Middle Turonian) in Kansas (Hattin, 1982).

**Referred specimens.** Cenomanian teeth: SMU 62772 (1 tooth), SMU 62773 (1 tooth), SMU 62774 (4 teeth), SMU 62775 (8 teeth), SMU 62776 (81 teeth), SMU 63280 (20 teeth), SMU 63281 (108 teeth), SMU 76420 (29 teeth); Turonian teeth: SMU 62783 (24 teeth), SMU 75583 (232 teeth); SMU 76442 (30 teeth).

**Description.** Williston (1900, p. 241) described *P. anonymus* as having "broadly conical crowns" and "very distinctly reticulate marginal areas", with "transverse ridges not reaching the rims of the crowns." The teeth he described and discussed (KUVP 55352, Fig. 7, pl. XXIX) conform to his description but needs to be expanded here to include: a moderately elevated and rounded cusp with a 0.55-0.87 tooth height (TH) - crown height (CH) ratio with an evenly convex tooth crown oriented 90° to the base of the crown; transition from cusp to marginal area is smooth and gently sloping. The crown of the medial teeth are crossed by ten to twelve prominent, closely spaced, yet fine parallel to sub-parallel transverse ridges; the lateral teeth have eight to ten ridges and posterior teeth with three to five ridges. The ridges extend across and down the sides of the cusp terminating at the tooth margin where some may curl or bifurcate as they merge with the marginal area. The ridges are closely spaced and some may exhibit an inverted “u” shape. The tooth margin is shelf-like, covered by short and thin to coarse and granular ridges that are concentric with the crown. In anterolateral files the tooth crown is gently raised with a distally offset tooth cusp. The transverse ridges extend across the entire length of the crown and may be straight or curved bifurcating at their distal ends. Lateral teeth have a weakly developed cusp that is offset distally, whereas the crowns of posterior teeth are flat.





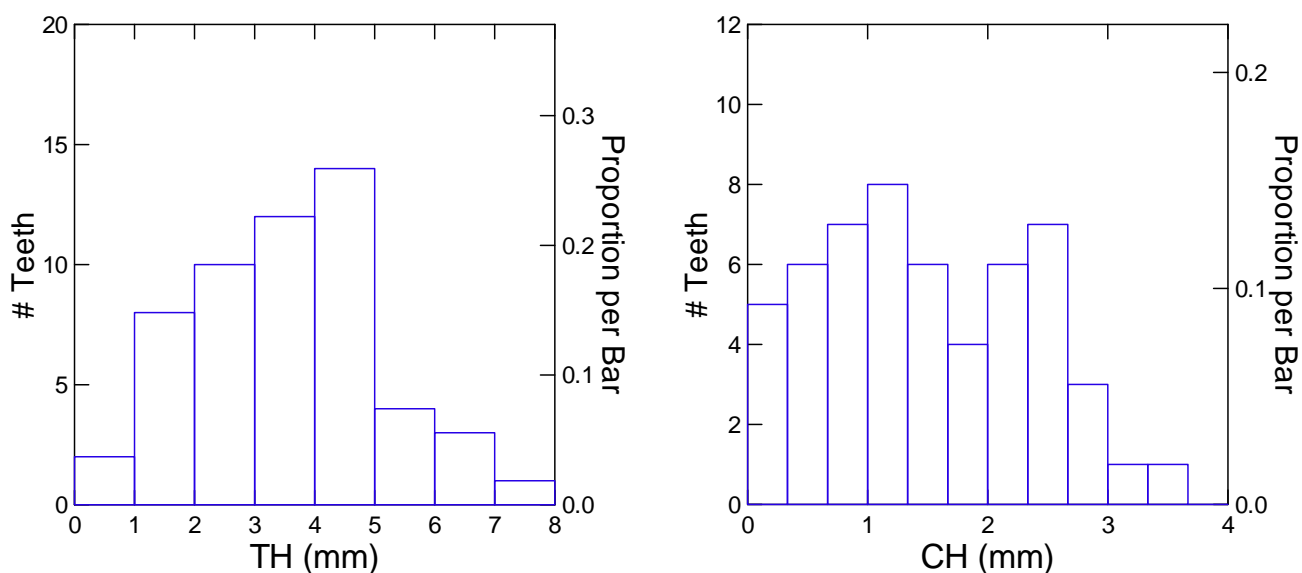
**Figure 23.** Tooth Height-Crown Height values for type specimen *P. anonymus* KUV 55255.

**Stratigraphic and Geographic occurrence.** *Ptychodus anonymus* ranges from the Middle Cenomanian through Middle Turonian deposits throughout the Western Interior Seaway including the Greenhorn Formation and Carlile Shale in Kansas (Williston, 1900); the Turner Park Member (Late Cenomanian) of the Britton Formation (Friedman, 2004), the Bridge Creek Member (Late Cenomanian) of the Mancos Shale (Murphy et al., 2007), the Kamp Ranch Formation (Middle Turonian) of the Eagle Ford Group (Meyer, 1974, Welton and Farish, 1993, Hamm, 2003, 2004) the Middle Turonian Boquillas Formation of Texas (Cicimurri and Bell, 1996); the Lincoln Limestone Member (Late Cenomanian) of the Greenhorn Formation (Shimada and Martin, 1993); and the Greenhorn Limestone (Cenomanian-Turonian) in Arizona (Williamson et. al, 1993), Colorado (Cicimurri, 2001, 2004), South Dakota (Parkin et, al., 2002).

**Discussion.** *Ptychodus anonymus* is the first species of the genus *Ptychodus* to occur within the Western Interior Seaway, and shares a common ancestor with *Paraptychodus* (Fig. 69). It shares a similar pattern of transverse ridges with *Paraptychodus washitaensis* and is the first species to develop an elevated crown with a distinctive shelf-like margin with granular and concentric marginal ornamentation; a trend that continues in other high crowned species. *Ptychodus anonymus* is ubiquitous from the Middle Cenomanian through Middle Turonian and is geographically widespread distribution from Texas to Canada.

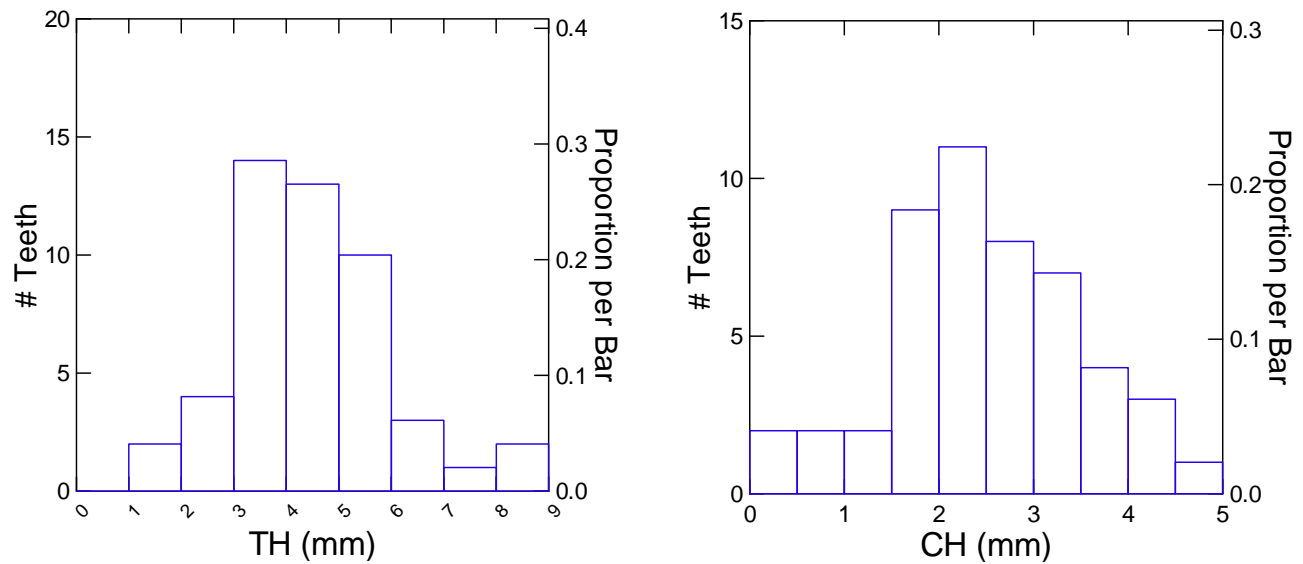
Two distinct, stratigraphic and morphological varieties of *P. anonymus* have been identified during this study. One could be easily be ascribed to a new species but is not, as the only difference in tooth morphology is tooth size, which most likely represents a continuous lineage of increased crown height and thicker ridge development.

The first morphotype is restricted to Cenomanian deposits below the *Collignonicerias woollgari* zone (**Plate 6A, figs. E-P**). It is a small, robust tooth form, typically smaller than 1 cm in dimension with a TW-TL ratio range of 0.84 and eight very thin,  $< 0.5$  (crown length /# of ridges) and closely spaced transverse ridges. The physical characteristics and average tooth characteristics of the type specimen (KUV 55352) are nearly identical to the sample of teeth from the Cenomanian form from Texas (**Appendix III**).



**Figure 24.** Tooth Height-Crown Height values from Cenomanian *P. anonymus* specimens.

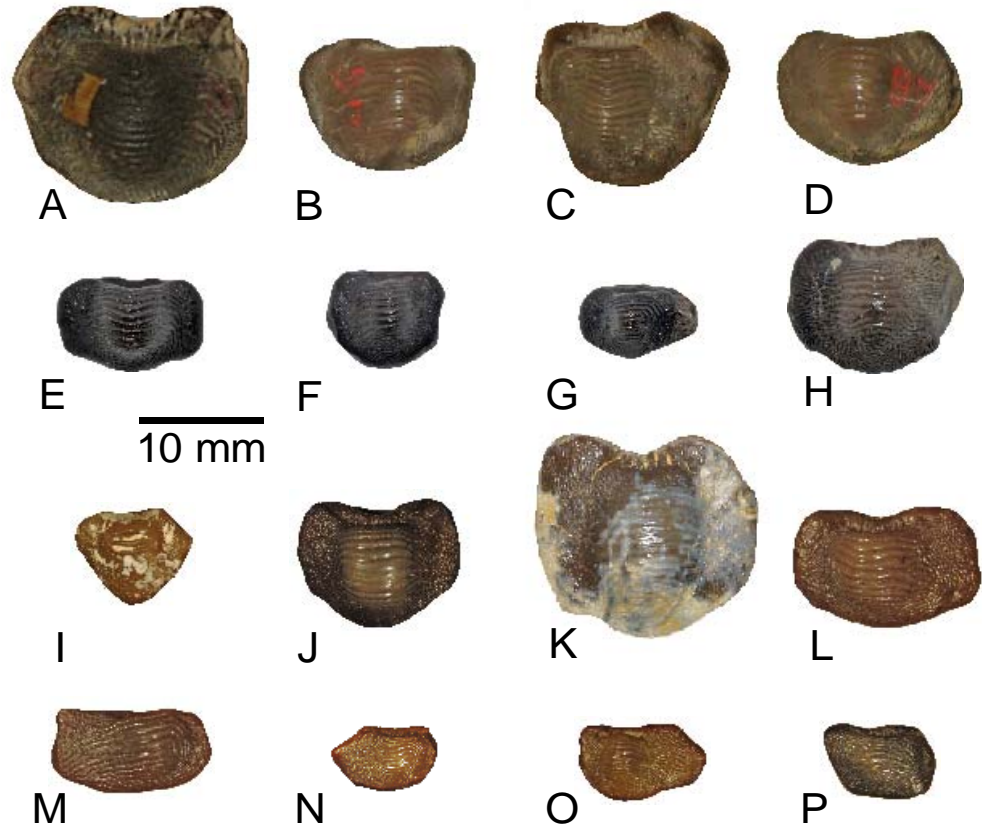
The second morphotype is found within the Middle Turonian *Collignonicerias woollgari* zone (**Plate 5B**). The anterior teeth are larger in size, sometimes exceeding 1 cm in all dimensions with thicker transverse ridges ( $> .5$ ,  $CL / \#$  tooth ridges), an identical TL-TW ratio (.84) but with much larger tooth height and crown height values (**Fig. 24**). These values show an increase in symmetric values, which may indicate increasing body size from the Cenomanian through the Turonian.



**Figure 25.** Tooth Height-Crown Height values for Texas Turonian *P. anonymous* specimens.

Late Turonian teeth referred to *P. anonymous* are identical to the typical ptychodontid occurring next stratigraphically, and should be referred to *P. mammillaris*. The two species cannot, and should not be grouped into a single species as the types for each differ greatly in morphology with respect to the transition from the crown to the margin, thickness and spacing of the transverse ridges and the patterning and size of the marginal ornamentation.

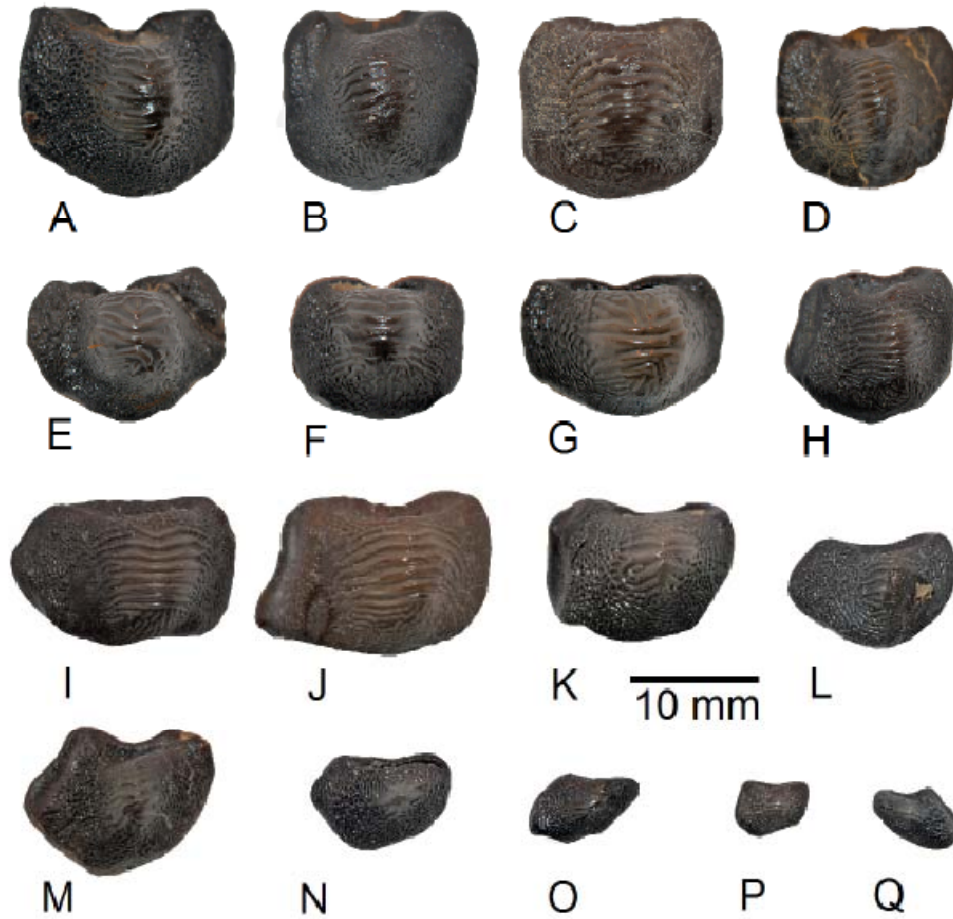
## PLATE 6A

*Ptychodus anonymus*

**Figures A-D**, KUVP 55352, (syntypes); **A**, anterior tooth, **B-D** lateral teeth;. **Figures E-G**, SMU 62774; **E**, medial tooth, **F**, lateral tooth, **G**, posterior tooth; **Figures H-P**, SMU 76240; **H**, medial, **I**, upper medial; **J-L**, lateral files, **M-P**, anterolateral/posterior files. All in occlusal views

**PLATE 6B**

*Ptychodus anonymus*



**Figures A-H**, SMU 76442, anterior teeth; **Figures I-M**, anterolateral files; **Figures N-Q**, posterior files. All in occlusal view.

*PTYCHODUS ATCOENSIS* n. sp.

(Plates 7A-7B)

*Ptychodus* sp. Meyer, 1974: p. 71-72.*Ptychodus* sp. Welton and Farish, 1993: p. 70.

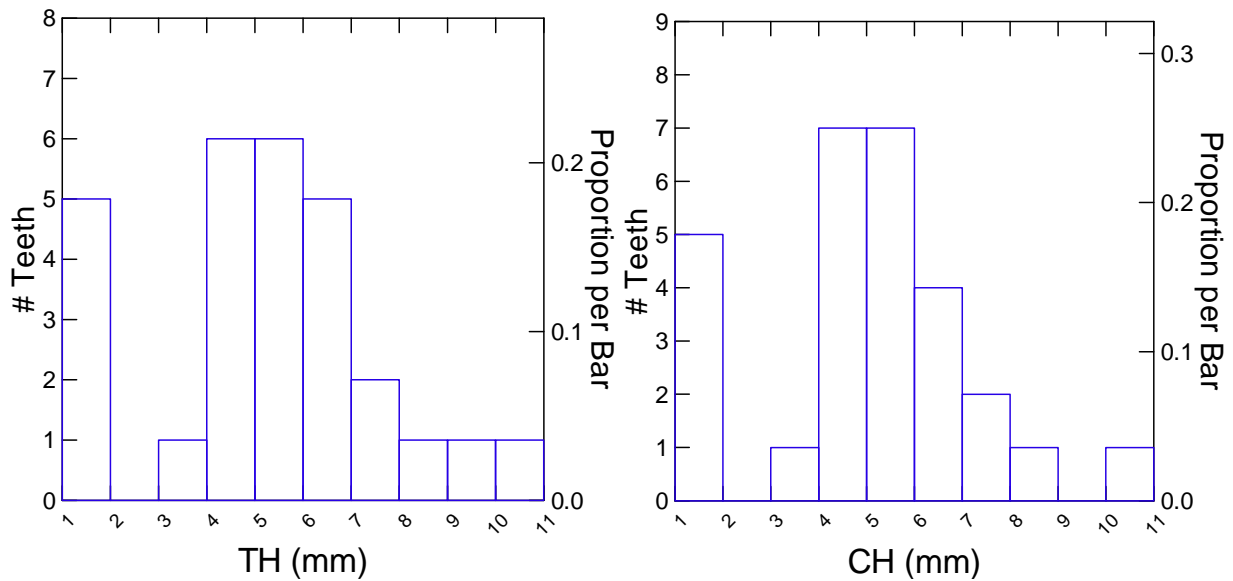
**Diagnosis.** Tooth Crown high and oriented 90° to the margin area in the medial files; crown crossed by six to eight thick, chevron-shaped parallel ridges; lateral files have moderately high crowns with a narrow crown angle, 30-90° with four to five parallel ridges; posterior teeth are low crowned with two to three ridges and less than a 20° crown angle; differs from other species as the ridges are thick, chevron shaped and terminate sharply at a coarsely granular and concentric margin.

**Etymology.** Specific name for the only geologic horizon it has been recovered from, the base Atco Formation of the Austin Group in Texas.

**Type specimen.** SMU 75598 (single tooth) (**Plate 7, fig A**).

**Referred specimens.** SMU 63313-14 (13 teeth); SMU 63302 (12 teeth); SMU 75594 (single tooth); SMU 75595 (2 teeth); SMU 76432 (12 teeth); SMU76433 (6 teeth); SMU 76434 (2 teeth); SMU 76435 (4 teeth); SMU 76436 (8 teeth); SMU 76437 (2 teeth) (**Plate 7, figs. B, C, I, J**).

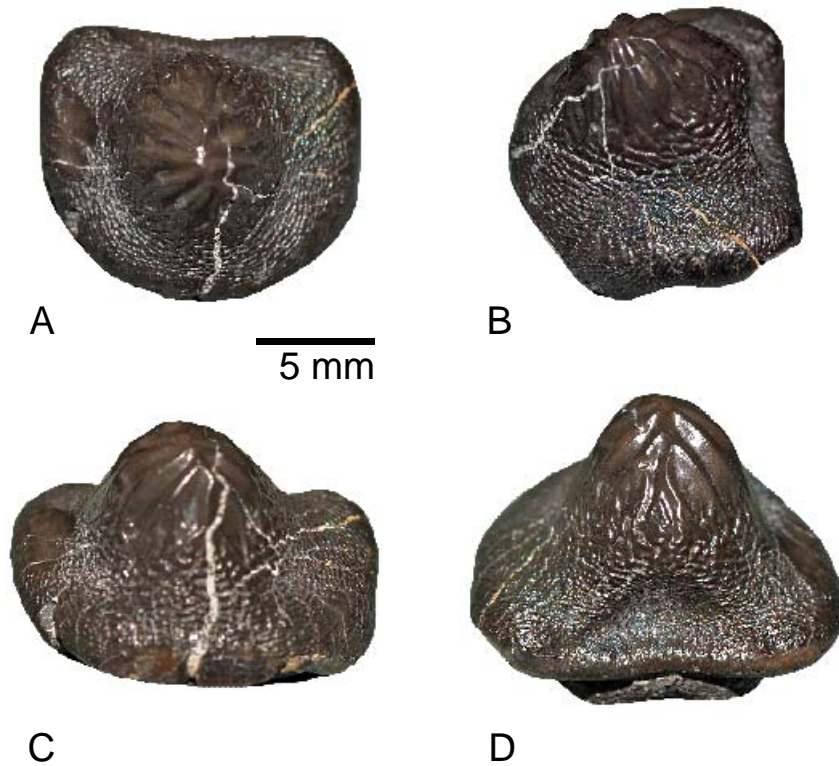
**Description.** Medial teeth have a high and bulbous crown with straight sides that meet at nearly 90 degree angle with the margin. There are between five and ten prominently raised thick, clearly delineated, parallel transverse ridges that extend across the apex and down the sides of the crown. The ridges are thick at the base and thin at the apex creating a sharp cutting edge. The labial and lingual most ridges converge apically towards the center of the crown, meeting at the center-most ridges, creating a distinctive chevron pattern. Each ridge maintains its thick and sharp edge as they extend down the sides of the cusp terminating at the margin. The marginal area is wide and shelf-like, ornamented with coarsely granular and concentric ridges. Lateral and posterior file teeth are polygonal and irregularly shaped with a raised crown and similar ridge pattern with offset crowns and decreasing tooth size as in other members of the genus.



**Figure 26.** Tooth Height-Crown Height values for all *Ptychodus atcoensis* specimens observed.

**Stratigraphic and Geographic occurrence.** *Ptychodus atcoensis* has only been recovered from the *Nicaisolopha bellaplicata* zone at the base of the Atco Formation of the Austin Group in Texas (Meyer, 1974, Welton and Farish, 1993, Hamm, 2003, 2004).

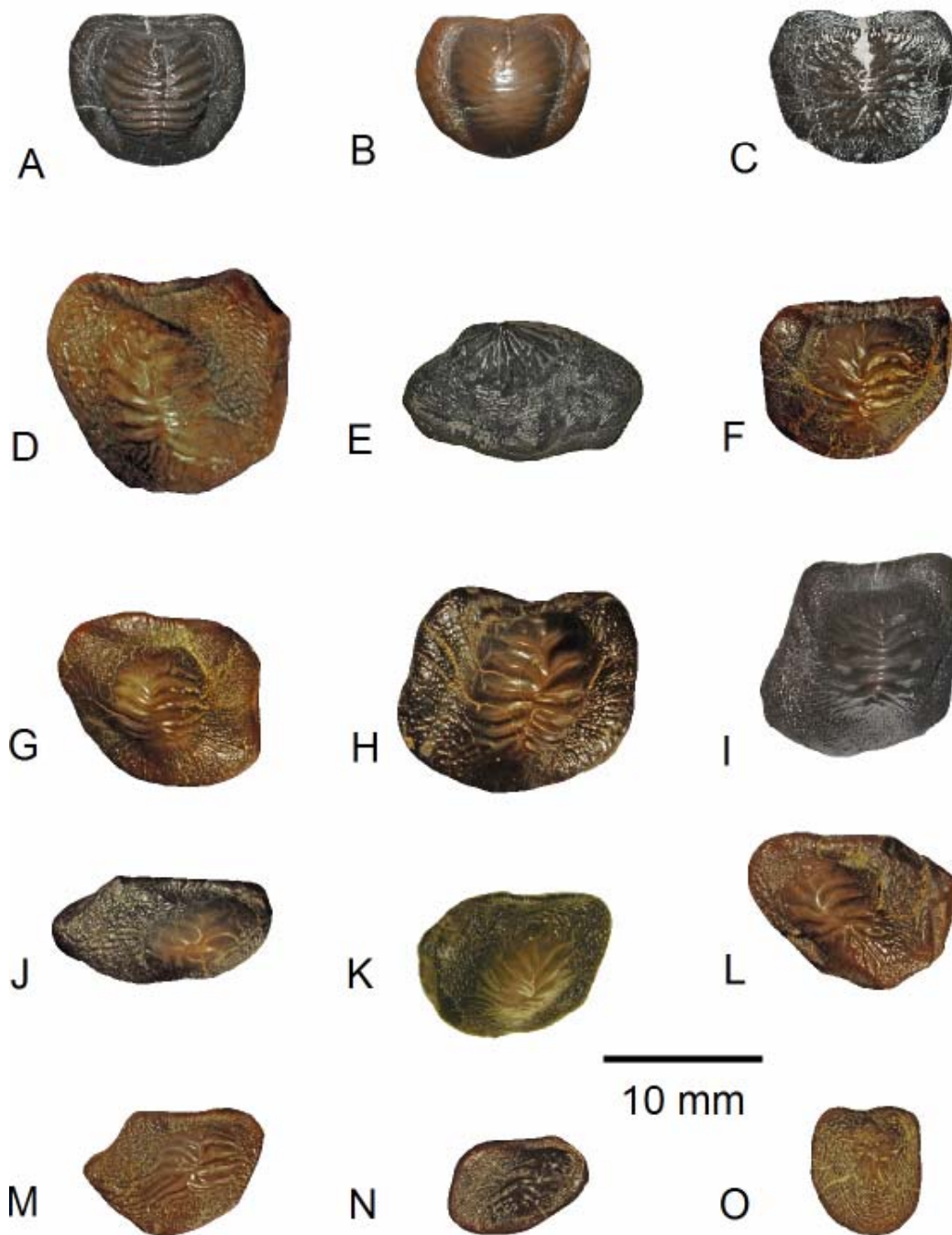
**Discussion.** *Ptychodus atcoensis* is a rare species and only found within the lag deposit at the Austin/Eagle Ford contact. Welton and Farish (1993) noted this morphotype as an undescribed species that superficially resembles *P. mortoni*. A close examination of the shape of the crown along with the pattern and arrangement of the transverse ridges is similar to *P. anonymus* and *P. mammillaris*. It differs from these taxa is the prominence, thickness and chevron pattern of the ridges. *Ptychodus atcoensis* has been suggested to be a transitional form between *P. anonymus* and *P. mortoni* (Meyer, 1974). However, this is not likely as *P. mortoni* has a pre-Niobrara cyclothem occurrence (Blanco-Pinion, et al., 2007) and each co-occur in the basal Atco Formation (Hamm, 2005). The pattern, prominence and thickness of the transverse ridges and their relationship to the marginal area in *P. atcoensis* distinguish it from all other ptychodontids and represent a valid species.

**PLATE 7A***Ptychodus atcoensis* n. sp.

**Holotype** SMU 75598, para-medial-second file tooth? **Figure A**, apical view; **Figure B**, labial view; **Figure C**, anterior view; **Figure D**, posterior view.



## PLATE 7B

*Ptychodus atcoensis* n. sp.

**Figures A, C** (SMU 76433); **Figure B** (SMU 76436) lower medials; **Figures D, G** (SMU 76434) para-medial files; **Figure E** (SMU 75599), right lateral file; **Figures H, M** (SMU 76437); **Figure I** (SMU , lateral; **Figures I** (SMU 76432), right lateral file; **Figures. F, J, K, L,** (SMU 76436) lateral files **Figure M, N, O** (SMU 76436) posterior files; **Figure O**, upper medial. All in apical view.

*PTYCHODUS OCCIDENTALIS* (Leidy, 1868)

(Plates 8A-8C)

*Ptychodus occidentalis* Leidy, 1868: p. 207, fig.

*Ptychodus occidentalis* Williston, 1900a: p. 33, pl. 11, fig. 4.

*Ptychodus occidentalis* Williston, 1900b: p. 242, pl. 29, fig.4

*Ptychodus deccurrens bifurcus* Meyer, 1974: p. 36, fig. 10.

*Ptychodus occidentalis* Russell, 1988: p. 672.

*Ptychodus occidentalis* Welton and Farish, 1993: p. 64.

*Ptychodus occidentalis* Cumba and Tokaryk: 1999

*Ptychodus occidentalis* Cicimurri, 1998: p. 57, pl. 6, 1-4; pl. 7, 1-5.

*Ptychodus occidentalis* Cicimurri, 2001a: p. 31, 32, fig. 6 E-G.

*Ptychodus occidentalis* Cicimurri 2001b: p. 183.

*Ptychodus occidentalis* Shimada et al., 2006: pp. 6-7, fig. 6, 7-9.

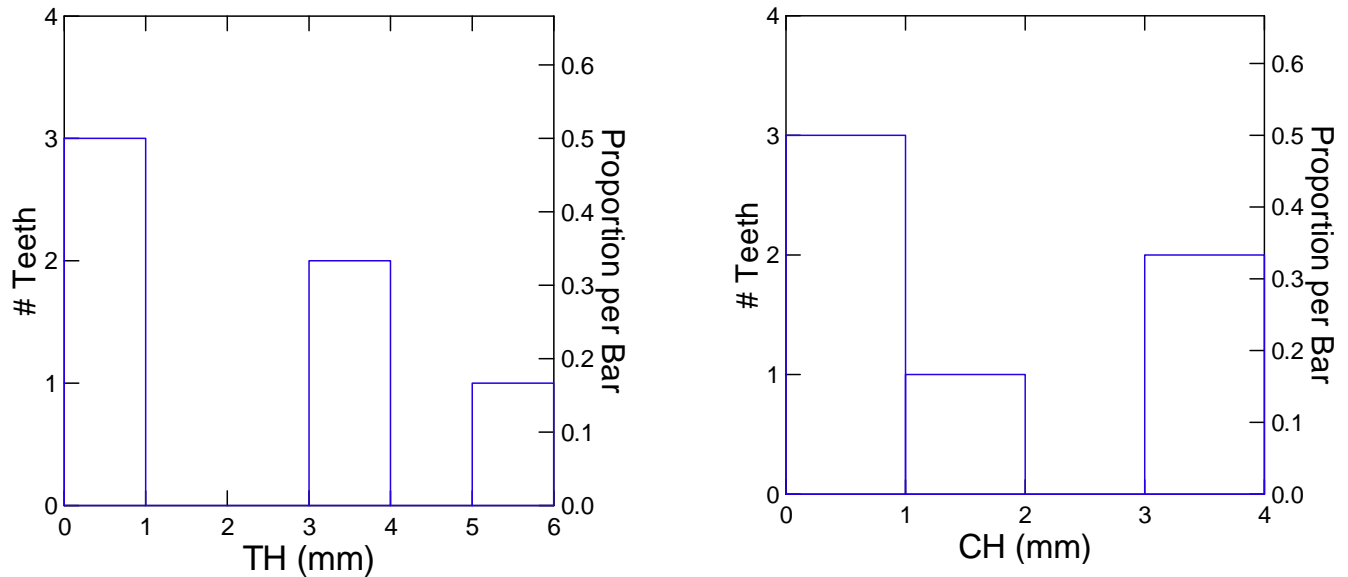
*Ptychodus occidentalis* Murphy et al., 2007: Vol. 27, supp. to No. 3, 122A.

**Diagnosis.** Medial teeth high and bulbous crossed by no less than 10 and up to fifteen parallel ridges that extend to and bifurcate to the lateral crown edges; lateral file teeth have low and rounded crowns with seven to ten ridges; posterior teeth are flat with a 1:1 TH-CH ratio with no less than five ridges. Differs from other species in that the ridges are very fine, thin and closely spaced and extend down the sides of the crown and bifurcate into even finer anatomizing ridges across the marginal area. The marginal area is indistinct in medial files and absent in lateral and posterior files where the teeth are flatter and the ridges extend fully to the lateral tooth edges.

**Type specimen.** ANSP 1460, ANSP 1461, ANSP 1463 and ANSP 1465; all single teeth.

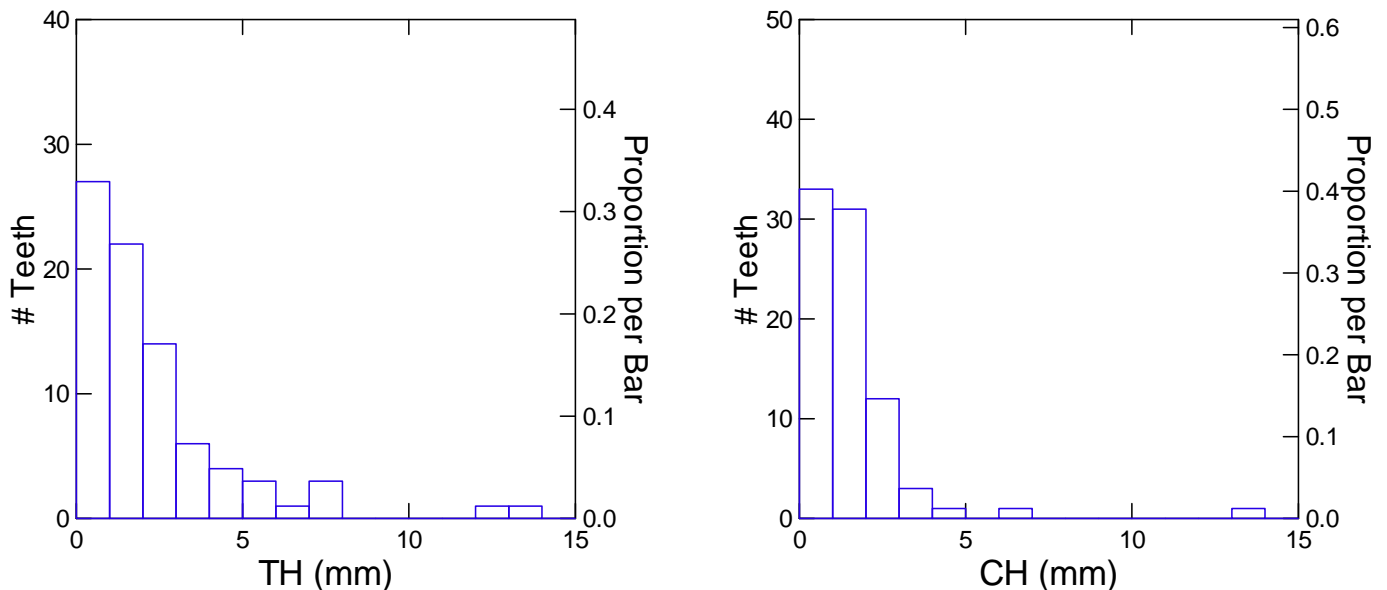
Leidy (1868, p. 207) stated this material was collected from “a few miles east of Fort Hays, Kansas”; Stewart (1990) notes the horizon as the Graneros Shale (Middle Cenomanian).

**Referred specimens.** FHSM VP 15075-15078 (single teeth); FHSM VP 15141-15145 (327 teeth); FHSM VP 16700 (92 teeth); KUVF 55259, 55260 (single teeth); SDSM 35233, 35234 (30 teeth); SMU 62764 (single tooth), SMU 62765 (single tooth), SMU 62766 (12 teeth), SMU 62782 (single tooth).



**Figure 27.** Tooth Height-Crown Height values for the type specimen of *P. occidentalis* ANSP 1460, ANSP 1461, ANSP 1463 and ANSP 1465.

**Description.** The largest teeth observed are from the lower medial file and have high symmetrical, rounded and bulbous crowns crossed by five to fifteen fine, sinuous and often discontinuous ridges cross the cusp apex. These ridges bifurcate and anastomose distally, becoming finer until they reach the mesial and distal tooth edges. The transition from the crown to margin is almost indeterminate as the margin is less pronounced than in other species. Ornamentation on the mesial and distal ends are extensions of the apical transverse ridges that curl and bifurcate into finer discontinuous ridges; anterior and posterior margins comprised of very fine longitudinal ridges that also curl, bifurcate and anastomose distally. The majority of specimens observed during this study comprised mostly of lateral and posterior file teeth (**Fig. 28**). These teeth have very low to non-existent crowns with the tooth edges being equal to the edges of the crown (1:1 ratio) ornamented with straight and parallel transverse ridges.



**Figure 28.** Tooth Height-Crown Height values for Texas and Kansas *Ptychodus occidentalis* specimens.

**Stratigraphic and Geographic occurrence.** Cenomanian-Turonian deposits including the Belle Fourche Member (Middle Turonian) of the Ashville Formation in Saskatchewan, Canada (Cumba and Tokaryk, 1999) and South Dakota (Cicimurri, 1998, 2001a, 2001b); the Dakota Sandstone (Middle Cenomanian) in Kansas (Leidy, 1868; Stewart, 1990); the Greenhorn Formation (Cenomanian-Turonian) in Colorado (Shimada et al., 2006); the Woodbine Formation (Cenomanian) and Kamp Ranch Formation (Middle Turonian) in Texas (Meyer, 1974; Welton and Farish, 1993; Hamm, 2003). Russell (1988) listed *P. occidentalis* as one of the ptychodontids from the Niobrara Formation; however there are no referable specimens to support this claim and is here considered invalid because of its limited stratigraphic occurrence within the Western Interior.

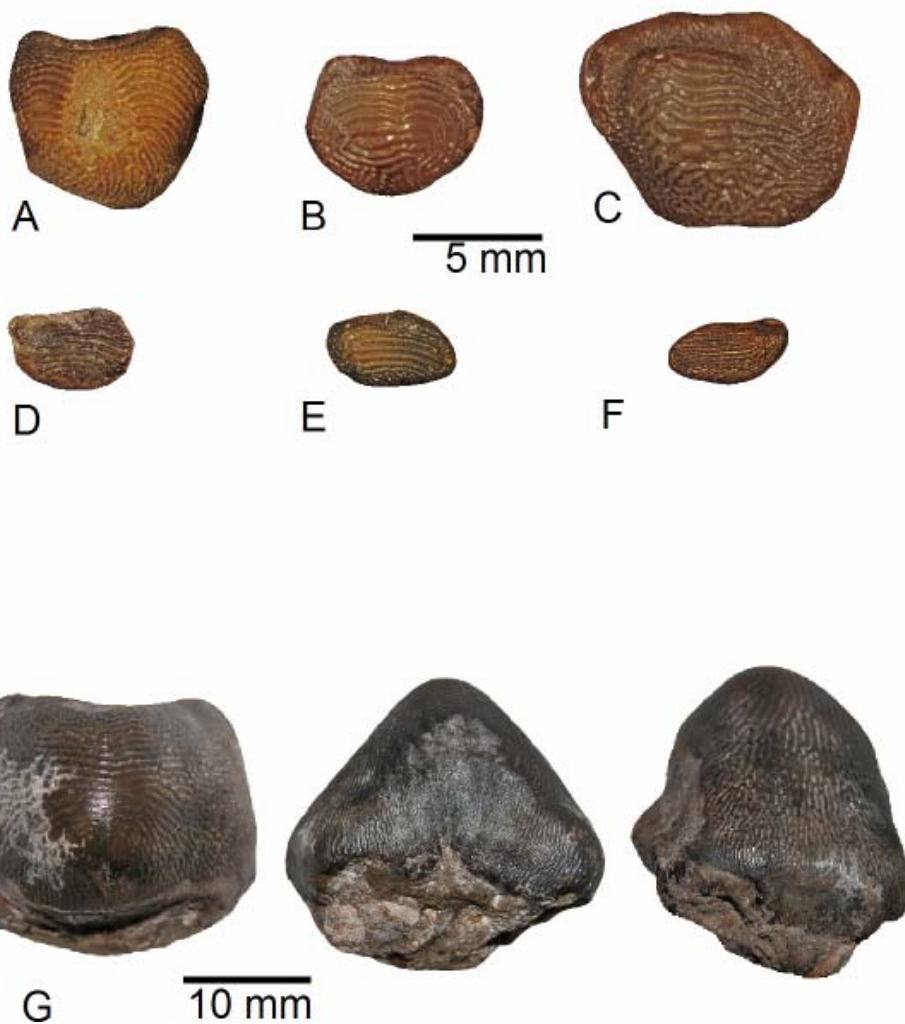
**Discussion.** *Ptychodus occidentalis* has similar pattern of radiating crown ornamentation with *P. mortoni* and bifurcating marginal ornamentation similar to *Paraptychodus* and *P. decurrens* (Fig. 69). *Ptychodus occidentalis* is differentiated from *P. mortoni* by having a bulbous crown with a

greater number of and finer transverse ridges. It is more derived from *Paraptychodus* and *P. decurrens* in regards to crown morphology and the presence of a well defined labial protuberance, lingual sulcus and greatly angled mesial and distal tooth edges.

*Ptychodus occidentalis* has a short stratigraphic range, being found only in Middle Cenomanian through Middle Turonian deposits throughout the seaway. It appears to be more prevalent in the northern to middle sections of the Western Interior Seaway as it is represented by larger tooth samples, with 92 isolated teeth from the Cenomanian in Kansas (FHSM VP 13200, **Plate 13**); 30 teeth from the Cenomanian in South Dakota (Cicimurri, 1998) and 367 teeth (FHSM VP 15075-15078; 15141-15145) from the Greenhorn Formation in Southeast Colorado (Shimada et al., 2006), whereas the sample size from the Gulf Coast is much smaller, with only 15 referable specimens (SMU 62764-62766, 62782, **Plate 14**) from Texas.

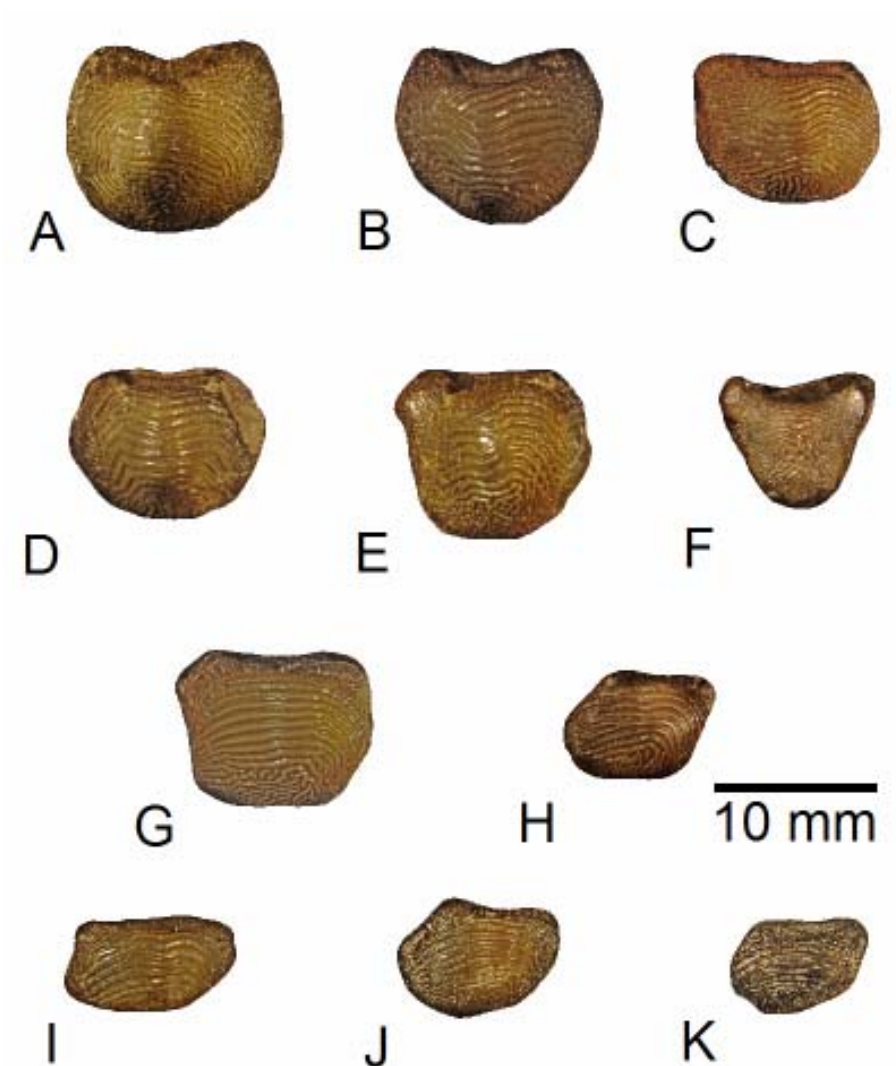
The reason for the difference in the numbers of specimens between the northern and southern ends of the seaway is intriguing. The paucity of material from the southern end of the seaway is most likely due to collecting bias, as reflected by the number of referable specimens. The present data indicates that *P. occidentalis* is endemic to the Western Interior Seaway.

## PLATE 8A

*Ptychodus occidentalis*

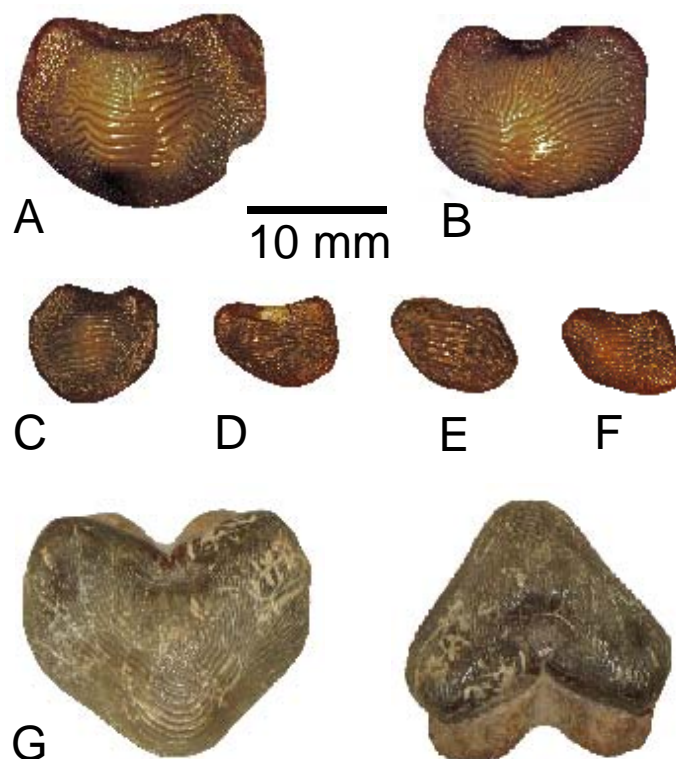
**Figure A**, ANSP 1461; **Fig. B**; 1463; **Figure C**; 1464, anterior files; **Figure D**, ANSP 1466, lateral file; **Figure E**, ANSP 1460; **Figure F**, 1462, posterior teeth; **Figure G**, ANSP 1465, lower medial. All in occlusal view.

## PLATE 8B

*Ptychodus occidentalis*

**Figures A-H**, FHSM VP 13200. **Figure A**, upper medial; **Figures B-C**, lower medials; **Figures D-G**, anterior file, ? para-medial; **Figures E-H**, anterolateral files. All occlusal view.

## PLATE 8C

*Ptychodus occidentalis*

**Figure A**, SMU 62764, lower medial; **Figure B**, SMU 62765 para-medial?, **Figure C-F**, SMU 62766, lateral files; **Figure D**, SMU 62766, posterior file; **Figure G**, KUVF 55260, in occlusal and posterior views.



*PTYCHODUS WHIPPLEI* (Marcou, 1858)

(Plates 9A-9E)

- Ptychodus whipplei* Marcou, 1858: p. 33, pl. 1, fig. 4.
- Ptychodus whipplei* Leidy, 1873: p. 300, pl. 18, figs. 19, 20.
- Ptychodus whipplei* Newberry, 1876: p. 137, pl. 3, fig. 2.
- Ptychodus whipplei* Woodward, 1889: p. 152.
- Ptychodus whipplei* Williston, 1900: p. 243, pl. 29, figs. 10, 15.
- Ptychodus* cf. *whipplei* Aguilera, 1907: p. 240.
- Ptychodus whipplei* Maldonado-Koerdell, 1948: p. 299, pl.6.
- Ptychodus whipplei* Cappetta, 1973: pp. 504-514.
- Ptychodus whipplei* Edwards, 1976: pp. 67-70.
- Ptychodus whipplei* Stewart and Martin, 1993: Vol. 72, pp. 241-248.
- Ptychodus whipplei* Evetts, 1979: p. 62, pl. 1, figs. 6-12.
- Ptychodus whipplei* Wolberg, 1985: p. 2, fig. 3A.
- Ptychodus whipplei* Welton & Farish, 1993: pp. 68-69.
- Ptychodus whipplei* Williamson, Kirkland, and Lucas, 1993: pp. 448-449, fig. 3, 1-2.
- Ptychodus whipplei* Cicimurri and Bell, 1996: 28A.
- Ptychodus whipplei* Cicimurri, 1998: pp. 61-62, pl. 8, 3-8.
- Ptychodus whipplei* Cappetta and Case, 1999: p. 11, pl. 2, figs. 4-6.
- Ptychodus whipplei* Lucas and Johnson, 2002: p. 49.
- Ptychodus whipplei* Cicimurri, 2003: p. 7, fig. 4, J-K.
- Ptychodus whipplei* Hamm, 2004: Vol. 24, supp. to No.3, 67A.
- Ptychodus whipplei* Hamm, 2005: Vol. 25, supp. to No. 3, 67A.
- Ptychodus whipplei* Shimada, 2006: p. 166, fig. 4B.

**Diagnosis.** Teeth compact and symmetrical, differs from other species in that the tooth cusp is well developed, post-like and highly elevated. The crown is crossed by thin and sometimes weakly developed parallel transverse ridges. The tooth crown is distinctly differentiated from a clearly defined marginal shelf that is covered by fine concentric marginal ornamentation. The labial protuberance, lingual sulcus and multi-angled mesial-distal tooth edges are well developed.

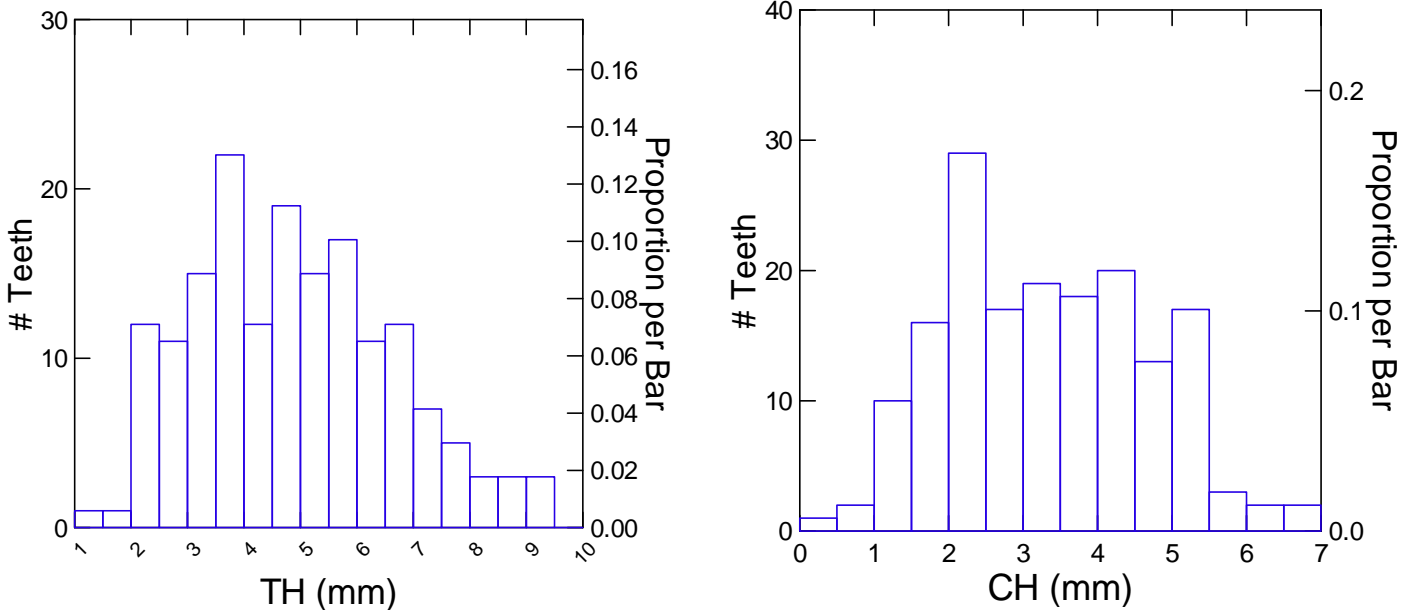
**Type specimen.** P. 15705, Natural History Museum, London, from the El Vado Member of the Mancos Shale (Early Coniacian) New Mexico (Lucas and Johnson, 2002).

**Referred specimens.** Turonian material: SMU 63289 (11 teeth); SMU 63290, composite dentition (169 teeth); SMU 75581 (single tooth); SMU 76409 (>100 teeth); SMU 76410 (>100 teeth); SMU 76411 (36 teeth); SMU 76412 (8 teeth); SMU 76413 (10 teeth); SMU 76414 (3 teeth); SMU 76415 (>100 teeth); SMU 76424 (233 teeth). Coniacian material: SMU 75596 (single tooth); SMU 75597 (single tooth); SMU 76416, composite dentition (170 teeth); SMU 76416 (175 teeth); SMU 76417 (37 teeth); SMU 76418 (>100 teeth); SMU 76419 (>100 teeth).

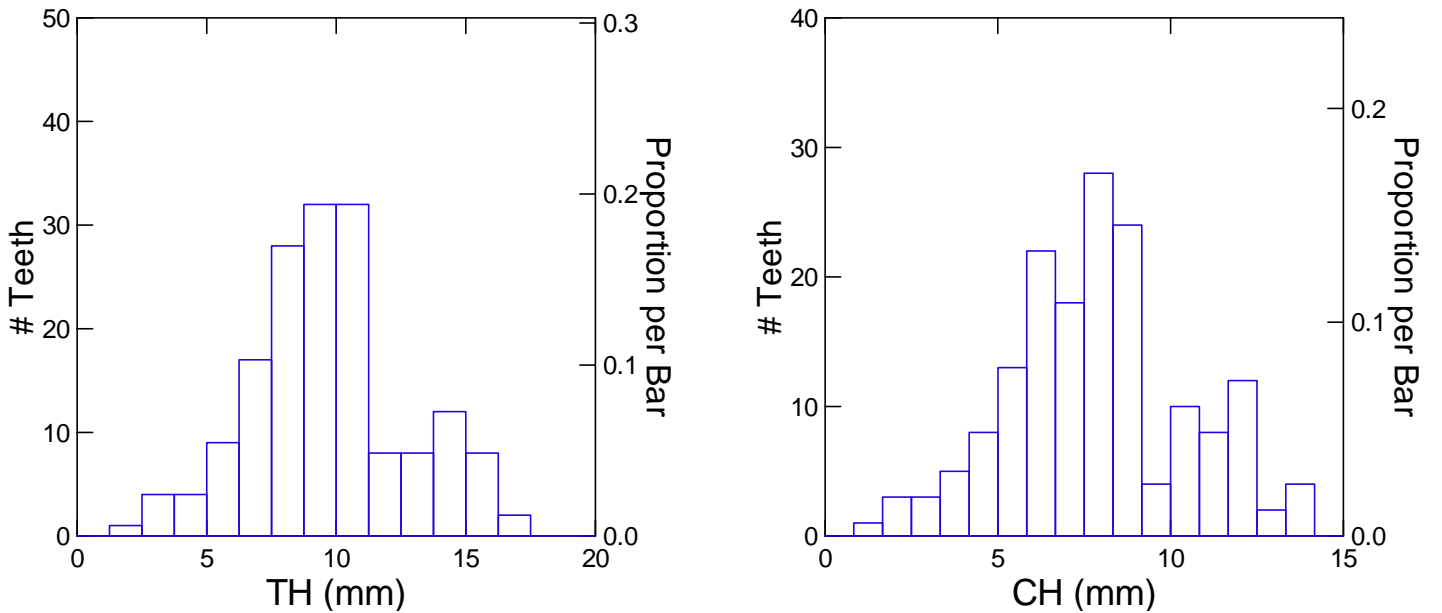
**Description.** The teeth of *P. whipplei* are typically square in outline, having a high and distinctly developed rounded, knob-like cusp with steep sides. The apex of the cusp is covered by three to five weak transverse ridges in the Middle Turonian morphotype, to indistinct and irregular ridges in the Early Coniacian type. In each, the labial tooth edge is rounded and greatly overhangs the tooth root, whereas the lingual edge has a distinct and deep sulcus. The tooth cusp intersects the marginal area at a 90° angle in the medial files. Extremely fine and discontinuous enameloid ridges form a concentric pattern on the marginal area.

Teeth of the Turonian morphotype has small and compact teeth that exhibit uniform and gradual changes in tooth height and crown height from the medial out to posterior files (**Fig. 29**). The transverse ridges are restricted to the apex of the cusp and do not extend down the lateral cusp edges. The transition from the cusp to margin is sharp in the medial files and becomes more gradual in the lateral files. The tooth cusp of the lateral teeth are rather symmetrical than being meso-distally elongate as is seen in other species with only a slight (2-5°) of offset.

In contrast, the Coniacian form is much larger in size among all tooth files (**Fig. 30**) and exhibits more pronounced changes in symmetry and amount of cusp offset, from 90° in the medial file to 65° of offset in the posterior files. The tooth cusp in the Coniacian form is taller and slightly compressed laterally, with three to four transverse ridges that extend down the side of the top half of the crown; terminating sharply at the marginal area. Unlike the Turonian form, the transition from cusp to marginal area is steeply sloping and sharp amongst all tooth files.



**Figure 29.** Tooth Height-Crown Height values of Turonian *P. whipplei* composite tooth set SMU 63290.



**Figure 30.** Tooth Height-Crown Height values of Coniacian *P. whipplei* composite tooth set SMU 76416.

**Stratigraphic and Geographic occurrence.** *Ptychodus whipplei* is found only in Middle Turonian and Early Coniacian deposits which include the Blue Hill Member of the Carlile Shale (Middle Turonian) in Kansas (Everhart et al., 2003); Kamp Ranch Formation (Middle Turonian) of Texas (Hamm, 2004, 2005); the El Vado Member of the Mancos Shale (Early Coniacian) New Mexico (Marcou, 1858; Lucas and Johnson, 2002); from the *Nicaiolopha bellaplicata* zone at the base of the Atco Formation of the Austin Chalk Group (Early Coniacian) in Texas (Leidy, 1873; Meyer, 1974; Welton and Farish, 1993; Cicimurri, 1998; Hamm, 2004).

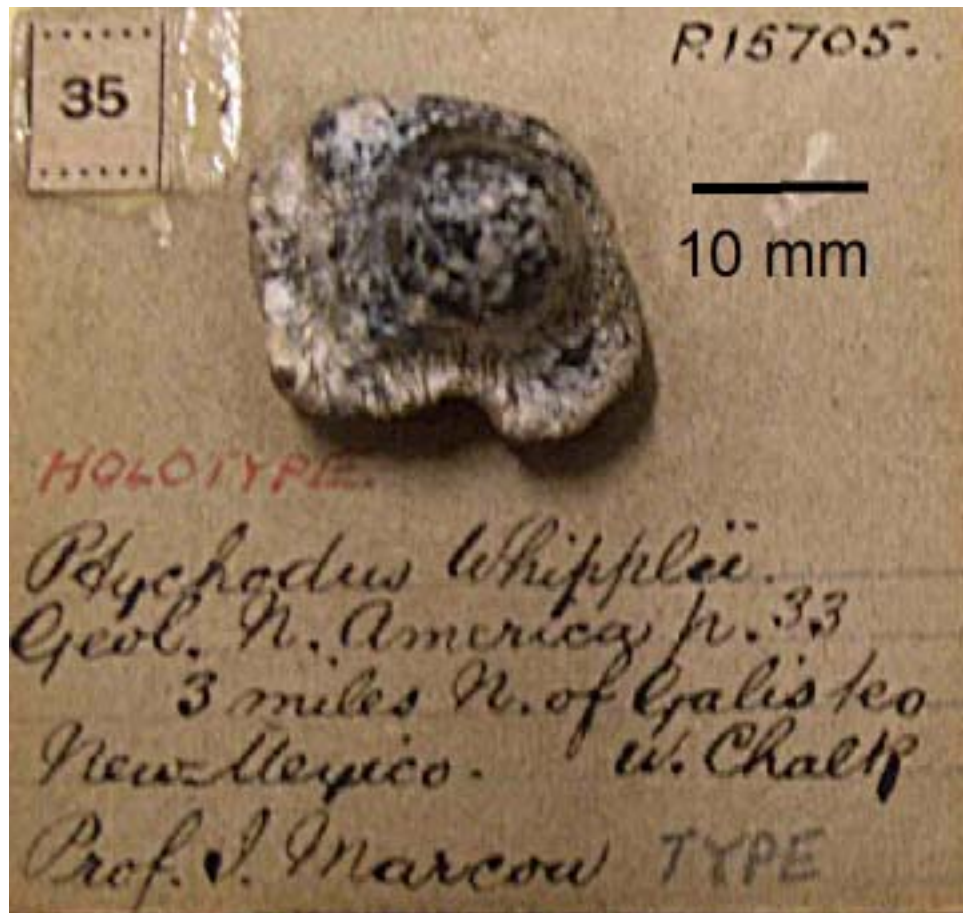
**Discussion.** I observed two stratigraphic and morphological differentiated types of *P. whipplei* during this study. The first morphotype is found in Middle to Late Turonian deposits within the *Collignonicerias woollgari* and *Prionocyclus hyatti* ammonite zones throughout the WIS. The TH-CH ratios range from 0.62 in the medial files to 0.53 in the lateral files. The tooth cusps are circular in cross section and there is only a slight mesial inclination of the crown, even in the posterior files. Crown heights range from 11mm in the medial files to 3.7 mm in the posterior files. The TW-CW ratios range from 0.54 in the medial files to 0.65 in the lateral files. The transverse ridges are prominent and easily distinguishable from one another. The transition from cusp to marginal area is sharp with marginal ornamentation composed of fine, continuous ridges that are concentric with the crown. These features are similar to some Middle Turonian *P. anonymus* specimens from the Kamp Ranch Formation of the Eagle Ford Group in Texas. It is possible that *P. whipplei* split from *P. anonymus* in the Middle Turonian (**Fig. 69**), developing a more elevated and post-like cusp, while others in the population maintained a lower and broader crown.

Teeth from Early Coniacian deposits (*Nicaiolopha bellaplicata* Zone) are much larger in all dimensions (**Appendix III**). They have tooth crowns that higher, 19mm in height in medial file to 7mm in the posterior files, with an average of 0.71 TH-CH ratios. The crowns are wider and thicker (0.61 TW-CW ratio) and exhibit increased asymmetry from 90° in the medial files to 30° in the posterior files. The ridge pattern is irregular and indistinct instead of clearly delineated and parallel in the Turonian form. The margin is ornamented with a combination of coarse concentric enameloid granules and irregular bifurcating ridges. The separation of each tooth type within differing geological horizons represents differences in habitat. The Turonian form is found within a shallow marine environment, whereas the Coniacian form is found in

large concentrations in the basal Atco Formation, a deeper water environment at the southern end of the seaway.

Welton and Farish (1993, pg. 68) noted, “at least three associated partial dentitions of *P. whipplei* are known from the Cretaceous of Texas”. However, none of these could be located in an institution for study. *Ptychodus whipplei* is the most common ptychodontid occurring within the Cretaceous of Texas and over a thousand teeth from the Turonian and Coniacian were obtained during this study. The various tooth morphologies present in each sample were compared to those within other associated tooth sets and there were enough representative tooth file positions to create composite dentitions for each variety (**Plates 9B, 10A**).

## PLATE 9A

*Ptychodus whipplei*

**Holotype.** P. 15705, from the Early Coniacian of New Mexico. Occlusal view.

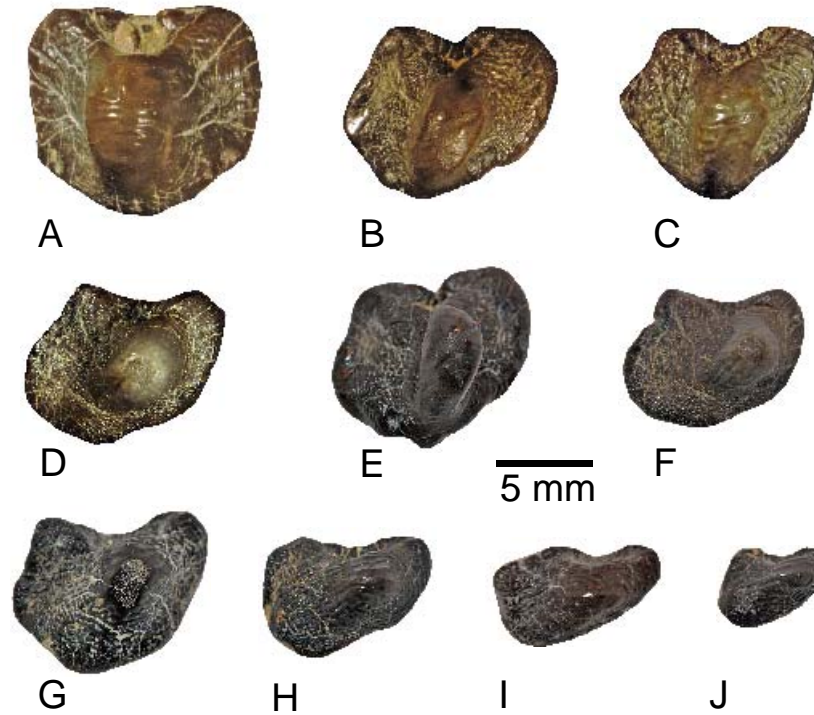
**PLATE 9B**

*Ptychodus whipplei* SMU 63290



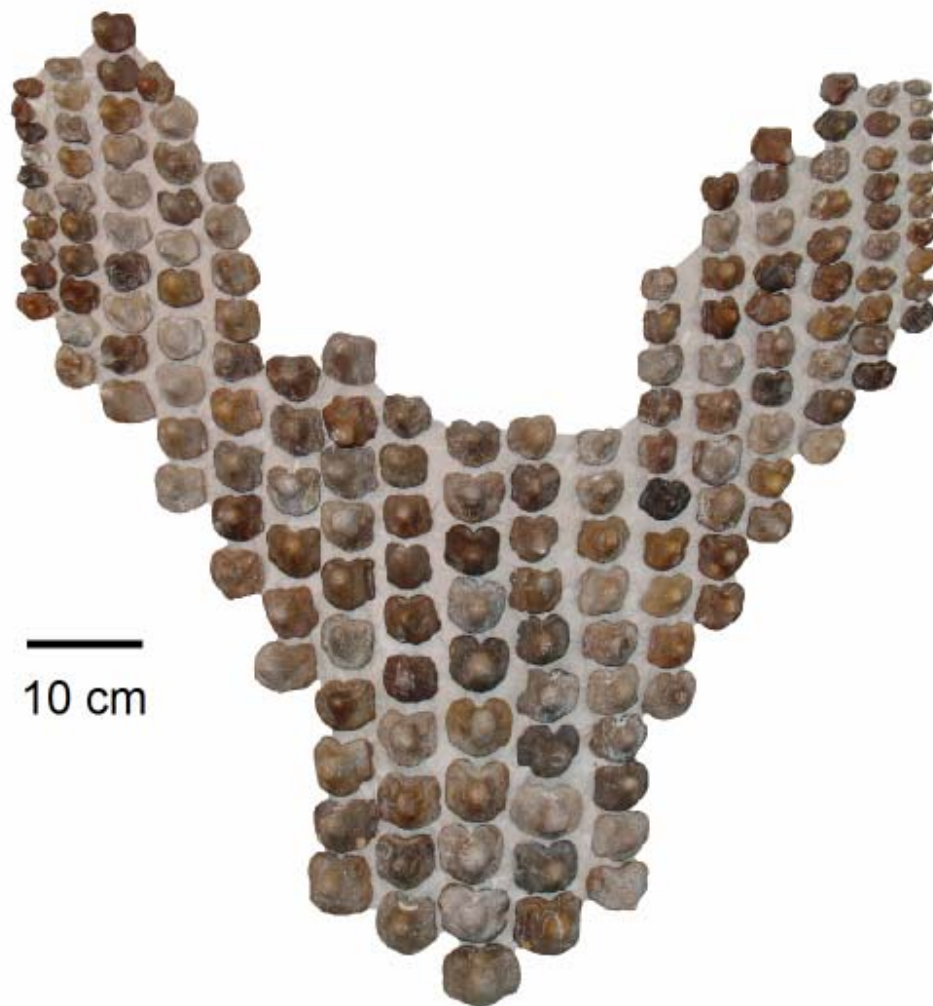
Composite dentition of lower tooth files from the Kamp Ranch Formation of the Eagle Ford Group (Middle Turonian) of Texas. Occlusal view.

## PLATE 9C

*Ptychodus whipplei* SMU 63290

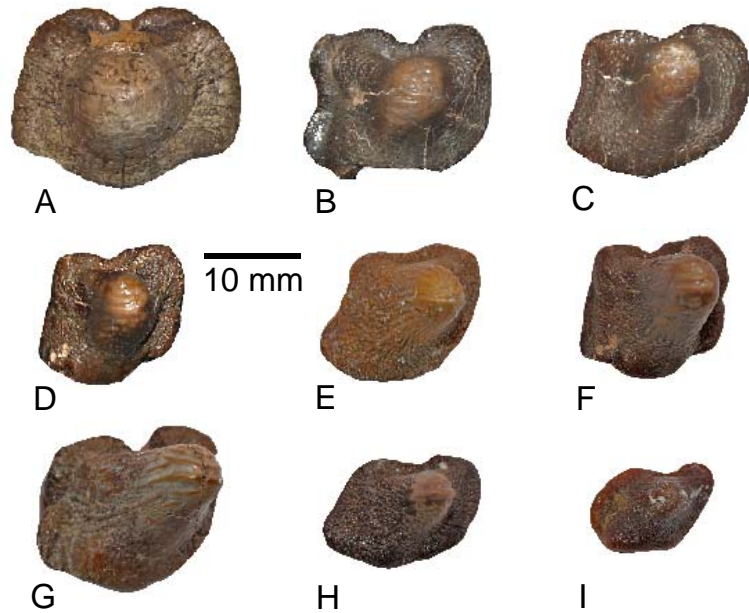
**Right composite tooth series:** **Figure A**, lower medial; **Figure B**, para-medial; **Figure C**, 2<sup>nd</sup> file; **Figure D**, 3<sup>rd</sup> file; **Figure E**, 4<sup>th</sup> file; **Figure F**, 5<sup>th</sup> file; **Figure G**, 6<sup>th</sup> file; **Figure H**, 7<sup>th</sup> file; **Figure I**, 8<sup>th</sup> file; **Figure J**, 9<sup>th</sup> file; **Figure K**, 10<sup>th</sup> file. All in occlusal view.



**PLATE 9D***Ptychodus whipplei* SMU 76416

Composite dentition of lower tooth files from the basal Atco Formation of the Austin Group in Texas. Occlusal view.

## PLATE 9E

*Ptychodus whipplei* SMU 76416

**Right composite files: Figure A, lower medial; Figure B, para-medial; Figure C, 2<sup>nd</sup> file; Figure D, 3<sup>rd</sup> file; Figure E, 4<sup>th</sup> file; Figure F, 5<sup>th</sup> file; Figure G, 6<sup>th</sup> file; Figure H, 7<sup>th</sup> file; Figure I, 8<sup>th</sup> file; Figure J, 9<sup>th</sup> file; Figure K, 10<sup>th</sup> file. All in occlusal view.**

*PTYCHODUS RUGOSUS* (Dixon, 1850)

(Plates 10A-10G)

*Ptychodus rugosus* Dixon, 1850: p. 362 (1850), p. 391 (1878: 2nd edition) pl. 31, fig. 5.*Ptychodus rugosus* Woodward, 1889: p. 136, pl. 5, fig. 1.*Ptychodus rugosus* Priem, 1896: p. 288, pl. 9, figs. 1, 12, 18, 21.*Ptychodus anonymus* Williston, 1900: pp. 239-240, pl. 25, pl. 26, fig. 1, pl. 27.*Ptychodus rugosus* Leriche, 1902: p. 94, pl. 2, fig. 13, 15.*Ptychodus rugosus* Leriche, 1906: p. 75.*Ptychodus rugosus* Woodward, 1912: p. 231, pl. 48, figs. 1, 5, 8, 11.*Ptychodus rugosus* D'Erasmus, 1922: p. 21, pl. 2, figs. 22, 23.*Ptychodus rugosus* De Beaufort, 1923: p. 62, pl. 5, fig. 2 a 5, non fig. 1.*Ptychodus rugosus* Leriche, 1929: pp. 214, 218.*Ptychodus rugosus* Casier, 1953: pp. 7, 9, 13, 14, 16, 23, 40, fig. 4 in text, pl. 1, fig. 2, 2a.*Ptychodus rugosus* Hermann, 1977: pp. 65-69, pl. 2, fig. 8.*Ptychodus rugosus* MacLeod and Slaughter, 1982: pp. 403-409.*Ptychodus anonymus* Stewart, 1990: p. 21.*Ptychodus rugosus* Welton and Farish, 1993: pp. 66-67.*Ptychodus anonymus* Everhart et al., 2003: Vol. 22, p. 23.*Ptychodus anonymus* Everhart and Caggiano, 2004: pp. 125-136, figs. 2, 3, 4.*Ptychodus anonymus* Everhart, 2005c: p. 63.

**Diagnosis.** Lower medial teeth square in apical view with a high, elevated and rounded tooth crown oriented 90 to the margin. The apex of the cusp is crossed by no more than six wavy, discontinuous transverse ridges. The ridges terminate sharply at a 90° angle to a shelf-like marginal area which is covered by thin and concentric enameloid ridges. In the lateral files, the crowns become greatly offset and grades into the margin which is covered with concentrically oriented, thicker or rugose, enameloid ridges. The posterior files are rectangular in outline with a nearly flat occlusal surface and parallel transverse ridges. Upper medial files much smaller with a centrally located occlusal bump surrounded by very thin and concentric marginal ornamentation. Dentition with eight to ten individual lateral tooth files in the right and left tooth series not including the medial file.

**Type specimen.** BMNH 39793 from the Zone of *Micraster cor-testidinarium* Zone (Early Coniacian) of the English Chalk.

**Referred specimens.** SMU 69001 (upper dentition), SMU 69002 (lower dentition); SMU 69003 (dermal denticles); SMU 69004-69015 (vertebral centra); SMU 69016-69018 (partial vertebral centra); FHSM VP 2222 (upper dentition); FHSM VP 2223 (lower dentition); FHSM VP 2073 (lower dentition); FHSM VP 14854 (34 teeth); AMNH 19553 (upper and lower dentitions and vertebral centra); CSU-K-07-05, 1, 2 (isolated teeth) **Plates 10A-10H.**

**Description.** Nearly all *P. rugosus* specimens observed during this study are represented by relatively complete dentitions from differing stages of ontogeny. The information gathered from these specimens demonstrates the changes on tooth morphology throughout its lifespan. Specimens representing the upper dentitions are AMNH 19553, FHSM VP 2222 and SMU 69002.

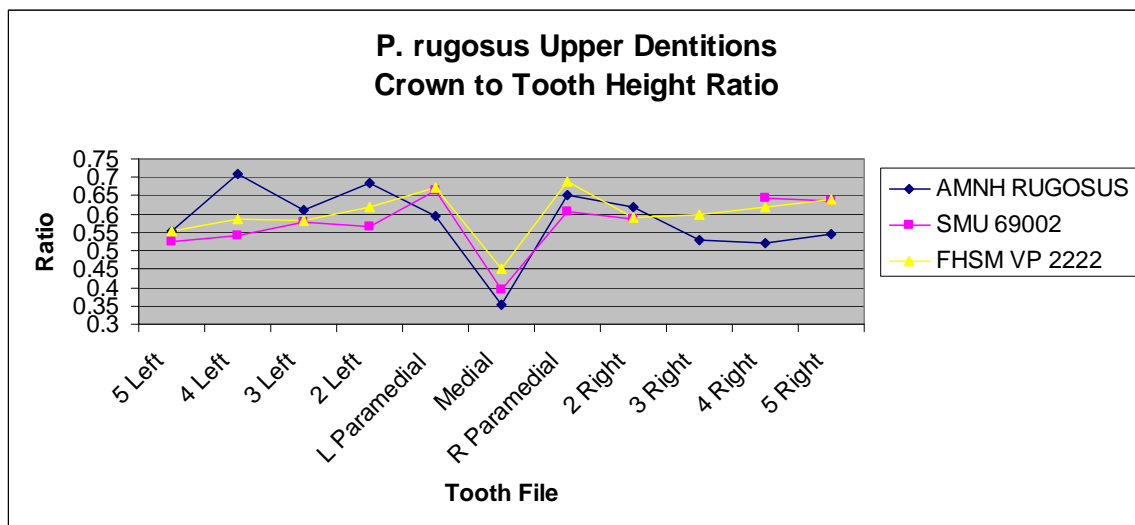
The medial file in the upper dentition is comprised of small symmetrical teeth that are square in outline having a small centrally located “bump” (0.39 TH-CH average ratios) of dentine located in the middle of a flat occlusal surface. Depending on the size/age (juvenile or adult) of the specimen the occlusal bump can be well developed having ornamentation identical to the other tooth files, or it can be poorly developed being completely smooth. The marginal area is well developed, but featureless surrounding the “bump”. Contrary to the lower dentition, the para-medial files are the largest and most symmetrical teeth with a 0.64 TH-CH ratio.

Teeth of the paramedial and anterolateral tooth files become progressively elongate (TW-CW 0.63-0.76 ratio) labio-lingually. The crown height decreases in height from the medial file outward, and the overall tooth shape continues to extend mesio-distally. The posterior files are differentiated from the anterolateral files by being more symmetrical and rectangular in shape, with only a slightly inflated to completely flat occlusal surface.

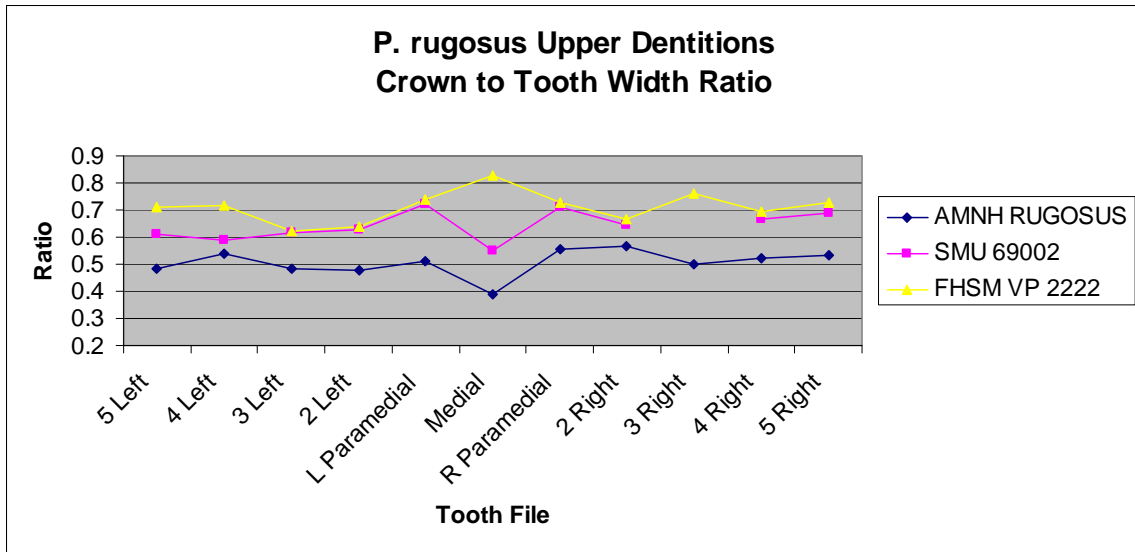
AMNH 19553, FHSM VP 2223, FHSM VP 2073 and SMU 69001 are lower dentitions. In these dentitions, teeth of the median files are square in outline in occlusal view, having a high tooth cusp (0.68 TH-CH average ratios) that is rounded at the apex bearing three to six irregular, wavy and discontinuous transverse ridges that extend down the mesial and distal edges of the cusp terminating at the margin. The TW-CW ratio is narrow, averaging 0.78. The tooth margin is covered in parallel to wavy enameloid ridges oriented perpendicular and concentrically to the transverse ridges extending down the tooth cusp and into the deep sulcus located on the lingual

edge. The labial edge has a pronounced protuberance that overhangs the tooth root with very fine, non distinct ornamentation.

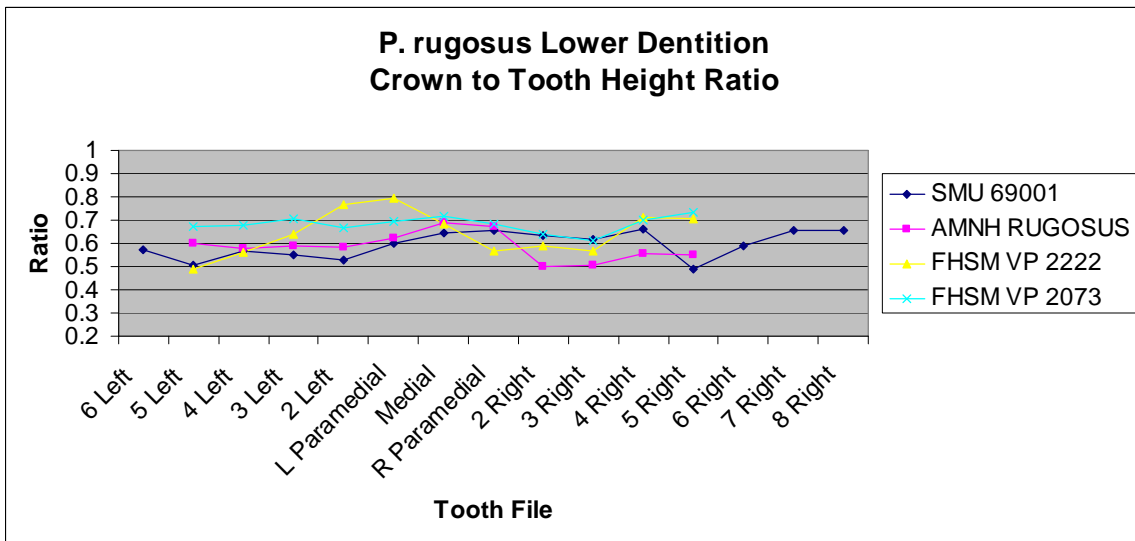
The TW-CW and LW ratio analysis indicates that it is possible to determine ontogenetic changes within the species (**Figs. 33, 35**). The smallest specimen based on tooth size, AMNH 19953 has a lower ratio values amongst each file versus the largest specimen, FHSM VP 2222. The graphs show a symmetrical pattern of values within all of the tooth files from each dentition. These trends are interpreted as an indicator of allometric growth from the youngest to oldest individual within the species. This conclusion is also supported by tooth size within the dentition as a whole, and not by a single tooth specimen (**Appendix III**). There is about a 25% differentiation in height to width values between the upper and lower dentitions. However, the physical characteristics of each tooth within each dentition are identical, and it is impossible to determine whether a single tooth belongs in the upper or lower dentitions, excluding teeth of the medial files.



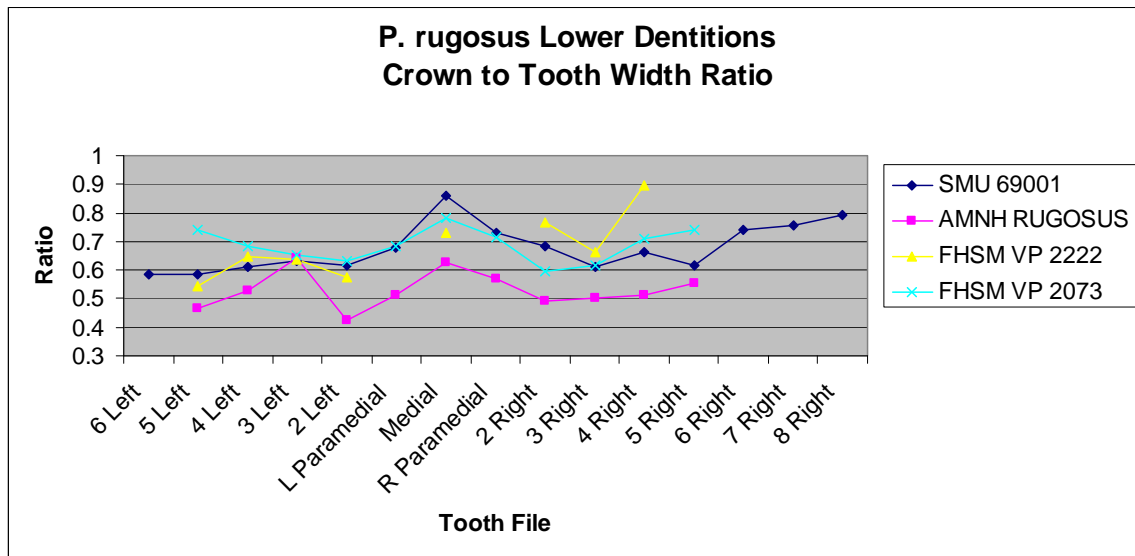
**Fig. 31.** *Ptychodus rugosus* Upper Dentition Crown Height to Tooth Height ratios



**Fig. 32.** *Ptychodus rugosus* Upper Dentition Crown Width to Tooth Width Ratios



**Fig. 33.** *Ptychodus rugosus* Lower Dentition Crown Height to Tooth Height Ratios



**Fig. 34.** *Ptychodus rugosus* Crown Width to Tooth Width Ratios

**Stratigraphic and Geographic occurrence.** According to locality data all of the Kansas specimens (FHSM VP-2121, 2222, AMNH- 19553) are from the lower Smoky Hill Chalk (Late Coniacian) which encompasses Hattin's (1982) Marker Units 1-3; and Stewart's (1990) zone of *Protosphyraena pernicioisa*.

Planktonic foraminifera samples recovered with SMU 69001-69018 place it within the *Marginotruncana concavata* Subzone (Early Santonian) of the *Globotruncana builloides* zone (Pessagno, 1967) of the Austin Group in Texas. The Kansas specimens of *P. rugosus* did not have matrix to process for foraminifera for use in stratigraphic correlations. Reported here are the first two isolated tooth specimens of *P. rugosus* (CSU-K-07-05, 1, 2) that were recovered from the *Calculites obscurus* Zone of the Blufftown Formation (Late Santonian-Early Campanian) in Alabama. All specimens correlate stratigraphically with the distribution of specimens from the English Chalk (Zone of *Micraster cor-testidinarium*) (Dibley, 1911; Woodward, 1911).

**Discussion.** MacLeod (1982) described an associated tooth set of *P. rugosus* (SMU 69001-69018) comprised of 206 teeth within 8 tooth files in the upper and 347 within 8 files in the lower dentition (**Figs. 10, 11**) and 11 complete and 3 partial vertebral centra (**Fig. 21**). Until now, this was the only confirmed specimen of *P. rugosus* reported from within the Western Interior Seaway.

Specimens previously assigned to “*P. anonymus*” (Williston, 1900; Stewart, 1990; Everhart and Caggiano, 2004) from the Smoky Hill Member of the Niobrara Chalk in western Kansas are identical in tooth morphology to the type specimen of *P. rugosus* (BMNH 3979) from the English Chalk (Late Coniacian-Santonian) and are here re-diagnosed as such. The best preserved specimens from the Niobrara Chalk are represented by both juvenile (AMNH 19553, **Pl. 10F**) and adult forms (FHSM VP 2121, FHSM VP 2222, **Pls. 10B-10D**; FHSM VP 2073, **Pl. E**), each exhibiting all tooth file positions, expressing the differences in tooth morphology between each tooth file.

These specimens are among the largest and best preserved dentitions worldwide with dentition lengths of 63.5 cm in FHSM VP 2121, 2222; SMU 69001-2 and 58 cm in FHSM VP 2073. The dental arrangement of AMNH 19553 is glued to a piece of cardboard and reconstructed incorrectly. However, based on tooth size and tooth file lengths the length of the dentition is estimated to be 21.5 cm.

Case et al. (1990) reported the occurrence of juvenile or embryonic anterolateral teeth of *P. rugosus* from the Niobrara Formation in Saskatchewan, Canada; however, this material (SMNH P496.12, P- 496.11, and P- 496.39) is based three very small teeth (2 x 3mm in size). They do not exhibit the specific characters of *P. rugosus* and are taxonomically questionable.

*Ptychodus rugosus* is a rare occurrence within the Western Interior Seaway and has a narrow geographic distribution from Alabama and Texas to Kansas. Disregarding Case et al. juvenile/embryonic teeth, Kansas is the northernmost geographic range. More specimens have been recovered from the Smoky Hill Chalk than anywhere else in the seaway. SMU- 69001-69018 (**Figs. 10, 11**) is the only known specimen from Texas and only two teeth, CSU-K-07-05-1 and -2 (**Plate 10 G**) have been recovered from the Blufftown Formation of Alabama.

Given the similarities in tooth morphology, *P. rugosus* is nested within the *P. anonymus*, *P. mammillaris*, *P. atcoensis* and *P. whipplei* polytomy (**Fig. 69**). Each share a high crown and similar pattern of transverse ridges; however *P. rugosus* differs from these taxa having a wider and thicker tooth crown with irregular and less pronounced ridges and a smooth labial tooth edge.



**PLATE 10A**

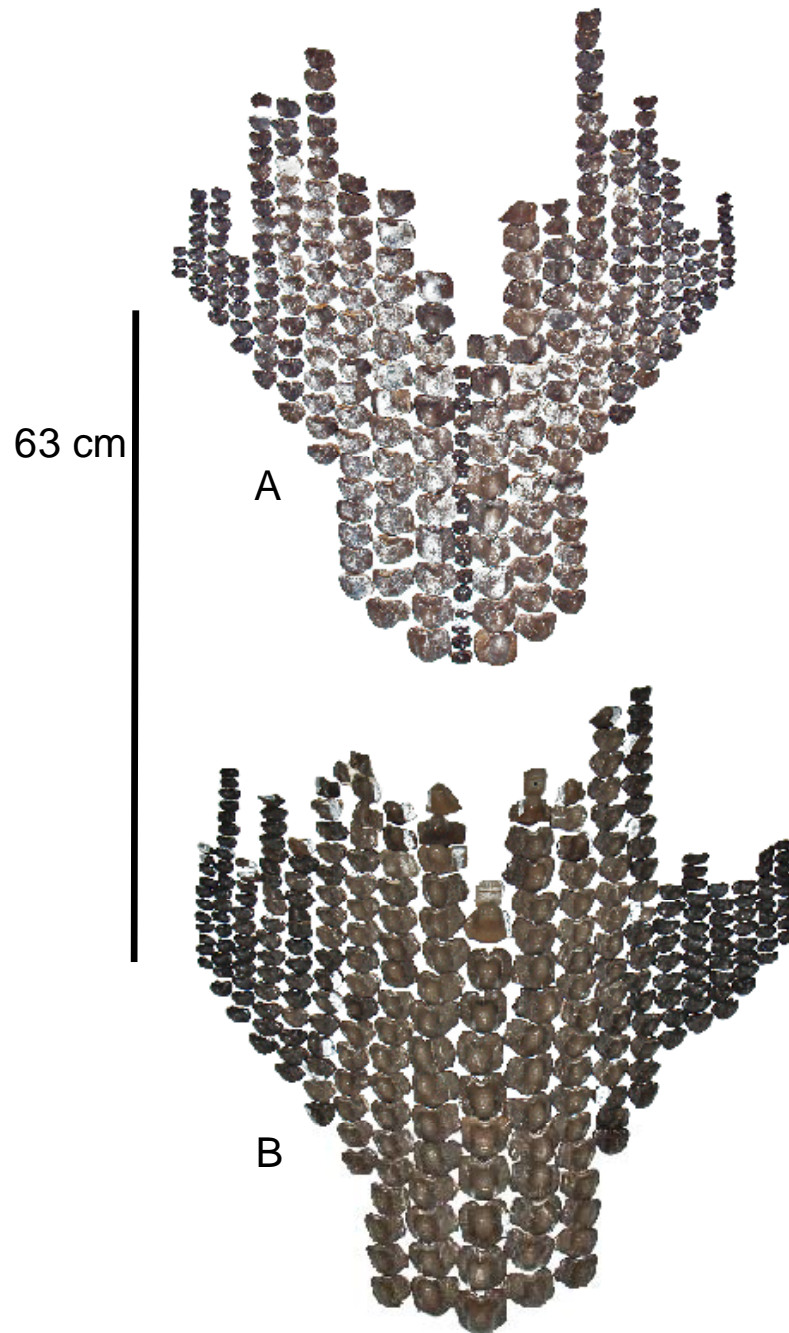
*Ptychodus rugosus* BMNH 61143-49



10 cm

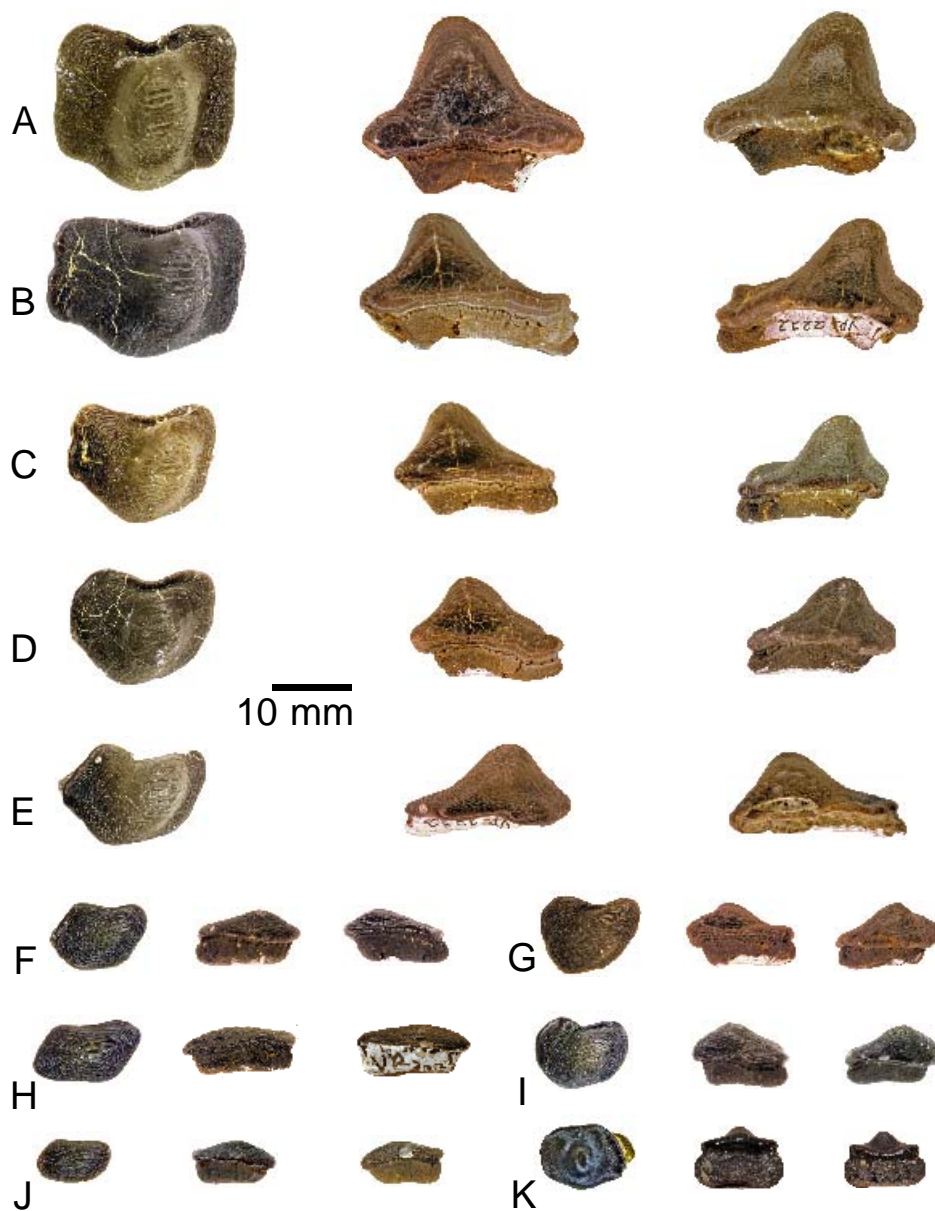
Type specimen, associated tooth set (102 teeth) from the Santonian of the English Chalk in occlusal view.

## PLATE 10B

*Ptychodus rugosus*

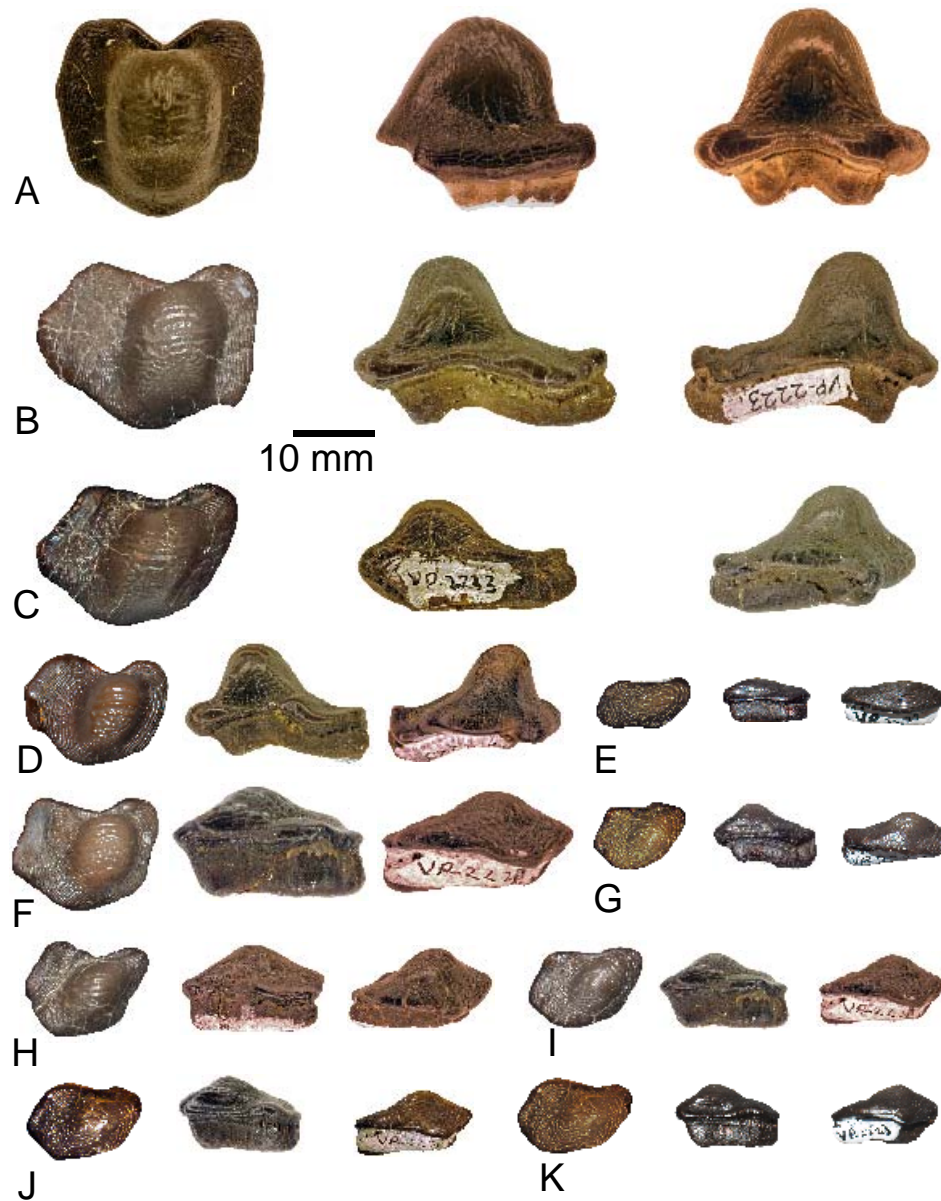
**Figure A**, FHSM VP 2222, associated teeth from the upper dentition; **Figure B**, FHSM VP 2223, associated teeth from the lower dentition. Both in anterior (rostral) and occlusal view.

## PLATE 10C

*Ptychodus rugosus* FHSM VP 2222

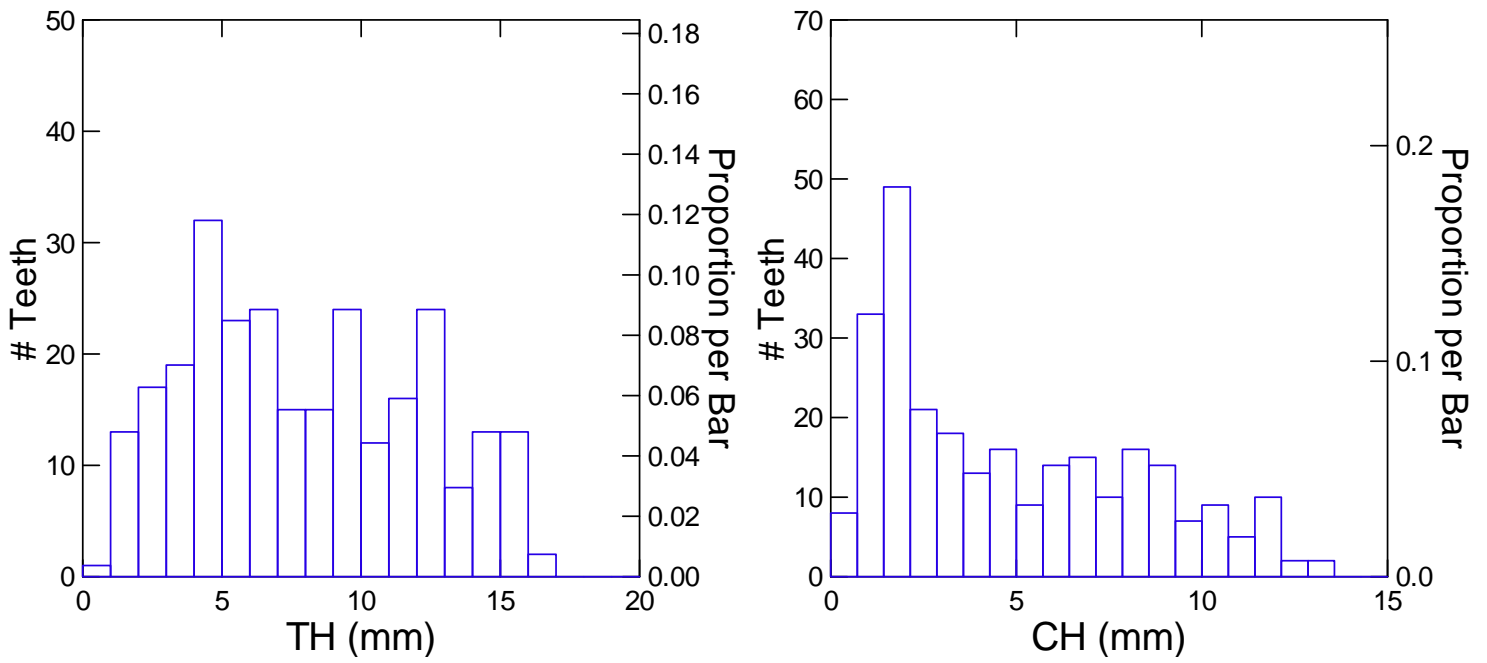
**Figure A**, upper para-medial; **Figure B**, 2<sup>nd</sup> file; **Figure C**, 3<sup>rd</sup> file; **Figure D**, 4<sup>th</sup> file; **Figure E**, 5<sup>th</sup> file; **Figure F**, 6<sup>th</sup> file; **Figure G**, 7<sup>th</sup> file; **Figure H**, 8<sup>th</sup> file; **Figure I**, 9<sup>th</sup> file; **Figure J**, 10<sup>th</sup> file; **Figure K**, upper medial file. All in occlusal, anterior and posterior views.

## PLATE 10D

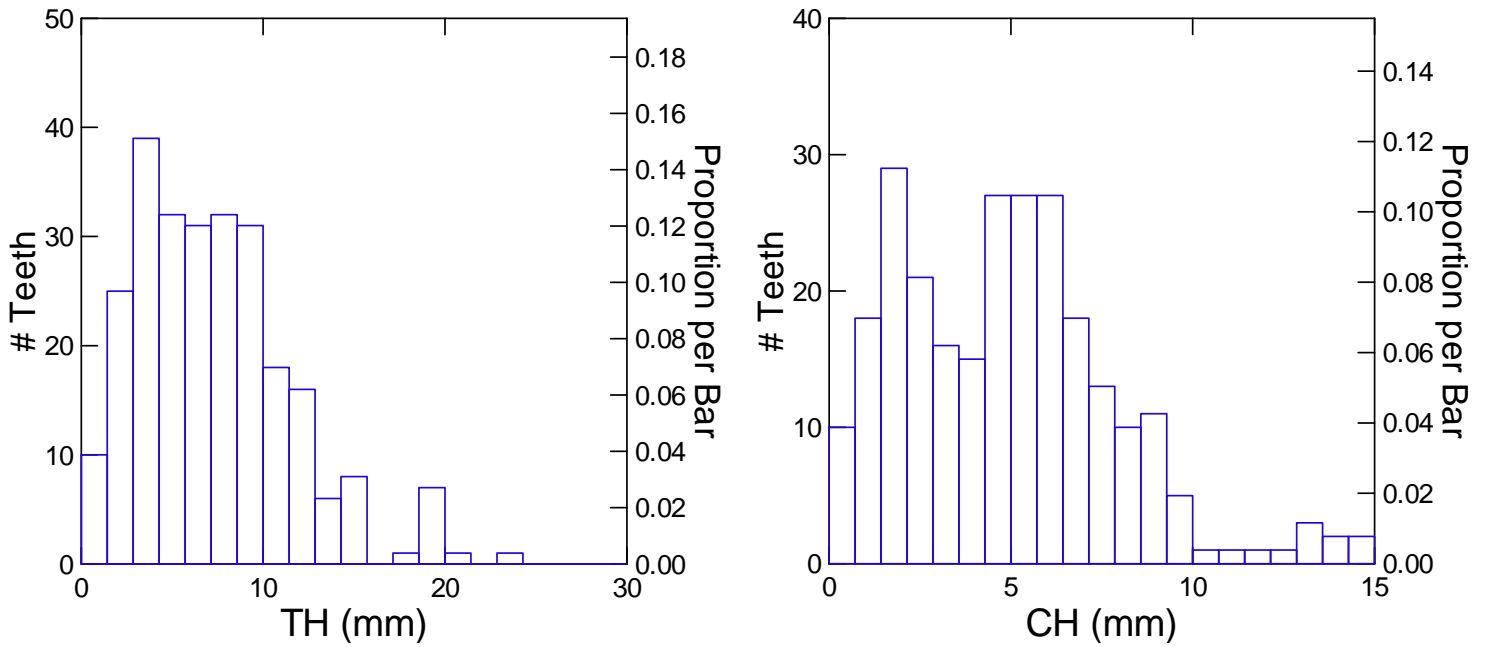
*Ptychodus rugosus* FHSM VP 2223

**Figure A**, lower medial; **Figure B**, para-medial; **Figure C**, 2<sup>nd</sup> file; **Figure D**, 3<sup>rd</sup> file; **Figure E**, 4<sup>th</sup> file; **Figure F**, 5<sup>th</sup> file; **Figure G**, 6<sup>th</sup> file; **Figure H**, 7<sup>th</sup> file; **Figure I**, 8<sup>th</sup> file; **Figure J**, 9<sup>th</sup> file; **Figure K**, 10<sup>th</sup> file. All in occlusal, anterior and posterior views.

**FHSM VP 2222 *P. rugosus* upper dentition**



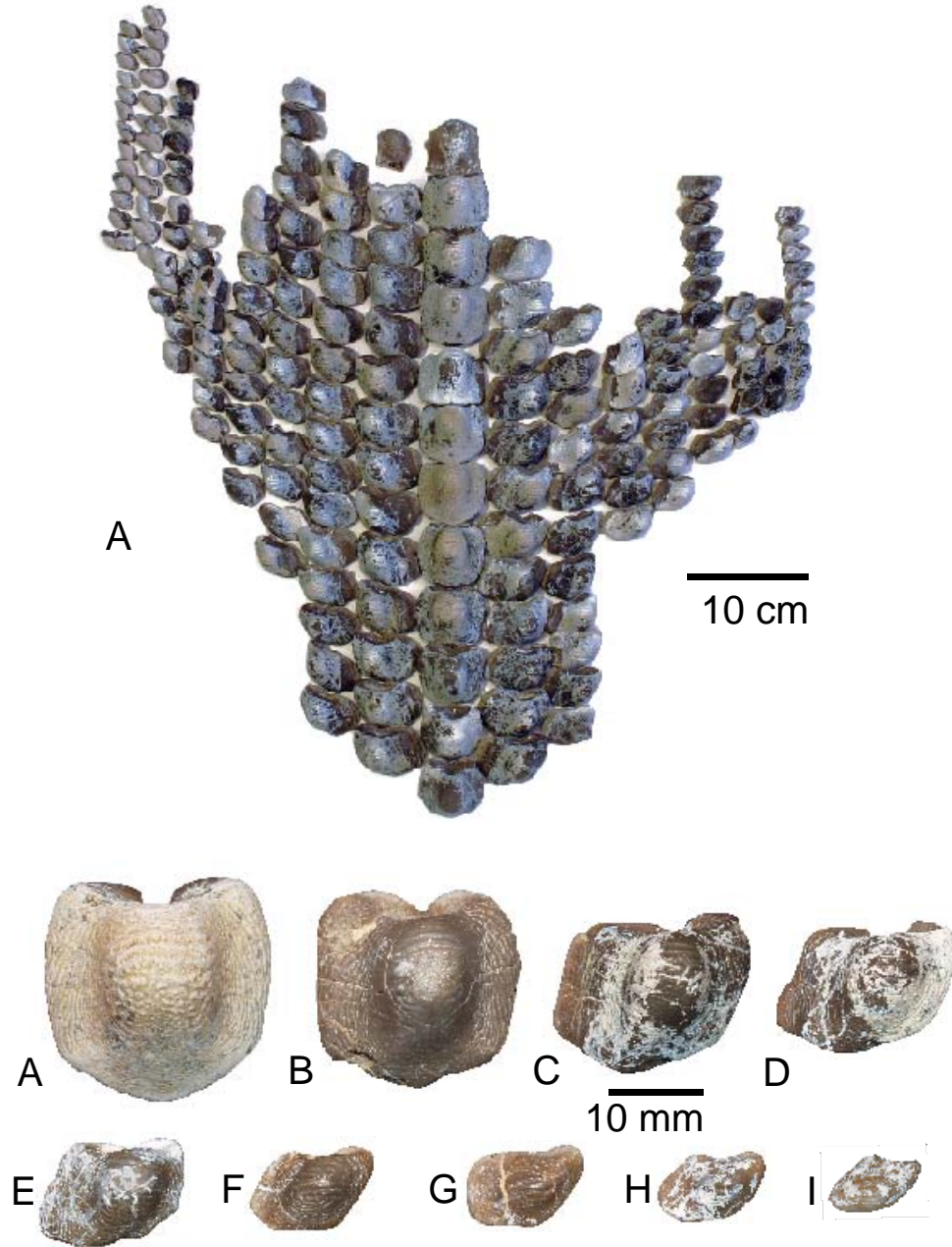
**FHSM VP 2223 *P. rugosus* lower dentition**



**Figure 35.** FHSM VP 2222, FHSM VP 2223 Tooth Height-Crown Height values.



## PLATE 10E

*Ptychodus rugosus* FHSM VP 2073

**Figure A**, FHSM VP- 2073, lower dentition; **Figure B**, lower medial; **Figure C**, para-medial; **Figure D**, 2<sup>nd</sup> file; **Figure E**, 3<sup>rd</sup> file; **Figure G**, 4<sup>th</sup> file; **Figure H**, 5<sup>th</sup> file; **Figure I**, 6<sup>th</sup> file; **Figure J**, 7<sup>th</sup> file; **Figure K**, 8<sup>th</sup> file. All in occlusal view.

FHSM VP 2073 *P. rugosus*

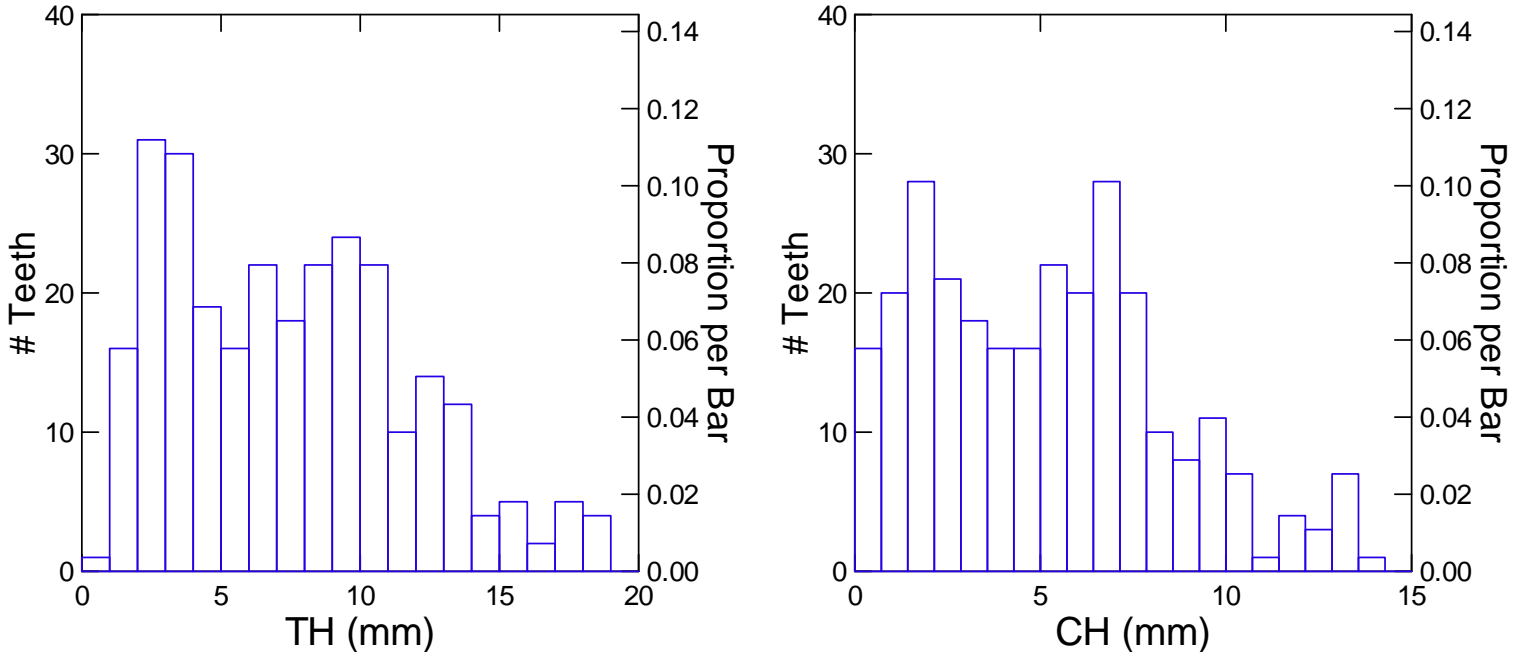
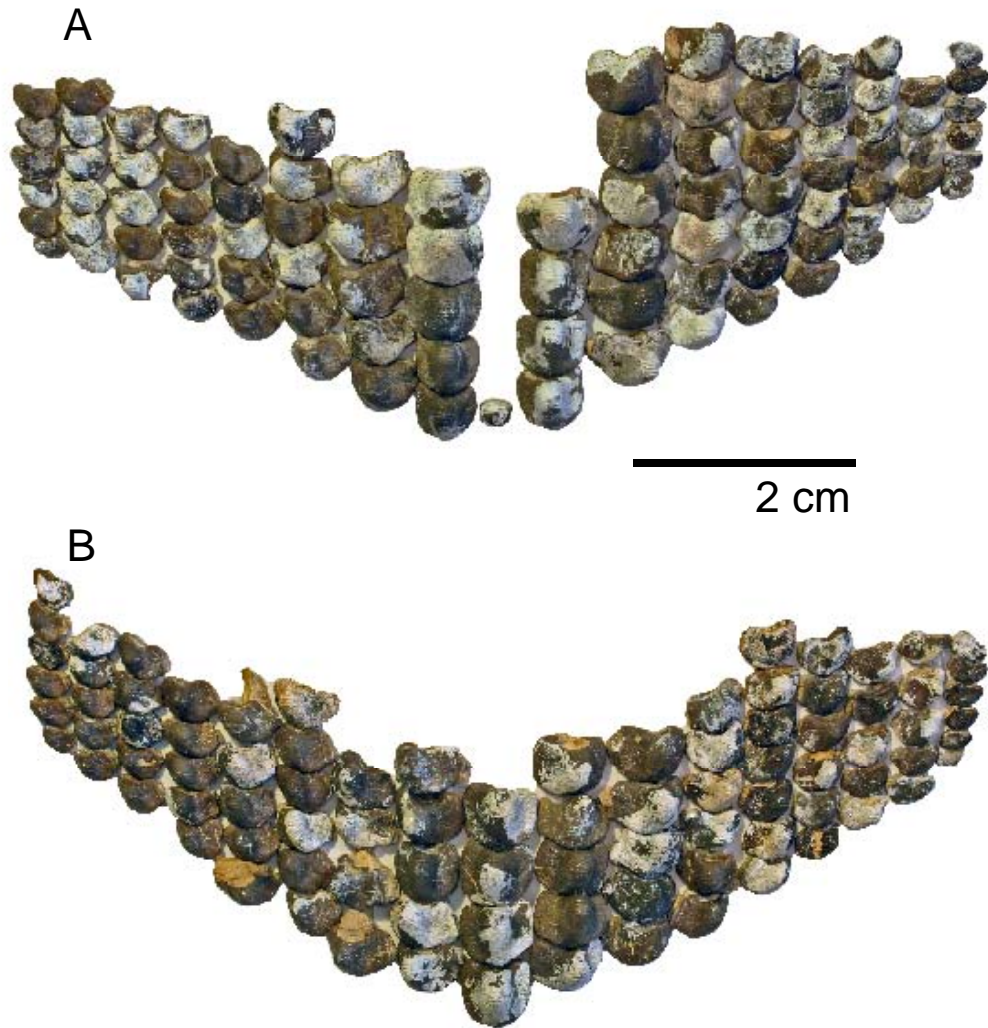


Figure 36. FHSM VP 2073 (*P. rugosus*) Tooth Height-Crown Height values.

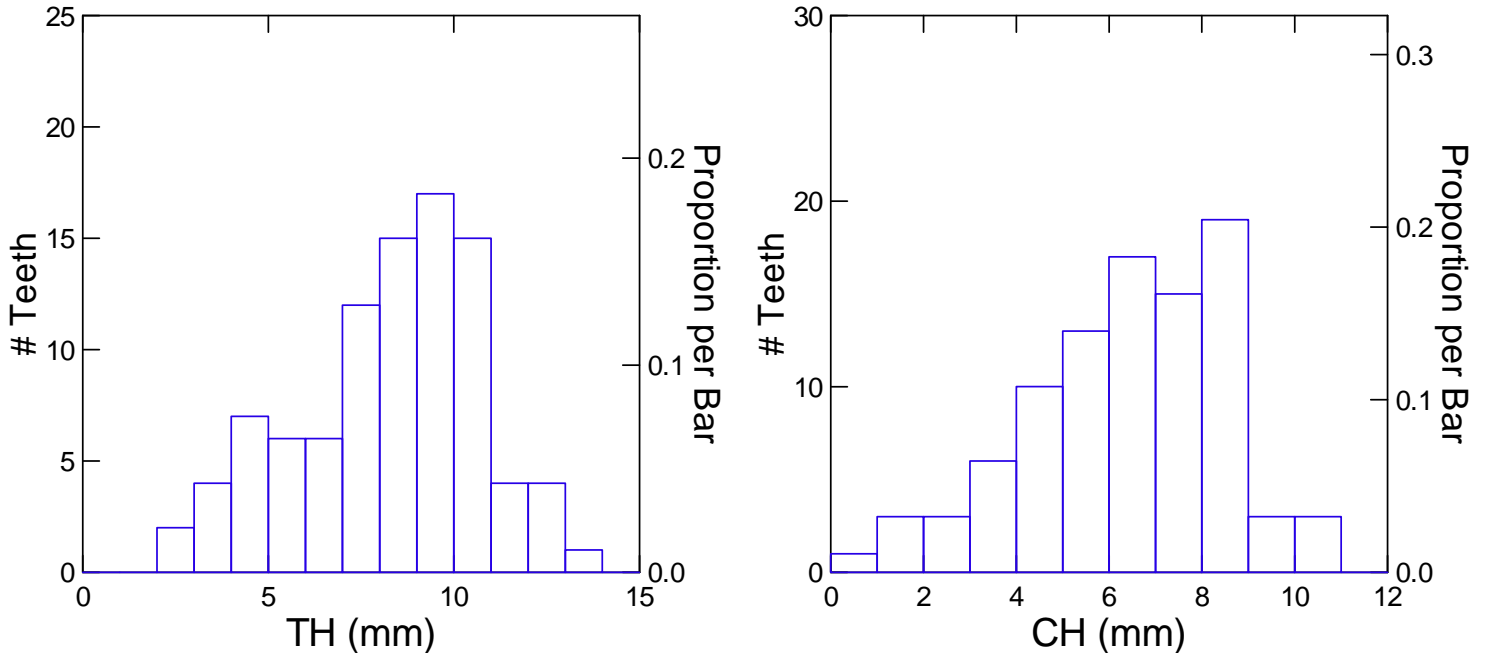
## PLATE 10F

*Ptychodus rugosus* AMNH 19553

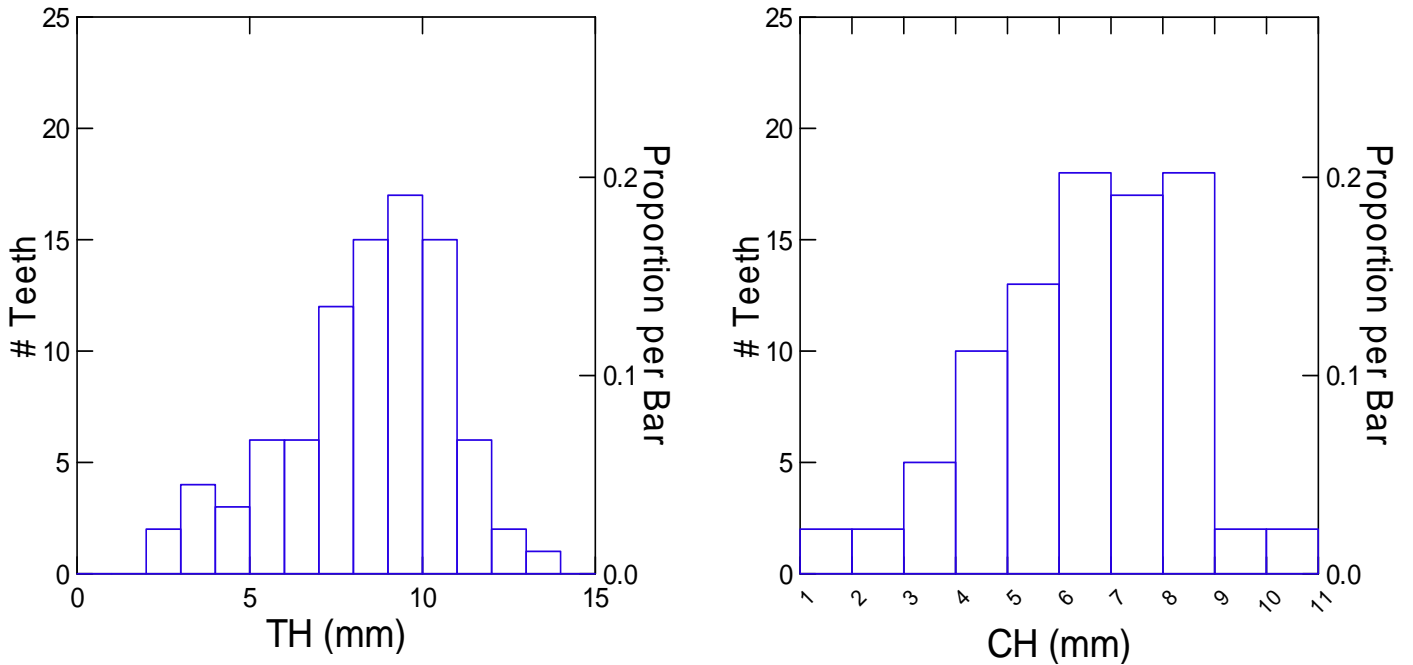
**Figure A**, AMNH 19553, upper dentition; **Figure B**, lower dentition in anterior (rostral) and occlusal views. Unnatural dental arrangement.



**AMNH 19953 *P. rugosus* upper dentition**

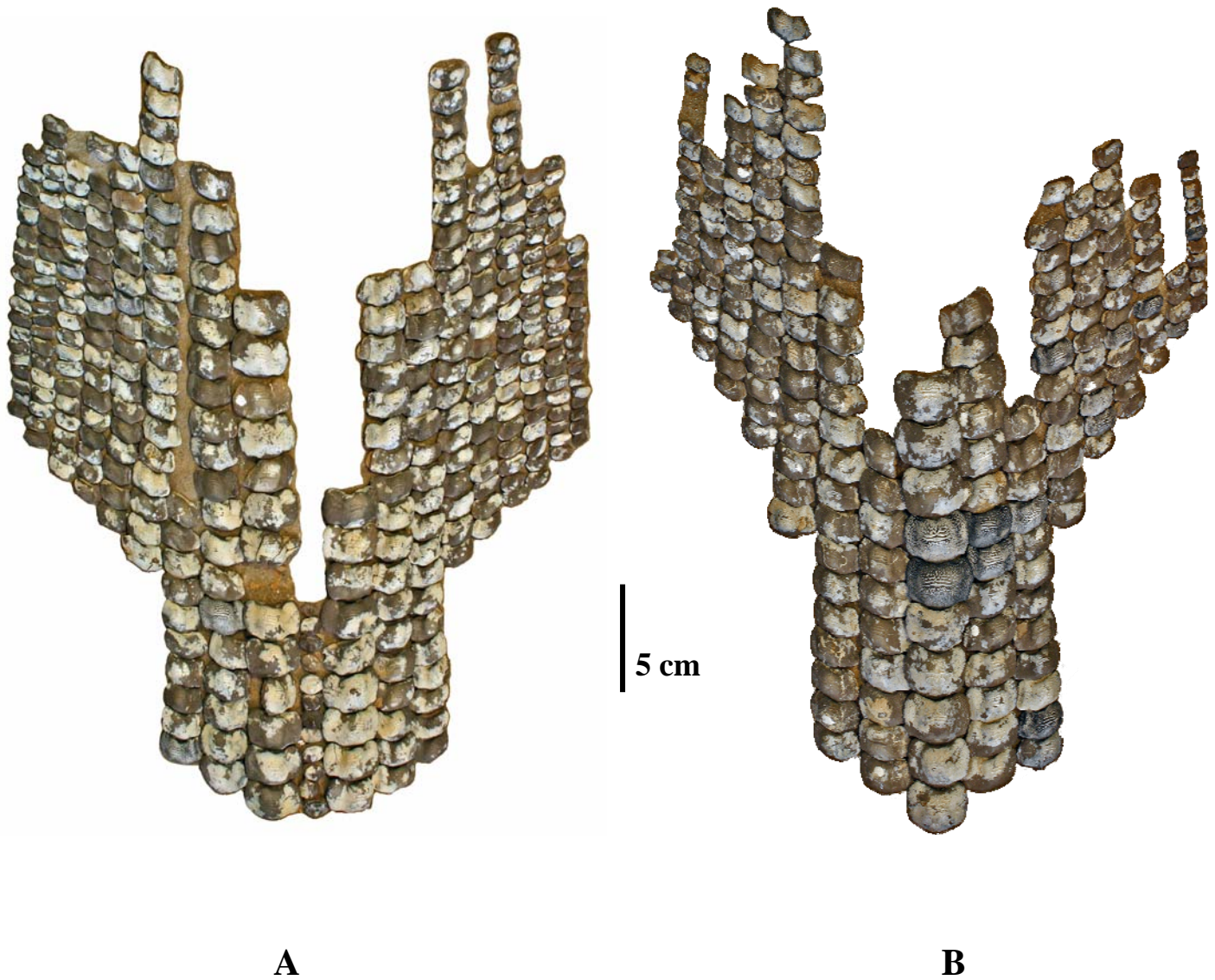


**AMNH 19953 *P. rugosus* lower dentition**



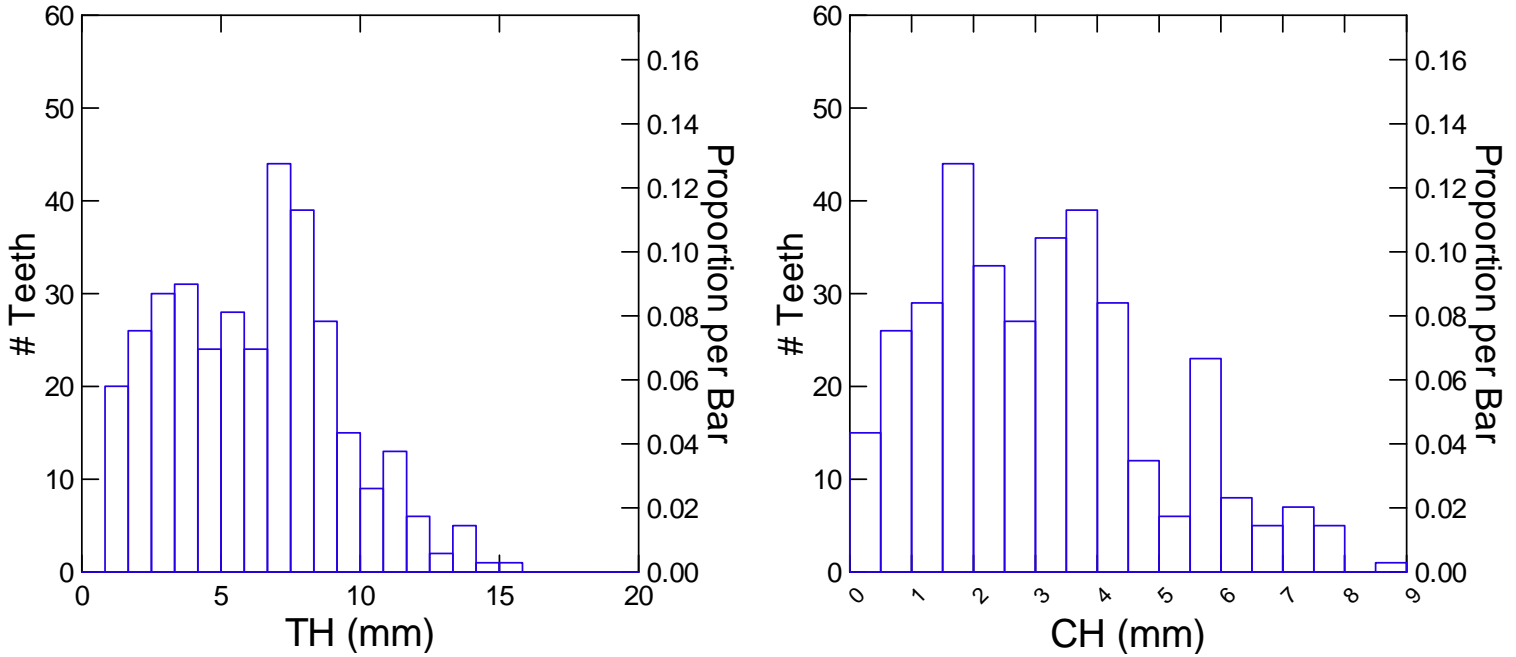
**Figure 37.** AMNH 19953 (*P. rugosus*) Tooth Height-Crown Height values.

## PLATE 10 G

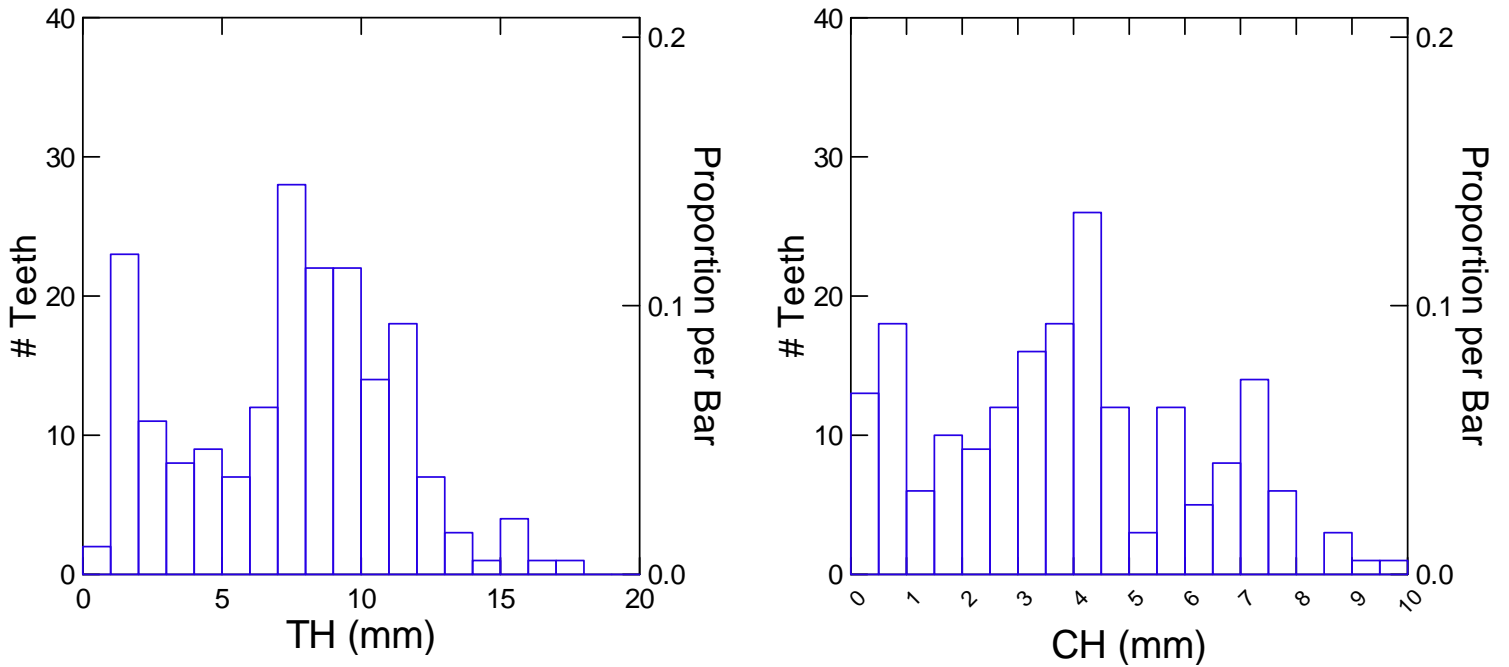
*Ptychodus rugosus* SMU 69001, 69002

**Figure A**, SMU 69002, upper dentition; **Figure B**, SMU 69001 lower dentition in anterior (rostral) and occlusal views. Natural dental arrangement.

**SMU 69002 *P. rugosus* upper dentition**



**SMU 69001 *P. rugosus* lower dentition**



**Figure 38.** SMU 69001-69002 (*P. rugosus*) Tooth Height-Crown Height values.

## PLATE 10H

*Ptychodus rugosus*

**Figure A**, CSU-K-07-05, 1, lower medial in occlusal, labial and lingual views. **Figure B**, CSU-K-05, 2, anterolateral, 2<sup>nd</sup>-3<sup>rd</sup> file in occlusal, lingual and posterior views.

*PTYCHODUS MARGINALIS* (Agassiz, 1839)

(Plates 11A-11C)

*Ptychodus polygyrus* var. *marginalis* Agassiz, 1835-39: p. 156, pl. 25, fig. 4-11, pl. 26, fig. 21-23.

*Ptychodus polygyrus* Kiripjanoff, 1853: p. 14, pl. 13, fig. 6.

*Ptychodus polygyrus* Geinitz, 1875: p. 297.

*Ptychodus polygyrus* Fritsch, 1878: p. 15, fig. 35.

*Ptychodus polygyrus* Gibbes, 1849: p. 299, pl. 62, fig. 5-6.

*Ptychodus polygyrus* Leidy, 1868: p. 208.

*Ptychodus polygyrus* Cope, 1875: p. 294.

*Ptychodus polygyrus* Woodward, 1889: p. 146.

*Ptychodus polygyrus* Williston, 1900a: p. 243, pl. 41, fig. 53.

*Ptychodus polygyrus* Leriche, 1902: p. 97, pl. 2, figs. 21-23.

*Ptychodus polygyrus* Dibley, 1911: p. 268, pl. 21, fig. 1, 2 .

*Ptychodus polygyrus* Woodward, 1912: p. 232, pl. 68, fig. 12-16; pl. 19.

*Ptychodus polygyrus* Leriche, 1929: p. 214.

*Ptychodus chappelli* Reinhart, 1951: pp. 195-201, pl. 6, figs. 1-3.

*Ptychodus polygyrus* Applegate, 1970: p. 393, fig. 179 A.

*Ptychodus chappelli* Wenz: 1972: pp. 91-93, fig. 1.

*Ptychodus polygyrus* Evetts, 1979: pl. 1, fig. 5.

*Ptychodus marginalis* Maleki, 1980: p. 55, pl. 1, fig. 7.

*Ptychodus* cf. *mammillaris* Williamson, et al., 1993: p. 450, fig. 3, 8-10.

*Ptychodus polygyrus* Cicimurri, 1998: p. 60, pl. 7, fig. 6, pl. 8, figs. 1-2.

*Ptychodus polygyrus* Welton and Farish, 1993: p. 65.

*Ptychodus polygyrus* Hamm, 2003: Vol. 22, supp. to No. 3, 62A.

*Ptychodus polygyrus* Everhart et al., 2003: p. 36.

*Ptychodus polygyrus* Everhart and Caggiano, 2004: pp. 125-136.

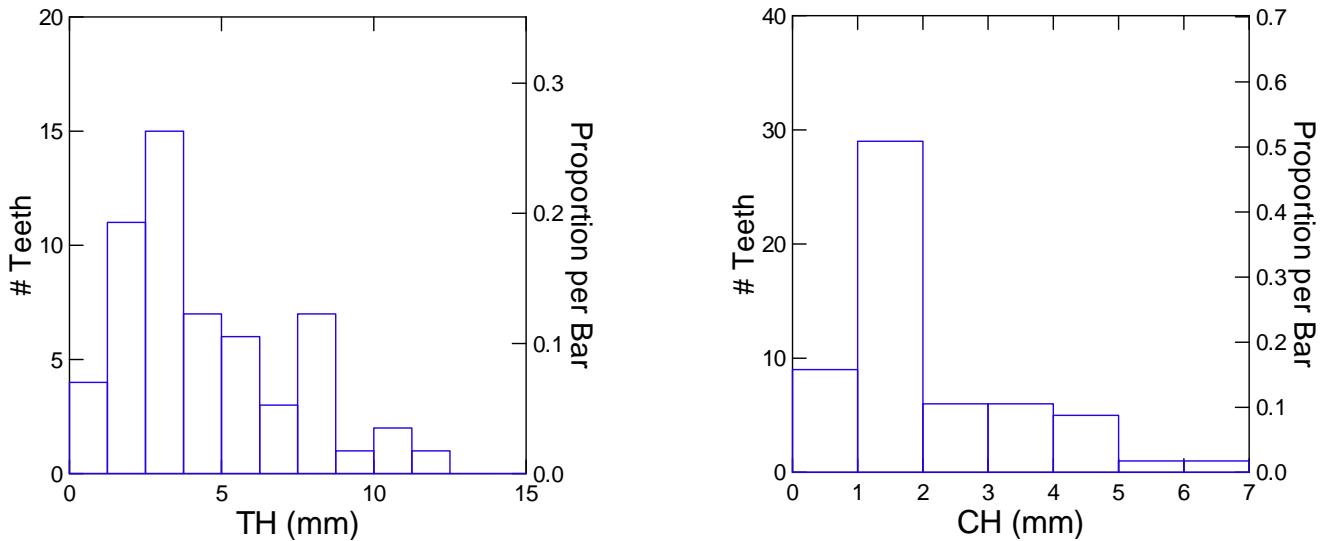
*Ptychodus* cf. *latissimus* Shimada and Fielitz, 2006: p. 194; *P. polygyrus* p. 195, fig. 2A.

**Diagnosis.** Teeth are square to rectangular in outline with a low to moderately inflated tooth cusp (0-10°), with a mean tooth height to crown height (TH-CH) ratio of 0.45. The upper medial files have three transverse ridges; lower medial files have ten to twelve ridges; lateral teeth eight to ten and posterior teeth with five to six ridges. Differs from other species as the transverse ridges are thick, closely spaced, parallel and slightly wavy across the apex that curl and loop anteriorly at the tooth margin. The marginal area is wide with an average tooth width to crown width (TW-CW) ratio of 0.97. The margin is ornamented with finely elongate and granular ridges that are concentric with, and completely surrounds the cusp. The TW-CW ratio in the posterior files is 1:1 as the height of the tooth is equal to the total crown height.

**Type specimen.** BMNH 4385 (**Plate 11A**) from the Zone of *Terebratulina gracilis* (Turonian) of the English Chalk Formation.

**Referred specimens.** FHSM VP-15008 (single tooth); KUVV 55255 (4 teeth); KUVV 55258 (single tooth); KUVV 13525 (3 articulated teeth); SMU 75577 (single tooth); SMU 76430 (47 teeth); SMU 76441 (single tooth); SMU 76438 (3 teeth); SDSM 34949 (1 tooth). **Plates 11B, 11C.**

**Description.** Material referred to *P. polygyrus* from the Western Interior compares favorably with *P. marginalis* from the English Chalk (**Plate 11A**). Anterior file teeth are square to rectangular in outline with gently rounded edges. The crown is gently raised with a flattened occlusal surface crossed by 10 to 14 parallel transverse ridges (**Appendix III**). The ridges are thicker at the base and thin upwards creating a sharp cutting edge at the apex. The ridges become thinner at the distal edges where they loop or interconnect with one another and disappear within the granulations of the marginal area. The margin is distinct, shelf-like and wide, with fine, concentric enameloid granulations. The tooth root is square and tabular with few foramina at the crown/root boundary. Anterolateral and posterior files are rectangular in outline, with the same pattern but fewer transverse ridges, numbering 5-6 on average. The lateral teeth can easily be confused with *P. mammillaris* as they share a similar ridge pattern across the center of the crown, but unlike *P. mammillaris*, the ridges in these files curve anteriorly at the marginal area.



**Figure 39.** Tooth Height-Crown Height values for all *Ptychodus marginalis* observed.

**Stratigraphic and Geographic occurrence.** Middle Cenomanian-Middle Turonian from the Greenhorn Formation (Late Cenomanian-Turonian) in Arizona (Williamson, et al. 1993) and Kansas (Williston, 1900a); the Kamp Ranch Formation (Middle Turonian) of Texas (Welton and Farish, 1993; Hamm, 2003) and the Turner Sandy Member (Middle Turonian) of the Carlile Shale in South Dakota (Cicimurri, 1998).

**Discussion.** The majority of specimens from North America have been erroneously referred to *P. polygyrus*. When Agassiz (1835) originally described *P. polygyrus* he also described three other taxa, including *P. marginalis* that he considered to be related to *P. polygyrus*. Based on the associated tooth set of *P. marginalis*, BMNH P. 10464 (**Plates 11A, 11B**) described by Agassiz and figured by Woodward (1911, Pl. XLVIII, figs. 12-16) it differs greatly in morphology from the type of *P. polygyrus*. In *P. marginalis* the tooth crown is gently elevated and rounded, with thin, closely spaced transverse ridges that are restricted to the apex of the crown. Whereas the ridges of the typical *P. polygyrus* are thick, widely spaced and extend to the mesial and distal crown edges, curving anteriorly and interconnecting with one another, preventing the formation of a distinct marginal area.

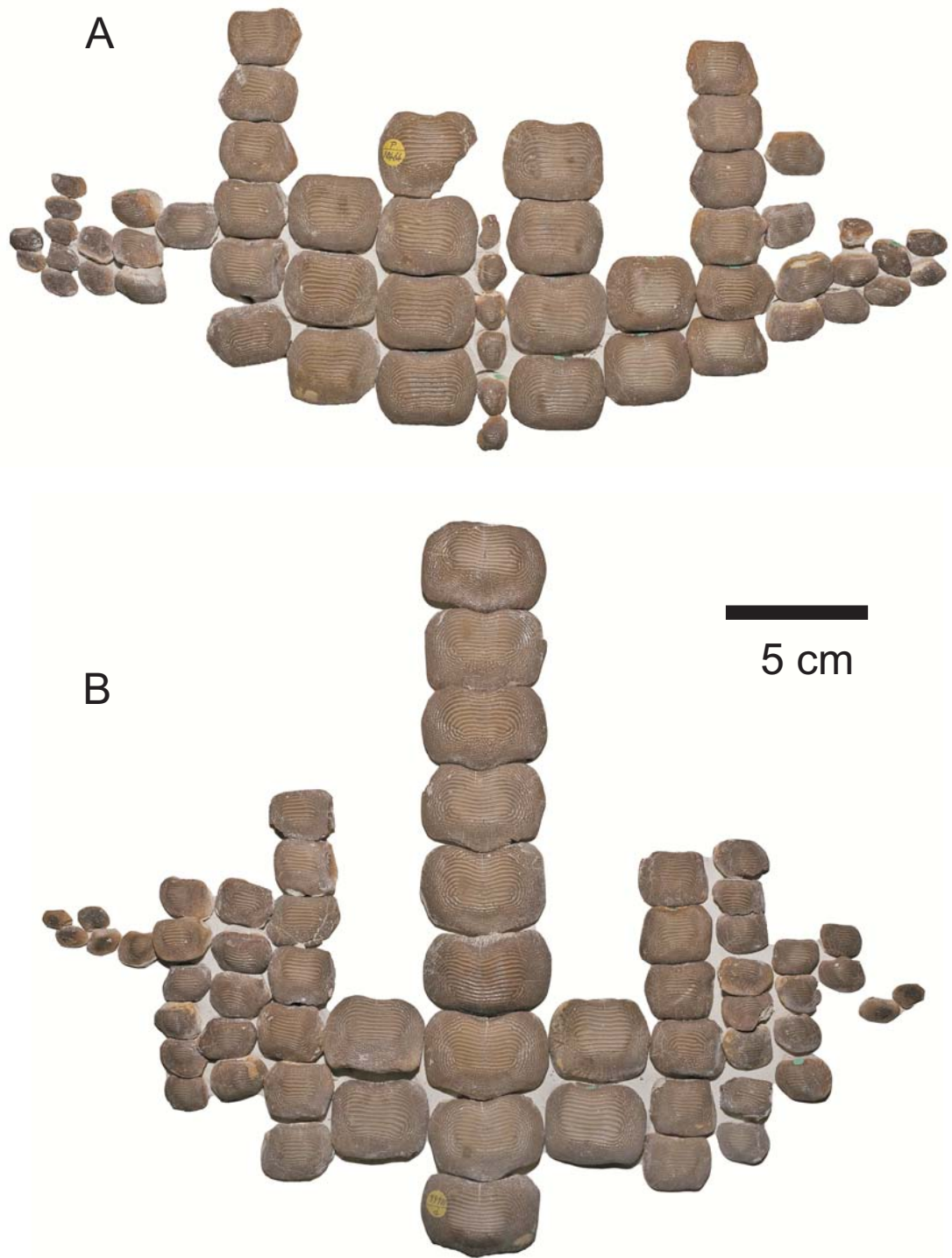
Dibley (1911) noted that *P. marginalis* and *P. polygyrus* are found in differing strata in the English Chalk. *Ptychodus marginalis* is stratigraphically older than *P. polygyrus* and is found within the *Sciponoceras gracile* zone (Middle Cenomanian) and *Collignoniceras*

*woollgari* Zone (Middle Turonian) in the Western Interior and English Chalk. A tooth figured by Williamson et al. (1993, p. 449, figs. 9, 10) is ascribed to *P. cf. mammillaris*. In their report they state that some of their material resembles other species including *P. marginalis*. The tooth figured, MNA 174A1 is morphologically and stratigraphically similar (Cenomanian-Turonian) to the range I have observed within the Western Interior and is here regarded as *P. marginalis*. Specimens referred to *P. chappelli* (Reinhart, 1951; Wenz, 1972) are also re-diagnosed as *P. marginalis* because they also exhibit identical tooth morphologies and stratigraphic distribution. Having a very distinctively low crown, *P. marginalis* is most likely related to other low crowned species including *P. martini* and *P. polygyrus* (**Fig. 69**).



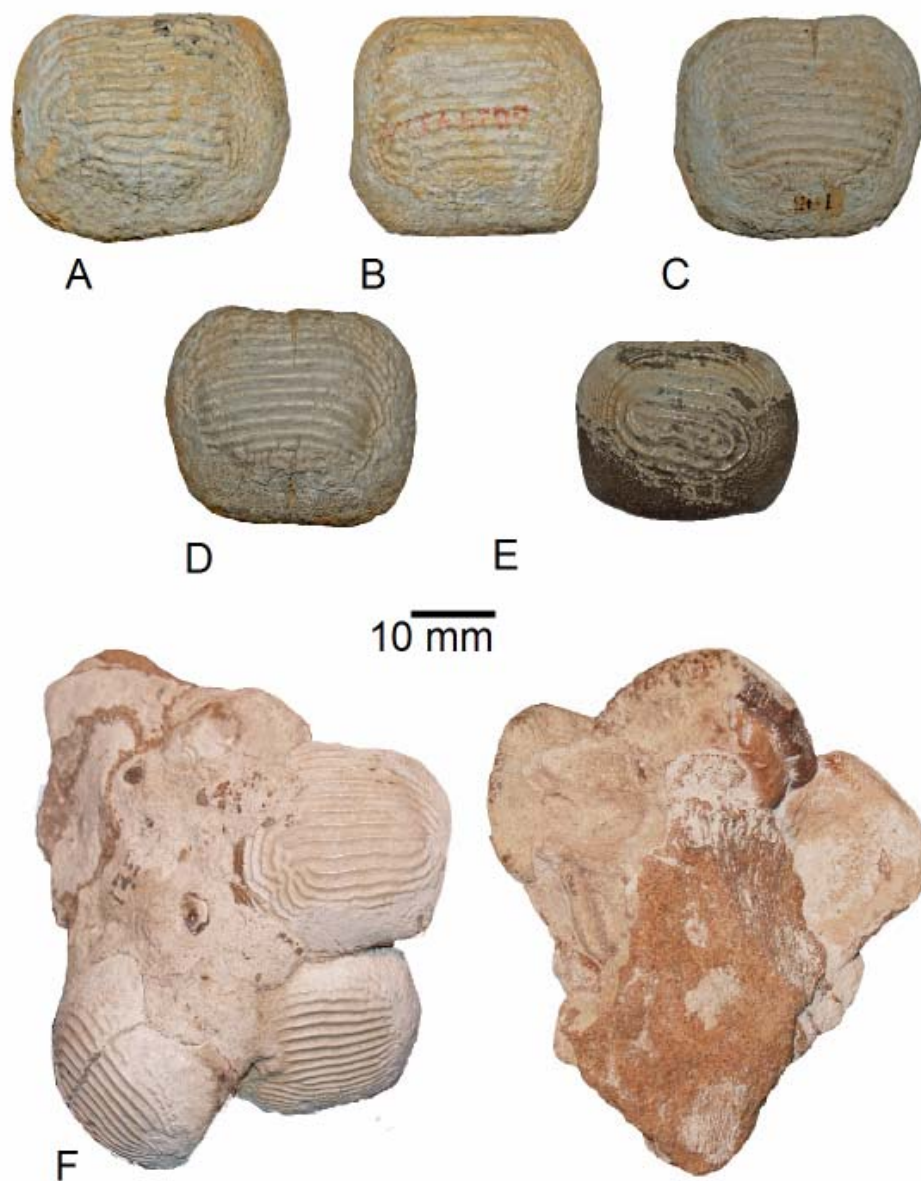
PLATE 11A

*Ptychodus marginalis* BMNH 10464



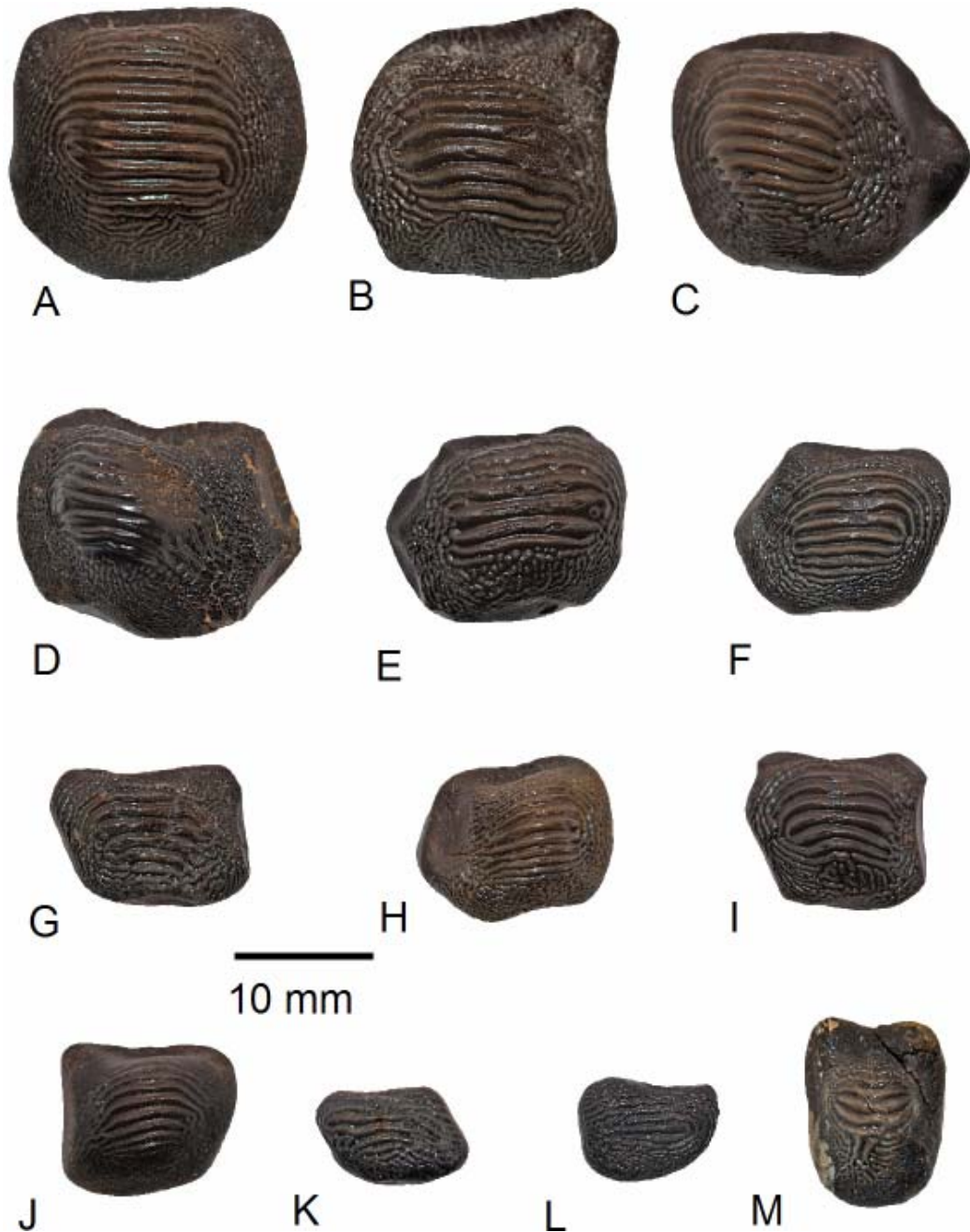
**Figure A**, upper dentition; **Figure B**, lower dentition, each in occlusal view.

## PLATE 11B

*Ptychodus marginalis*

**Figure A-D**, KUVP 55255, para-medial files; **Figure E**, KUVP 55258, lateral tooth; all in occlusal view. **Figure F**, KUVP 13525, articulated lower medial files in occlusal view; **Figure G**, posterior view showing tooth articulation within the palatoquadrates.

## PLATE 11C

*Ptychodus marginalis* SMU 76430

**Figures. A, B,** anterior files; **Figures. C-J,** anterolateral files; **Figures. K, L,** posterior files; **Figure. M,** upper medial file. All in occlusal view.

*PTYCHODUS POLYGYRUS* (Agassiz 1839)

(Plate 12)

*Ptychodus polygyrus* Agassiz, 1835-39: p. 156, pl. 25, fig. 6-11, pl. 25, fig. 23.*Ptychodus polygyrus* Kiripjanoff, 1853: p. 14, pl. 13, fig. 6.*Ptychodus polygyrus* Leidy, 1868: p. 208.*Ptychodus polygyrus* Geinitz, 1875: p. 297.*Ptychodus polygyrus* Cope, 1875: p. 294.*Ptychodus polygyrus* Fritsch, 1878: p. 15, fig. 35.*Ptychodus polygyrus* Woodward, 1889: p. 146.*Ptychodus polygyrus* Woodward, 1890: p. 41, pl. 1 figs.15, 20.*Ptychodus polygyrus* Leriche, 1902: p. 97, pl. 2, figs. 21-23.*Ptychodus polygyrus* Dibley, 1911: p. 268, pl. 21, fig. 1, 2.*Ptychodus polygyrus* Woodward, 1912: p. 232, pl. 68, fig. 12-16; pl. 19.*Ptychodus polygyrus* Leriche, 1927: p. 212.*Ptychodus polygyrus* Hermann, 1977: p. 75.

**Diagnosis.** Teeth square to rectangular, medial files measuring up to 80 mm in width; differs from other species by having thick transverse ridges that are widely spaced and extend fully to the lateral tooth margins where they loop and interconnect with one another. The marginal area is nearly absent on mesial and distal edges and the anterior and posterior tooth edges are marked by granular bumps of dentine in no discernable order.

**Type specimen.** BMNH- 10771, associated set of 76 teeth (**Pl. 12 figs. A-C**) from the Zone of *Micraster coranguinum* of the English Chalk.

**Referred specimens.** MNR 8701 associated set 131 teeth).

**Description.** The medial teeth of the type specimen (**Pl. 12 fig. A**) are rectangular, being wider than long with 10 to 12 thick and parallel transverse ridges that extend out completely to the mesial and distal tooth edges. At the midline of the tooth the ridges curve anteriorly creating a sigmoid pattern across the apex of the crown. At the distal tooth ends, the ridges also curve anteriorly and loop at the distal edges, interconnecting with one another in a looping fashion. There is not a distinctive marginal area meso-distally, but there are coarse enameloid ridges on

the anterior and posterior tooth edges. The transition from the anterior-most ridge to the anterior margin is sharp without any ridge bifurcation to the margin. There is no discernable pattern to the marginal ornamentation (i.e. not concentric with the crown).

Lateral and posterior tooth files are less elongate and square (**Pl. 12 Figs. B, C**). There are between seven and eight transverse ridges in the lateral files and six to seven ridges in the posterior files. The pattern of the transverse ridges is identical to the medial files, except for those of the posterior files. Here, the ridges become straighter and may or may not curve or interconnect with each other at the margins. The marginal area is absent on the meso-distal edges, however, there is a larger margin on the anterior tooth edge.

**Stratigraphic occurrence.** *Micraster coranguinum* and *Actiniocomax quadratus* zones (Santonian-Campanian) in the English Chalk.

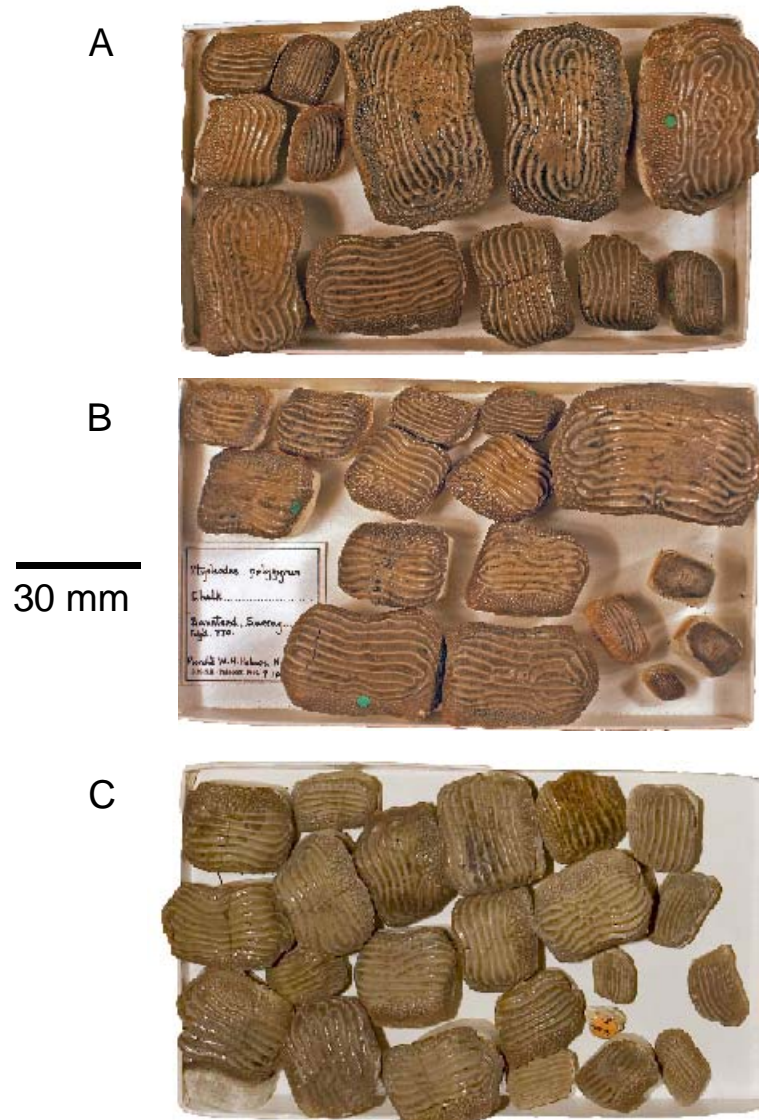
**Discussion.** The type specimen of *P. polygyrus* (BMNH P. 10771) is represented by an associated tooth set and differs significantly from *P. marginalis*. In the typical *P. polygyrus*, the transverse ridges are thick, even at their distal ends. In the anterior files they extend completely to the mesial and distal tooth edges and curve lingually, where they interconnect with one another, preventing the formation of a distinct marginal area. Anterolateral and posterior files maintain the same ridge pattern but they do not always fully extend to the margins, which is coarsely granular. Some of the ridges, typically the anterior and posterior most ridges, curve at the lateral margins, loop and interconnect with another ridge. In the lateral files the ridges do become finer at their distal ends merging and blending into a proportionally wide marginal area.

To date, *Ptychodus polygyrus* is found only in the Late Santonian and Early Campanian deposits in the English Chalk. Phylogenetically, *P. polygyrus* shares a close relationship to *P. marginalis* and *P. martini* (**Fig. 69**) as each are low crowned forms and share similar pattern of transverse ridges.



**PLATE 12**

*Ptychodus polygyrus* BMNH- 10771



**Figures A, B, C**, associated teeth from the type specimen, all in occlusal view.

*PTYCHODUS MARTINI* (Williston, 1900a)

(Plates 13A-13C)

*Ptychodus polygyrus* Gibbes, 1850: pl. 42.*Ptychodus martini* Williston, 1900a: p. 241, pl. 28.*Ptychodus polygyrus* Applegate, 1970: p. 397.*Ptychodus connellyi* MacLeod and Slaughter, 1980: pp. 333-335.*Ptychodus martini* Schultze et al., 1982: p. 13.*Ptychodus connellyi* Welton and Farish, 1993: p. 58.*Ptychodus martini* Hamm and Everhart, 1999: p. 34.*Ptychodus martini* Hamm, 2002: 62A.*Ptychodus polygyrus* Caggiano and Everhart, 2003: p. 28*Ptychodus martini* Everhart et al., 2003: p. 29.*Ptychodus cf. latissimus* Everhart et al., 2003: p. 29.*Ptychodus martini* Hamm and Shimada, 2004: pp. 215-222.*Ptychodus martini* Hamm, 2005: 67A.*Ptychodus martini* Everhart, 2005c: p. 244.

**Diagnosis.** Medial teeth elongate and rectangular with a flat to gently raised occlusal surface crossed by nine to ten widely spaced, parallel transverse ridges; lateral teeth are square in outline with seven to nine ridges and the posteriors are elongate and rectangular with five to six ridges. This species differs from others in that the crown is not elevated and has fine and parallel ridges that extend to a narrow margin area; marginal ornamentation consists of fine, bifurcating ridges oriented perpendicular to the crown face.

**Type Specimen.** KUVV 55277, associated tooth set from the Smoky Hill Chalk Member (Late Coniacian) of the Niobrara Formation (**Plate 13A**).

**Referred specimens.** KUVV 55257 (110 teeth); KUVV 55237 (single tooth); KUVV 55263 (two teeth); FHSM VP 76 (single tooth); FHSM VP 2121 (4 teeth); FHSM VP 12358 (single tooth); FHSM VP 14853 (single tooth); FHSM VP 15008 (single tooth); PF 127 (single tooth); SMU 69031 (single tooth), SMU 76264 (single tooth), SMU 76265 (single tooth), SMU 76427 (single tooth), SMU 76428 (single tooth), SMU 76429 (single tooth), SMU 76250 (single tooth) (**Plate**

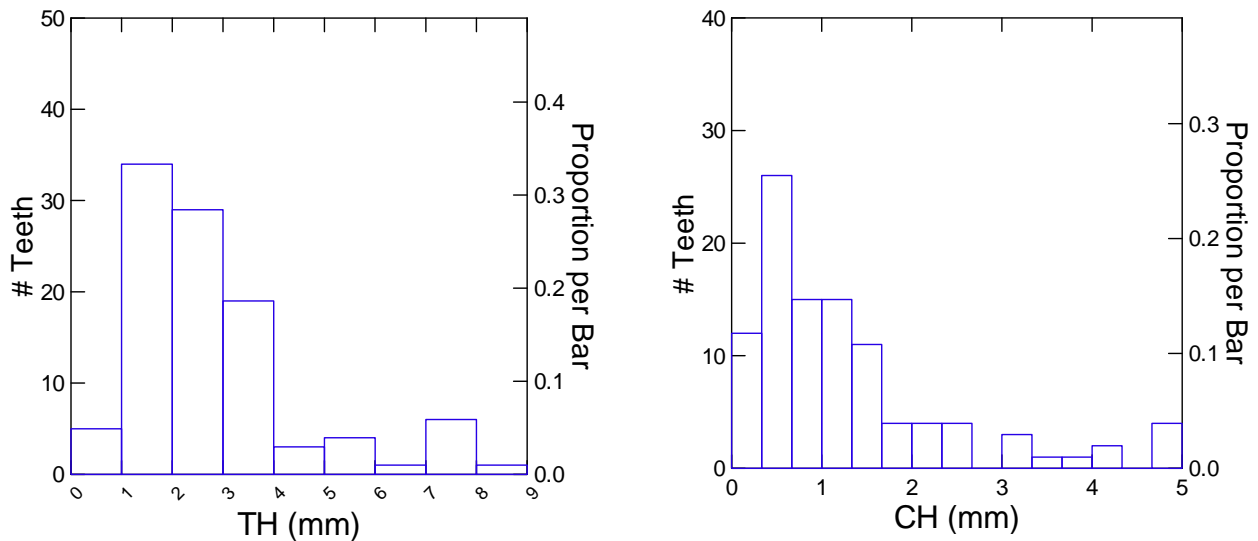
**13B).**

**Description.** The largest teeth in the type specimen of *P. martini* (KUVP- 55277) are from the lower medial file (**Appendix III**). There are eight teeth in the medial file; each are rectangular in outline with an extremely flat occlusal surface crossed (0.83 CH-TH ratio) by eight to nine parallel and slightly undulating ridges that extend fully to the lateral tooth edges. The ridges are closely spaced, thick at the base and thin at the apex, creating a sharp cutting edge. The ridges curve anteriorly at the mesial and distal edges and do not bifurcate at the lateral tooth margins.

The para-medial files are represented by eight teeth that are nearly rectangular with a gently raised (0.76 CH-TH ratio) and rounded occlusal surface with seven to eight transverse ridges that terminate at a narrow, shelf-like marginal area. Teeth of the anterolateral files have seven to eight parallel transverse ridges with a 0.72-0.77 CH-TH ratio. The tooth shape progressively becomes elongate and rectangular, having a 0.72-0.80 CW-TW ratio. The occlusal surfaces are flat, but are slightly elevated at the distal tooth edge. The posterior files have completely flat occlusal surfaces with an average of five transverse ridges that extend completely to the mesial and distal tooth margins.

In each file, the pattern and arrangement of the transverse ridges are consistently parallel and uniform with a slight sinusoidal pattern. In some of the teeth from various tooth files, there are small spheroidal enameloid bumps in between several of the ridges. They are not consistent as to which ridges within the tooth they occur or among a particular tooth within a file, nor do they consistently occur among all tooth files. The marginal area is coarsely granulated, similar to the margin in *P. latissimus*. Ornamentation on the labial and lingual margins is composed of fine bifurcating ridges oriented perpendicular to the crown.





**Figure 40.** Tooth Height-Crown Height values for Type specimen *P. martini* KUVV 55277.

**Stratigraphic and Geographic occurrence.** Previously documented specimens consisted of the holotype KUVV 55277 (Williston 1900a; 1900b; Schultze et al. 1982) four associated teeth, FHSM VP 2121 (Hamm 2002) from the Smoky Hill Chalk Member (Late Coniacian) of the Niobrara Formation of Kansas; the basal Atco Formation (Early Coniacian) in Texas (Hamm, 2004); and a single tooth (SMU 69031) formerly known as *P. connellyi* from the Roxton Member of the Gober Chalk (Early Campanian) in Texas (Hamm and Shimada, 2004).

**Discussion.** *Ptychodus martini* is one of the least known and rarest members of the genus. It is known by very few specimens from a limited stratigraphic range. Hamm (2004) reported a single specimen of *P. martini* from the Austin/ Eagle Ford Group contact (Early Coniacian) in Texas but did not refer to a specific museum catalog number at that time. This specimen along with newly recovered specimens (SMU 76250, 76264, 76265, 76427-76249) are here reported for the first time from the Austin/ Eagle Ford contact within the *Nicaiolopha bellaplicata* zone of the basal Atco Formation (Early Coniacian) of Texas.

They are represented by isolated teeth from varying tooth file positions. The largest tooth SMU 76429, (**Pl. 13A, fig. A**) measures 37 mm in width x 28 mm in length; it is symmetrical and rectangular in shape with nine parallel transverse ridges that curve anteriorly. SMU 76249 consists of four teeth, one representing the para-medial file, two from differing anterolateral

positions and one from the posterior file. The para-medial tooth (**Pl. 13B fig. A**) measures 26 mm in width x 18 mm in length and has seven transverse ridges. The two anterolateral file teeth (**Pl. 13B, figs. C, D**) measure 18mm in width x 15 mm in length and 14mm in width x 12mm in length with seven ridges, respectively. The posterior tooth (**Pl. 13B fig. E**) measures 14 mm in width x 7 mm in length and has five transverse ridges.

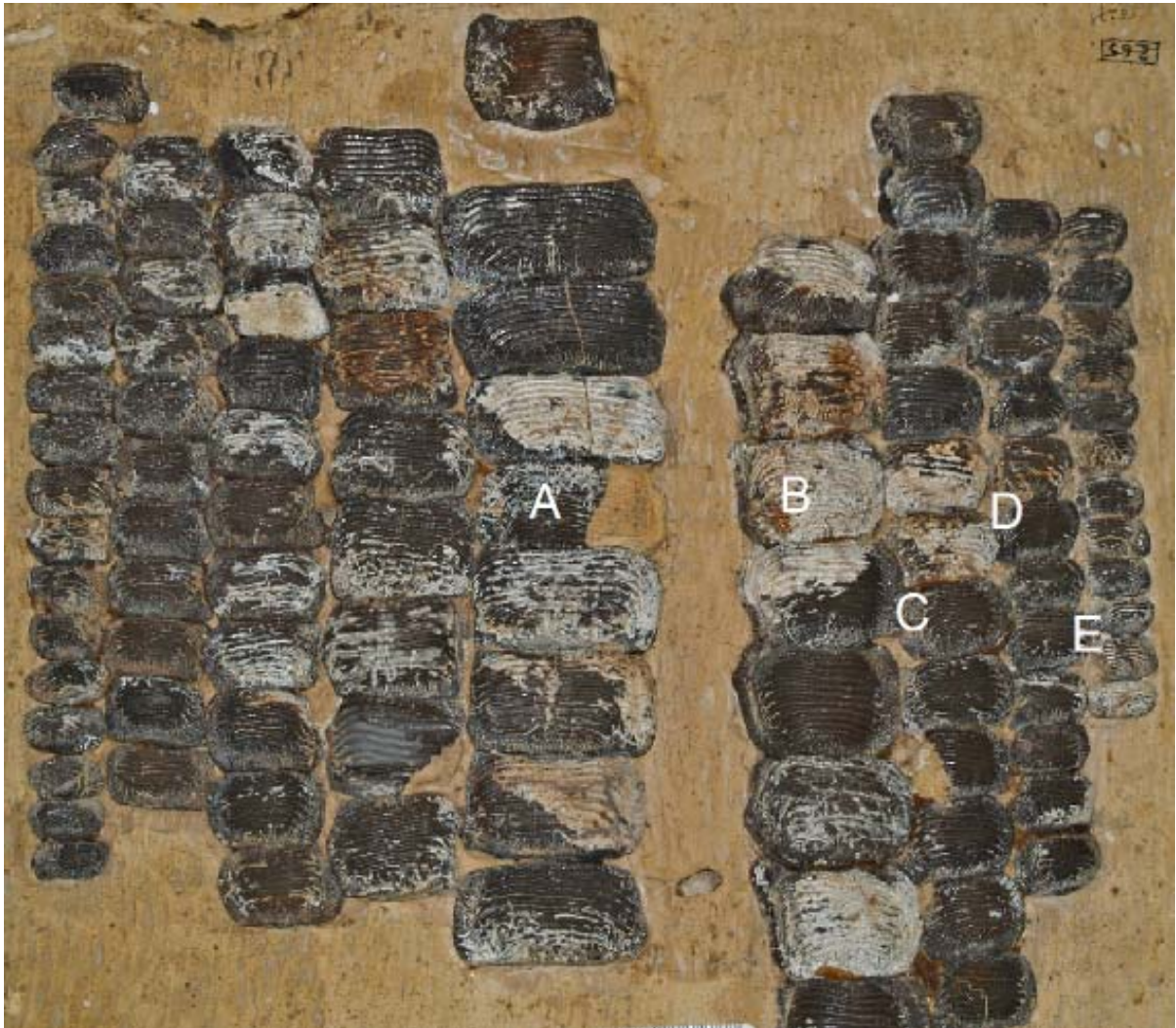
Caggiano and Everhart (2003) reported a single tooth of *P. polygyrus* (FHSM VP 15008) and a single tooth referred to *P. latissimus* (FHSM VP 14853) from below Hattin's (1982) Marker Unit 3 in the Smoky Hill Chalk Member of the Niobrara Formation. Each is here re-diagnosed as *P. martini* as they exhibit identical dental characteristics and stratigraphic occurrence as other known occurrences. A single tooth (PF 127) recovered from the uppermost Eutaw Formation or lowermost Mooreville Formation (Late Santonian-Early Campanian) in Alabama referred to *P. polygyrus* (Gibbes, 1849; Applegate, 1970) possesses characters of the typical *P. martini* para-medial file tooth and is re-diagnosed as such.

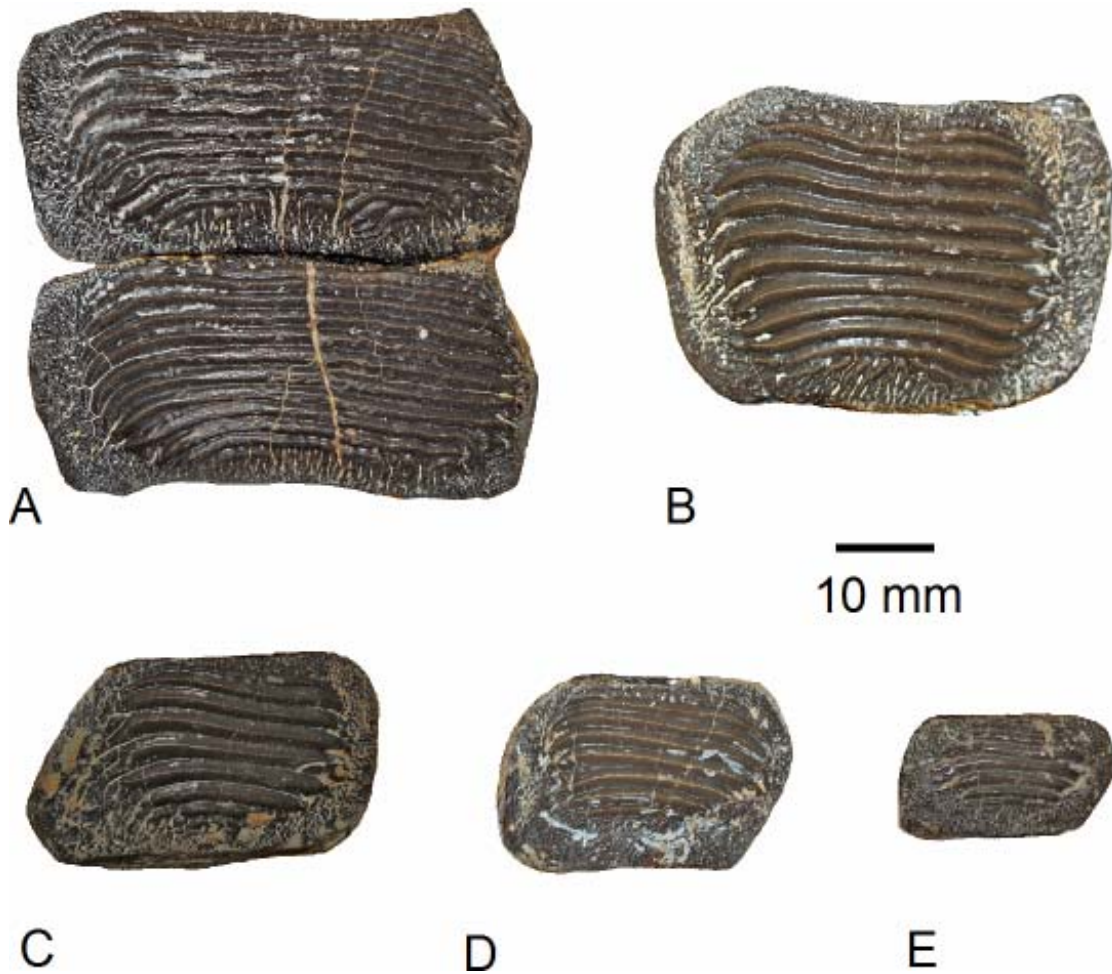
Taxonomically, *P. martini* shares a close relationship with *P. marginalis* and *P. polygyrus* (**Fig. 69**). Dibley (1911, p. 270) briefly stated: "teeth of the typical form [*P. polygyrus*] from the Niobrara Chalk of Kansas have also been described under the name of *P. martini*". However, *P. martini* is differentiated from *P. marginalis* and *P. polygyrus* in regards to the pattern and arrangement of the transverse ridges, their association with the marginal area and the total area the ridges occupy on the crown surface. In *P. martini*, the transverse ridges are parallel and slightly sinusoidal and extending fully to the lateral tooth edges; they do not loop or interconnect with other ridges as in the typical *P. polygyrus*. The marginal area of *P. martini* is relatively indistinct as the ridges typically extend fully to the lateral tooth margins. The anterior tooth edge possesses fine anatomizing ridges oriented perpendicular to the crown, whereas in *P. marginalis* the marginal ornamentation is granular and concentric with the crown without secondary or anastomizing ridges. It is set off from *P. marginalis* which has a wide and distinct margin composed of coarse enameloid granulations oriented concentric with the crown.

This material extends the stratigraphic distribution of the species from the Early Coniacian to the Late Santonian as well as the geographic distribution from central Texas to Kansas. The record suggests that *P. martini* is endemic to the Western Interior Seaway (Hamm and Shimada, 2004).

**PLATE 13A**

Type Specimen *Ptychodus martini* KUVV 55277. In occlusal view.

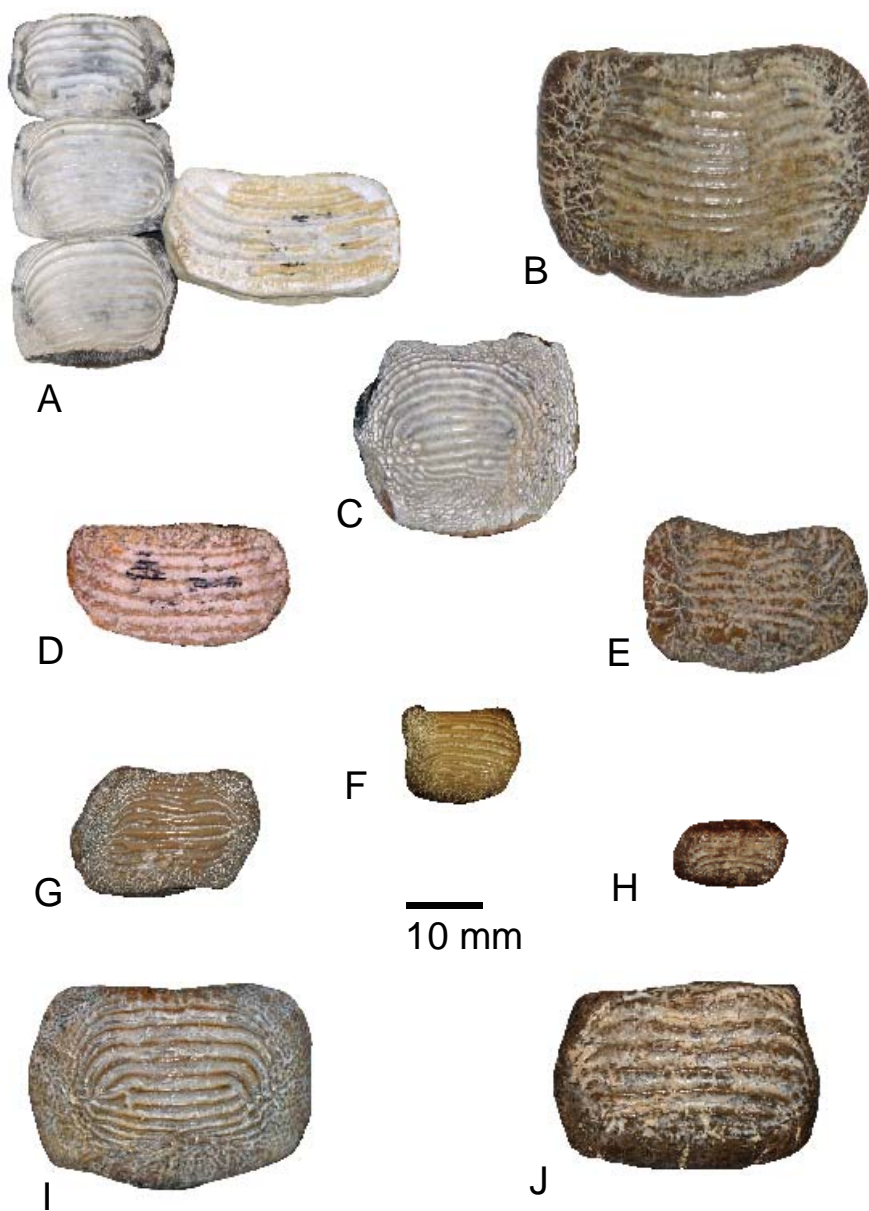


**PLATE 13B***Ptychodus martini*

**Figure A**, medial file; **Figure B**, PM; **Figure C**, 2<sup>nd</sup> file; **Figure D**, 3<sup>rd</sup> file; **Figure E**, 4<sup>th</sup> file. All in occlusal view.



## PLATE 13C

*Ptychodus martini*

**Figure A**, FHSM VP- 2121, lower medial and paramedials; **Figure B**, FHSM VP 12358, lower medial; **Figure C**, FHSM VP 15008, 2<sup>nd</sup> file; **Figure D**, SMU 69031, lower medial; **Figures E-H**, SMU 76249; E, anterior, F, anterolateral, G, anterolateral, H, posterior files; **Figure I**, SMU 76249, lower medial; **Figure J**, SMU 76248, 2nd anterior file. All in occlusal view.

*PTYCHODUS LATISSIMUS* (Agassiz, 1843)

(Plates 14A-14B)

- Ptychodus latissimus* Agassiz, 1843: p. 157, pl. 25a, fig.1-6, pl. 25b, fig. 24-26.
- Ptychodus decurrens* Reuss, 1845: p. 1, pl. 2, fig. 8.
- Ptychodus latissimus* Dixon, 1850: p. 362, pl. 30, figs. 1, 2; pl. 31, fig. 3.
- Ptychodus paucisulcatus* Dixon, 1850: p. 363, pl. 30, fig. 3.
- Ptychodus schlotheimi* Geinitz, 1850: p. 63, pl. 7, fig. 5, pl. 17, figs. 1, 3.
- Ptychodus latissimus* Kiprijanoff, 1852: p.3, pl.12, fig.1, 2.
- Ptychodus latissimus* Roemer, 1870: p. 323, pl. 36, fig. 7.
- Ptychodus latissimus* Geinitz, 1875: pp. 212, 213.
- Ptychodus latissimus* Fritsch, 1878: p. 15.
- Ptychodus latissimus* Woodward, 1889: pp. 147 a 149, pl. 5, fig. 7.
- Ptychodus latissimus* Leriche, 1902: pp. 91 a 93, pl. 2, fig. 1, 7.
- Ptychodus latissimus* Leriche, 1906: pp. 54, 66, 67, pl. 5, fig. 1, 2.
- Ptychodus dixoni* Dibley, 1911: p. 271, pl. 20, fig. 3, 5, pl. 22, fig. 2, 9.
- Ptychodus latissimus* Woodward, 1911: pp. 235, 239; pl. 50, figs.1, 4, 9, 10, 12, 16.
- Ptychodus mediterraneus* Canavari, 1916: p. 98, pl. 1-13.
- Ptychodus latissimus* D'Erasmus, 1922: pp. 17, 18, pl. 2, figs. 12, 13.
- Ptychodus latissimus* Leriche, 1929: pp. 211, 213.
- Ptychodus latissimus* Dalinkevicius, 1935: pp. 262-263.
- Ptychodus latissimus* Leriche, 1935: p. 54.
- Ptychodus latissimus* Casier, 1947: pl. 1, fig. 1.
- Ptychodus latissimus* Tan, 1949: pp. 18, 20.
- Ptychodus mediterraneus* Antunes, 1961: p. 513.
- Ptychodus latissimus* Glyckman, 1964: p. 176, pl. 5, fig. 8.
- Ptychodus latissimus* Hermann, 1977: pp. 69-71, pl. 2, fig. 10.
- Ptychodus latissimus* Welton and Farish, 1993: p. 60.
- Ptychodus latissimus* Cicimurri, 1999: p. 52, pl. 3, figs. 4-6.
- Ptychodus latissimus* Cappetta and Case, 1999: p. 10, pl. 2, fig. 5.

*Ptychodus cf. latissimus* Trbušek, 1999: p. 51-61, pl. 1, fig. 5.

*Ptychodus latissimus* Antunes and Cappetta, 2002: p. 104, pl. 1, fig. 3.

*Ptychodus paucisulcatus* Antunes and Cappetta, 2002: pp. 105, 106, pl. 1, figs. 4-9.

*Ptychodus latissimus* Niedźwiedzki and Kalina, 2003: p. 16, fig. 1.

*Ptychodus latissimus* Ladwig 2003: p. 43-46, fig. 1.

*Ptychodus latissimus* Hamm, 2004: 67A.

*Ptychodus latissimus* Hamm, 2005: 67A.

**Diagnosis.** Lower medial teeth, are rectangular in outline, with a gently raised, rounded occlusal surface crossed by seven to eight parallel transverse ridges. Lateral file teeth are square in outline with gently raised crowns and five to six ridges; posterior files are rectangular and nearly flat with three to four ridges. Differs from other species by having widely spaced, thick, and sharp parallel transverse ridges across a low crown terminating sharply at a wide marginal area covered with irregular and coarse enameloid granulations.

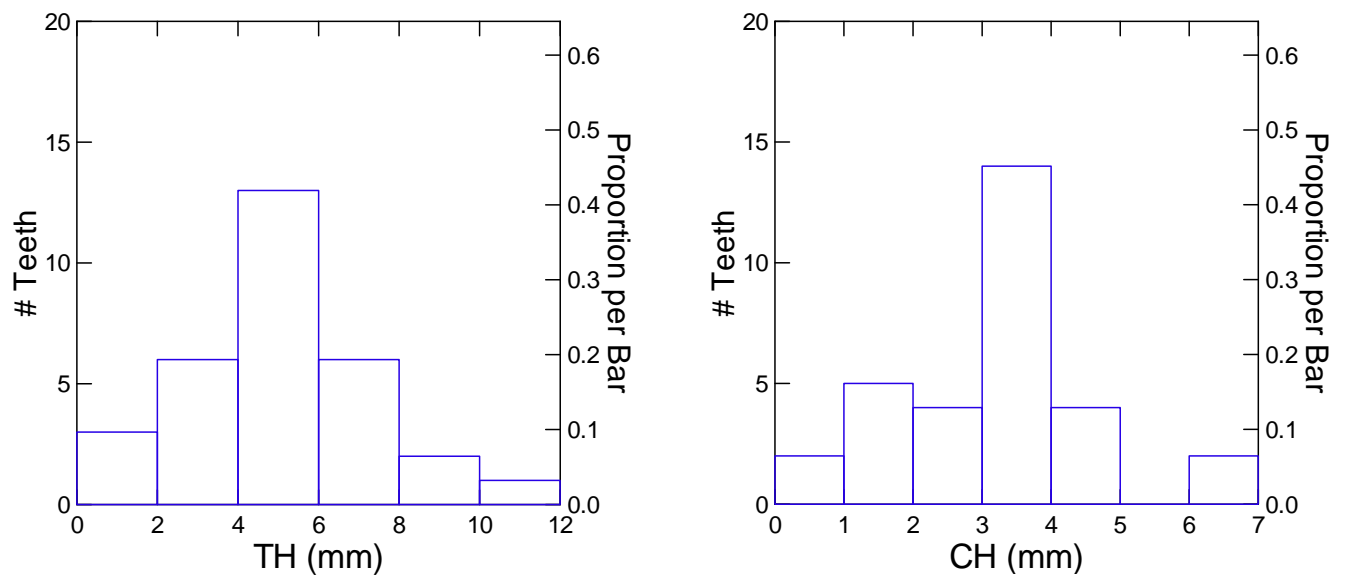
**Type specimen.** BMNH- 4355.

**Syntypes.** BMNH- 25826, 5864, 37350, 5603, 4355, 4358, 36103, 39129, P. 10260. All types from the Zone of *Micraster cortestudinarium* (Late Turonian-Early Coniacian) of the English Chalk.

**Referred specimens.** SDSM 34973 (single tooth), SMU 62786 (single tooth); SMU 62789 (single tooth); SMU 63286 (single tooth); SMU 63299 (single tooth); SMU 75590 (single tooth); SMU 75591 (single tooth); SMU 76251, SMU 76450 (5 teeth); SMU 76431 (6 teeth) and SMU 76342 (12 teeth).

**Description.** *Ptychodus latissimus* has among the most distinctive teeth of the family, having a moderately domed occlusal surface, averaging 5mm in crown height (**Fig. 41**), crossed by massive or thick transverse ridges. The ridges are thick at the base and thin upward at the apex forming a sharp cutting edge. The ridges are restricted to the central portion of the tooth crown then become narrow and thin at the crown edge, curving at the tooth margin. They do not loop or connect with any other ridges or bifurcate as in other low crowned species. Teeth of the lower median files are rectangular in outline, having the central portion of the crown being gently inflated crossed by six to eight transverse ridges. Anterolateral tooth files are square to rectangular in outline with five to six transverse ridges while the posterior files are highly

asymmetrical with four transverse ridges. In all files the marginal area is wide and has a very thick, rugose or granular texture. The labial tooth margin exhibits a dendritic pattern of fine longitudinal ridges whereas the lingual edge has the typical granular pattern as in other ptychodontids. The tooth root is weakly bilobed, there is a deep lingual sulcus. The labial tooth edge is gently rounded in anterior tooth files and flattens out becoming straight in the lateral files.



**Figure 41.** Tooth Height-Crown Height values for all *Ptychodus latissimus* observed.

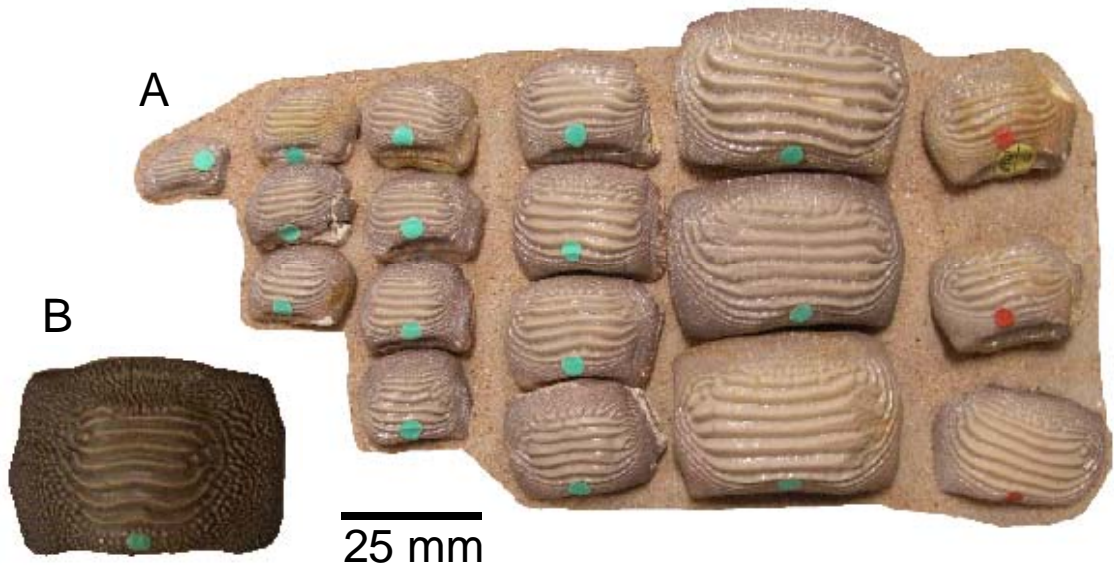
**Stratigraphic and Geographic occurrence.** *Ptychodus latissimus* is one of the rarest species of *Ptychodus*, making its first and only appearance within the Western Interior Seaway during the Early Coniacian. Specimens reported within the Western Interior Seaway are from the Sage Breaks Member of the Carlile Shale in South Dakota (Cicimurri, 1998) and the basal Atco Formation of the Austin Chalk in Texas (Welton and Farish, 1993; Hamm, 2004, 2005). Elsewhere, *P. latissimus* has been reported from the Late Turonian and Early Coniacian of the English Chalk (Dibley, 1911; Woodward, 1911); the Early Coniacian of Japan (Tan, 1949); the Late Turonian Itombe Formation of Angola (Antunes and Cappetta, 2002) and the Opole trough from Poland (Niedźwiedzki and Kalina, 2003).



**Discussion.** Reasonably complete tooth sets of *P. latissimus* are known from the English Chalk Foramation (Dibley, 1911; Woodward, 1911; Canavari, 1916). The names *P. paucisulcatus* and *P. mediterraneus* have been used interchangeably by other workers (Canavari, 1916; Antunes, 1961; Antunes and Cappetta, 2002) for isolated tooth specimens from the lateral files. Their material has the same physical characters, geographic and stratigraphic occurrences as similar tooth files from *P. latissimus*. It is my contention that both *P. paucisulcatus* and *P. mediterraneus* are conspecific, with *P. latissimus* having priority. Morphologically, *P. latissimus* shares a moderately raised crown, thick transverse ridges and a coarse marginal area, suggesting a close relationship with *P. mammillaris* (**Fig. 69**).

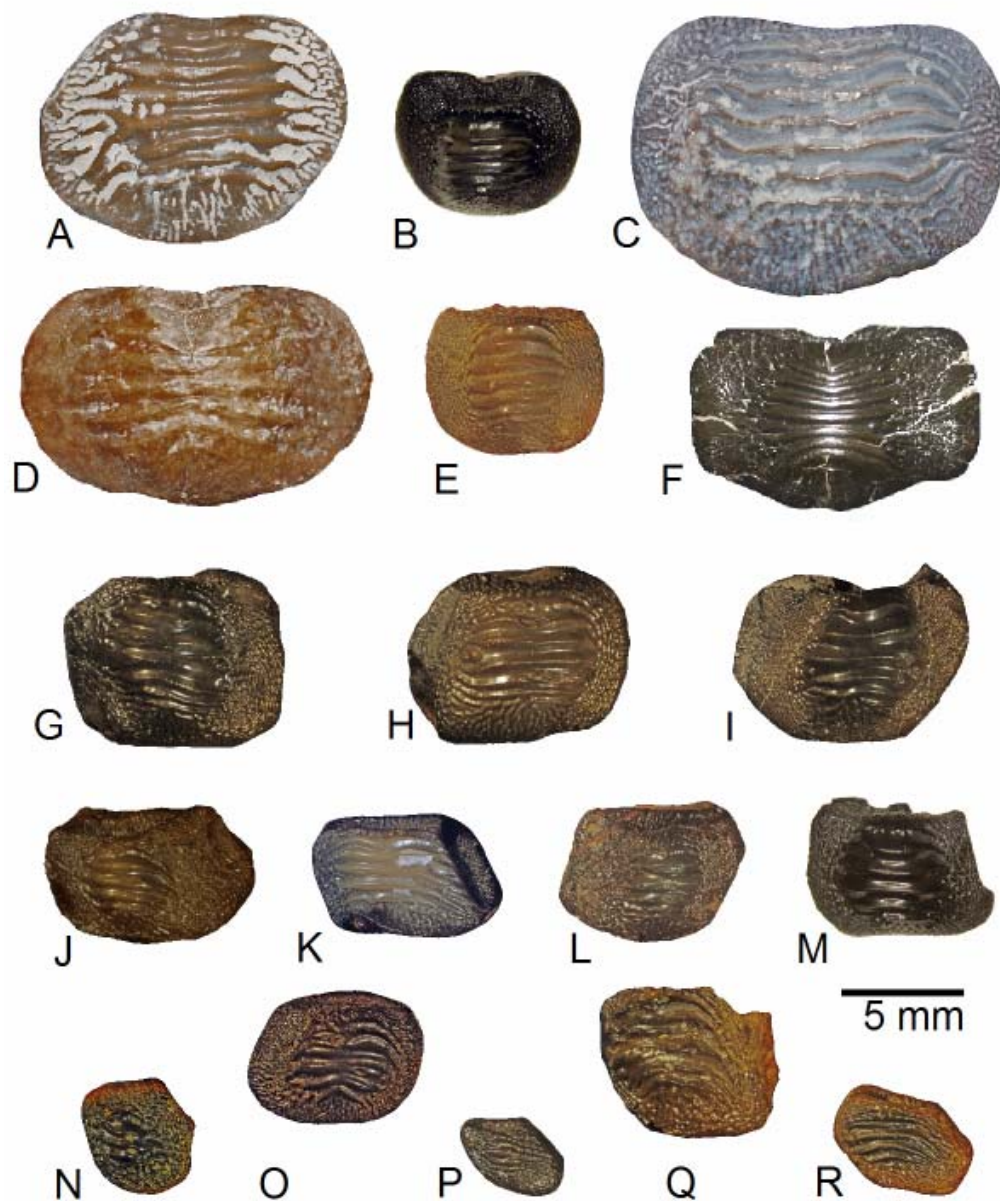
Within the Western Interior, *P. latissimus* is most prevalent within the *Nicaiosolopha bellaplicata* zone of the basal Atco Formation in Texas. Throughout the remainder of the seaway I was only able to recognize a single tooth specimen (SDSM- 34973) from the Sage Breaks Member of the Carlile Shale in South Dakota. It has been reported to occur within the Ozan Formation (Campanian) of the Taylor Group (Welton and Farish, 1993; Johnson et al., 2002). This report is considered invalid because (1, there are no cataloged specimens to substantiate this claim and (2, because of its limited stratigraphic occurrence worldwide.

## PLATE 14A

*Ptychodus latissimus*

**Figure A**, BMNH 10260, syntype, associated tooth set; **Figure B**, BMNH 4355, type specimen. In occlusal view.

## PLATE 14B

*Ptychodus latissimus*

**Figure s. A, C, D**, SMU 76251; **Figure B**, SMU 75591; A-B, anterior files, C, lower medial; **Figure E**, SMU 76431, anterior file; **Figure F-I**, SMU 76432, **F**, lower medial, **G-I** lateral files; **Figures J-P**, SMU 76432, anterolateral files; **Figures P, R**, posterior file. All in occlusal view.

*PTYCHODUS MORTONI* (Agassiz, 1839)

(Plates 15A-15M)

- Palate bones of a fish? Morton, 1834: p. 30, pl. 18, figs. 1-2.
- Ptychodus mortoni* Mantell, 1836: p. 27.
- Ptychodus mortoni* Morton, 1842: p. 215, pl.11, fig. 7.
- Ptychodus mortoni* Agassiz, 1839-1843: p. 158, pl. 25, fig. 1, 3.
- Ptychodus mortoni* Woodward, 1887: p.130.
- Ptychodus mortoni* Woodward, 1889: pp. 149, 150.
- Ptychodus mortoni* Woodward, 1894: p.191, pl. 5, fig.4.
- Ptychodus mortoni* Williston, 1900: p. 238, pl. 25, 26, 27.
- Ptychodus mortoni* Aguilera, 1907: p. 240.
- Ptychodus mortoni* Dibley, 1911: pp. 272, 273, pl. 22, fig. 7, 8.
- Ptychodus mortoni* d' Earasmo, 1922: pl. 19, pl. 2, fig. 5, 6.
- Ptychodus mortoni* Casier, 1953: pp. 6, 17, 35, 41.
- Ptychodus mortoni* Applegate, 1970: p. 393.
- Ptychodus mortoni* Stewart, 1990: p. 23.
- Ptychodus mortoni* Welton and Farish, 1993: pp. 62, 63.
- Ptychodus mortoni* Schwimmer, 1994: Vol. 14, supp to No. 3, 45A.
- Ptychodus mortoni* Cicimurri and Bell, 1996: Vol. 16, supp to No. 3, 28A.
- Ptychodus mortoni* Shimada, 1996: p. 6, fig. 5, A, B.
- Ptychodus mortoni* Cicimurri, 1998: pp. 55-57, pl. 5, 1-5.
- Ptychodus mortoni* Antunes and Cappetta, 2002: p. 105, pl. 2, figs. 3-10.
- Ptychodus mortoni* Brito and Janvier, 2002: pp. 785-790, fig. 2.
- Ptychodus sp.* Cicimurri, 2004: p. 7, fig. 4, J-K.
- Ptychodus mortoni* Hamm, 2004: Vol. 24, supp. to No. 3, 62A.
- Ptychodus mortoni* Hamm, 2005: Vol. 25, supp. to No. 3, 67A.
- Ptychodus cyclodontis* Muller et al., 2005: pp. 976-978, fig. 1.
- Ptychodus mortoni* Blanco-Pinion et al., 2007: pp. 25-30, fig. 2.

**Diagnosis.** Tooth crown conical, moderately high to high and differs from other species by having distinctive coronal ridges that radiate from a central point or antero-posterior cutting ridge at the apex of the cusp. The ridges are restricted to upper ½ of the crown then become thin and bifurcate down the lower ½ of the crown terminating at a finely and concentric granular margin.

**Type specimen.** BMNH- 28394, single medial tooth (**Plate 15 A, Figs. A-D**).

**Referred specimens.** A number of associated tooth sets were examined including AMNH 8310 (23 teeth); FHSM VP 335 (849 teeth), FHSM VP 336 (102 teeth), FHSM VP 2238 (100 teeth), FHSM VP 15532 (202 teeth), FHSM VP 16684 (51 teeth); KUVVP 59041 (287 teeth); MNHN 1898- 3 (73 teeth), FCT-341 (6 teeth); SMU 76278 (100 teeth), SMU 76359 (41 teeth). Isolated teeth include SMU (76251) and CSU-K-07-04 (1, 2, and 3), CSU-K-88-22 (1, 2).

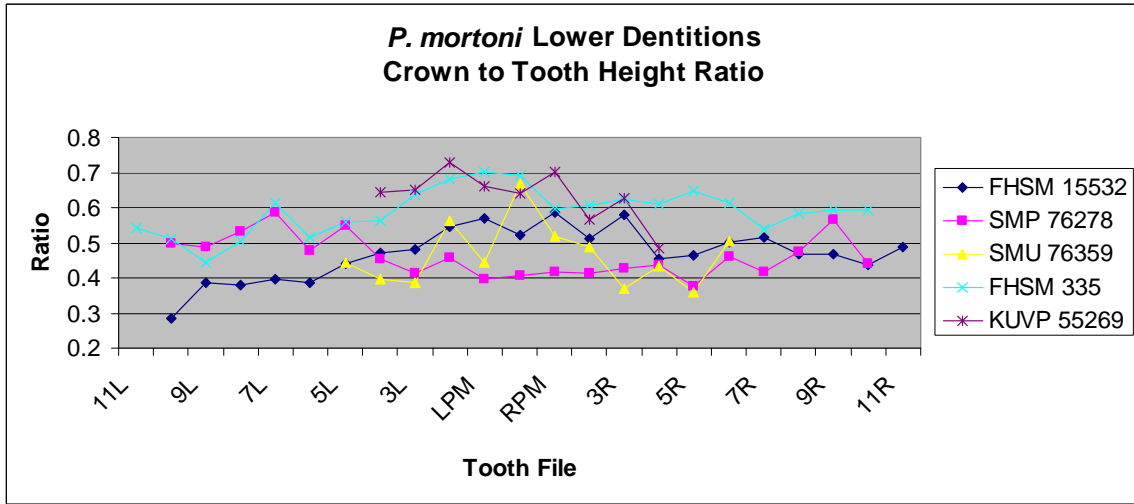
**Description.** Eleven associated tooth sets were observed exhibiting ontogenetic stages from juvenile to adult forms, each with differing tooth morphologies. The determination of ontogenetic stage is based on comparisons of tooth size and morphology within each tooth file in associated tooth sets, not isolated (i.e. unassociated) tooth specimens. This is the first report of referable tooth sets from the Early Coniacian (SMU 76278, SMU 76359) and isolated teeth from the Santonian of Texas (SMU 76251).

In juvenile forms, the lower medial files are square in outline with greatly rounded tooth edges. The tooth crown is broadly conical and circular in shape (0.4-0.5 TH-CH ratio) with a single raised cutting ridge aligned in the antero-posterior direction that numerous (>10) small ridges bifurcate and radiate from. The ridges are restricted to the upper 1/3 to 1/2 of the crown and terminate at a clearly defined and shelf-like margin. The margin is flat, composed of fine and concentric enamel folds around the periphery of the tooth. The top of the crown is angled at a 55° to the lateral most tooth edge. The lateral files become more elongate and rectangular in outline with the same occlusal and marginal ornamentation as the medial files. Dentition lengths range from 25 cm in FHSM-VP 16684 to 30 cm FHSM-VP 15532 to 35.5; SMU- 76278 is an incomplete tooth set and KUVVP 119675 was not obtained in time for reconstruction and their dentition lengths cannot be accurately determined.

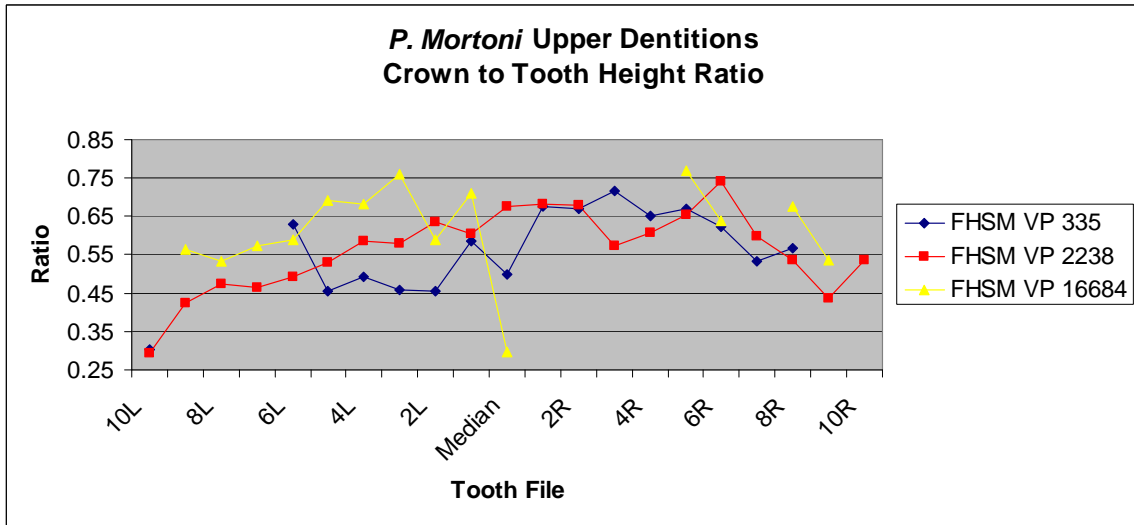
Three tooth sets are interpreted as sub- adult forms. In these dentitions, FHSM VP 2223, KUVVP 55268 and KUVVP 55270 the lower medial teeth have distinctive wing-like margins. The

medial teeth are rectangular outline rather than square and do not have any distinguishable raised cutting ridge. Instead, the ridges (>10) radiate from a single point at the apex of the crown and terminate at a 90° angle at a flat margin with concentric ornamentation. The top of the crown is oriented at a 45° angle to the margin and have a mean TH/CH and TW-CW ratios of 0.51. The lateral files become more elongate and rectangular in outline with the same wing-like margin and patterning of occlusal and marginal ornamentation as the medial files. I have also observed this morphology in isolated tooth specimens from the Smoky Hill Chalk in “intermediate sized teeth”, (i.e. not in the largest or smallest teeth). This difference in shape may represent ontogenetic change from juvenile to adult form. It may also be a periodic shift in dentition during reproductive seasons as in modern rays (Kajiura and Tricas, 1996). The dentition of FHSM 2238 is incomplete but the remaining portion measures 20 cm in length, while KUVVP 55268 measures 21 cm. The dentition of KUVVP 55270 is not in its natural arrangement and was not accessible to obtain accurate measurements.

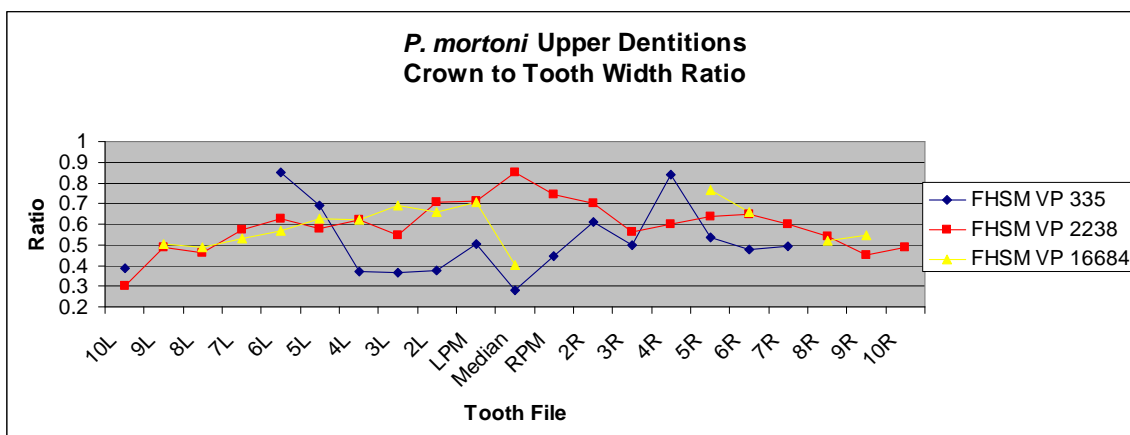
The adult forms FHSM VP 335 and FHSM VP 336 are represented by large dentitions with a great number of teeth with each (849 and 100 teeth respectively) compared to specimens from the same deposit. All tooth files are rectangular with a more complex pattern of ridge morphology. The crown is proportionally wider and longer (2:1 TL-TW ratio) with a raised labio-lingual cutting edge and two other proximately raised ridges that split from this ridge laterally. The tooth crowns are not raised and circular; instead are broad with a mean TW/CW ratio of 0.69. The tooth crown is divided into quadrants by the intersection of antero-lateral and labio-lingually directed ridges (>10). Secondary radial ridges diverge from the primary ridges located and extend down the marginal area. The ridges are widely spaced compared to the juvenile form and extend posteriorly into the lingual sulcus where they terminate at the marginal ridge. The sides of the cusp are gently sloping, at 30°, rather than being tall and conical. The margin occupies 2/3rds of the crown area, is finely granular and concentric with the ridge pattern and terminates at the lingual sulcus. Teeth from the anterolateral files become increasingly elongate and maintain a distinctively raised and sharp cutting edge.



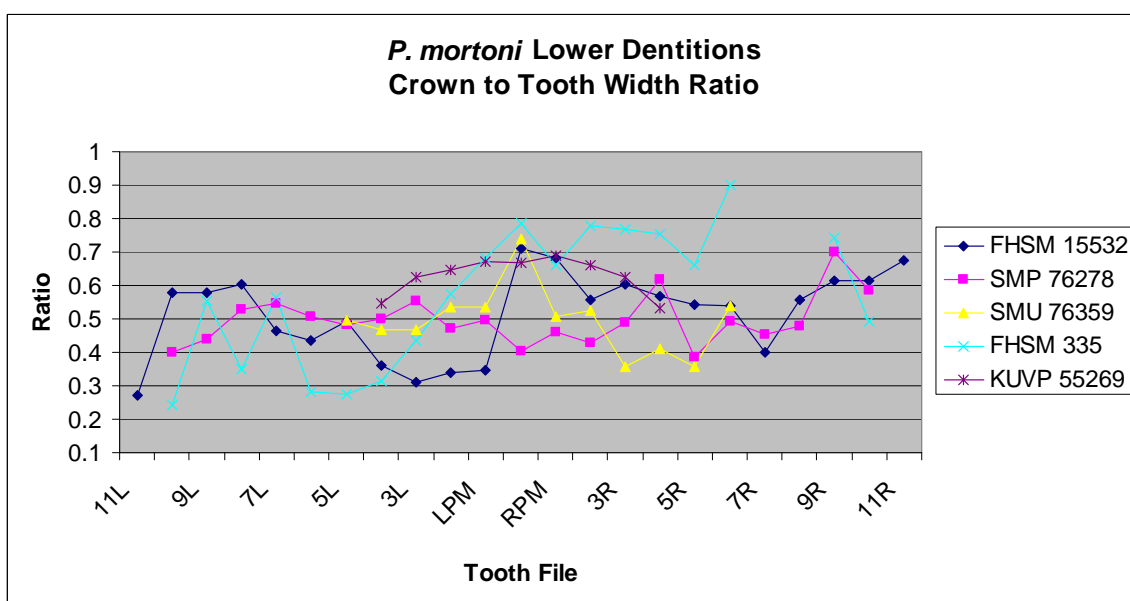
**Figure 42.** *Ptychodus mortoni* Lower Dentition Crown Height to Tooth Height Ratios.



**Figure 43.** *Ptychodus mortoni* Upper Dentition Crown Height to Tooth Height Ratios.



**Figure 44.** *Ptychodus mortoni* Upper Dentition Crown Width to Tooth Width Ratios.



**Figure 45.** *Ptychodus mortoni* Lower Dentition Crown Width to Tooth Width Ratios.

**Stratigraphic and Geographic occurrence.** *Ptychodus mortoni* first appears in Early Turonian deposits throughout the seaway and is widely dispersed from Cuba, Europe, North Africa, and Central America and throughout the Western Interior Seaway. Those deposits include the Carmita Formation in central Cuba (Mutter et al., 2005) and La Luna Formation of Northern South America (Brito and Janvier, 2002) and Vallecillo Member of the Agua Nueva Formation in Mexico (Blanco et al., 2007); the Boquillas Formation of Texas (Cicimurri and Bell, 1996); the Greenhorn Formation in South Dakota (Cicimurri, 2001) and the Late Turonian in the Itombe



Formation of Angola (Antunes and Cappetta, 2002). By the Coniacian *P. mortoni* has a narrower distribution, found primarily in Kansas and the Gulf Coast. These deposits include the Early Coniacian Atco Formation of the Austin Group in Texas (Welton and Farish, 1993; Hamm, 2004, 2005); the Middle Coniacian Fort Hays Limestone Member of the Niobrara Chalk (Shimada 1996); the Late Coniacian and Early Santonian Niobrara Formation of Kansas (Williston, 1900a, Stewart, 1990); Mancos Shale of New Mexico (Cicimurri, 1998); the Eutaw Formation in Georgia and the Blufftown Formation of the Mooreville Chalk in Alabama (Schwimmer, 1994).

***Historical background.*** Great confusion still exists regarding the authorship, type locality and tooth morphology of *P. mortoni*. The first illustrated *Ptychodus* tooth from North America was published by Samuel George Morton (1834, p. 30, pl. 18, figs.1-2) in which he identified an isolated tooth specimen as "The palate bones of a fish?" that was collected by Timothy Conrad from the Prairie Bluff Formation exposed along the Alabama River in Alabama. Morton then sent the specimen to Dr. Gideon Mantell in England for further identification. In the book *Fossils from the Sussex of England*, Mantell (1836, p. 27) mentioned the name "*Ptychodus mortoni*" but included no figures of the tooth. Mantell (1836) then published three line drawings, specifically referring to Morton's (1834) specimen; however, he mistakenly notes the horizon that the tooth was found in the "sand in New Jersey". Morton (1839, Vol. 8, p. 215, pl.1) identified and figured the tooth again as *P. mortoni* from drawings done by Mantell (1836) and this time noted that the specimen was found by "Mr. Conrad in the older cretaceous strata at Prairie Bluff, Alabama." Although Morton was the first to publish the name, he did so without a description of the tooth.

Later, Morton (1842, p. 215, pl. 11, fig. 7) published the figures Mantell had sent him (Fig. 1) and identified the specimen as *Ptychodus mortoni* (Mantell). Agassiz (1839, p. 158, pl. 25, fig. 1-3) then published a formal description of *Ptychodus mortoni* based on BMNH 28394 although Mantell (1836), Agassiz (1839), and Morton (1842) previously published the name. Most authors today regard Agassiz (1843) as the author of *P. mortoni*, but according to The International Code of Zoologic Nomenclature (ICZN, 1999, chap. 4, art. 12.2.7) regarding the naming of a species before 1931, the new name must be cited and a recognizable illustration or description must be published along with it. Because Mantell (1836) only cited the name, and

didn't include a figure, the first report with figured images and a formal description was not published until Agassiz, 1839. Agassiz again in 1843 (Vol. 3, p. 158, pl. 25, fig. 1-3) figured Morton's (1834) drawings which are identical to his 1839 described specimen. If Morton's (1834) figure is the specimen described by Agassiz (1839/42) then it (BMNH 28394) is the type of *P. mortoni* because it is the first accurate description and figure to be published. The authority for *P. mortoni* should then be Agassiz (1839).

The Prairie Bluff locality that Conrad collected the original specimen from has not been located. The sediments cropping out at Prairie Bluff Alabama include the Mooreville Chalk/Tombigbee Sandstone contact (Santonian/Campanian boundary). The type locality for the Prairie Bluff Chalk (middle Maastrichtian) is also located at Prairie Bluff Alabama; however it is stratigraphically younger than the known range for the genus (Middle Turonian –Late Santonian). It is most likely that Conrad's specimen was collected from the Blufftown Formation (Early to Middle Santonian) of the Mooreville Chalk near Erie, Alabama (Schwimmer and Williams, 1994, Schwimmer pers comm., 2007).

**Discussion.** Jaekel (1898) proposed that *P. mortoni* be placed into a new genus, *Hemiptychodus* based on it having a conical crown with a pattern of radial ridge ornamentation, features that are not shared with other members of the genus. However, closer examination shows *P. mortoni* shares a similar pattern of bifurcating marginal ornamentation with *Paraptychodus*, *P. decurrens* and *P. occidentalis* (**Fig. 69**). Throughout its range (Turonian-Santonian) several morphological variations exist in *Ptychodus mortoni*. These differences include changes in crown shape and ridge pattern; however, these are interpreted here as being plesiomorphic characters, as each configuration is present in contemporaneous and geographically separated deposits. This can be interpreted in several ways; either each morphotype represents sexual heterodonty and/or differing ontogenetic stages within the species, or the different crown morphologies originated within a single species and the change observed through time reflects adaptation to changing environment or prey items.

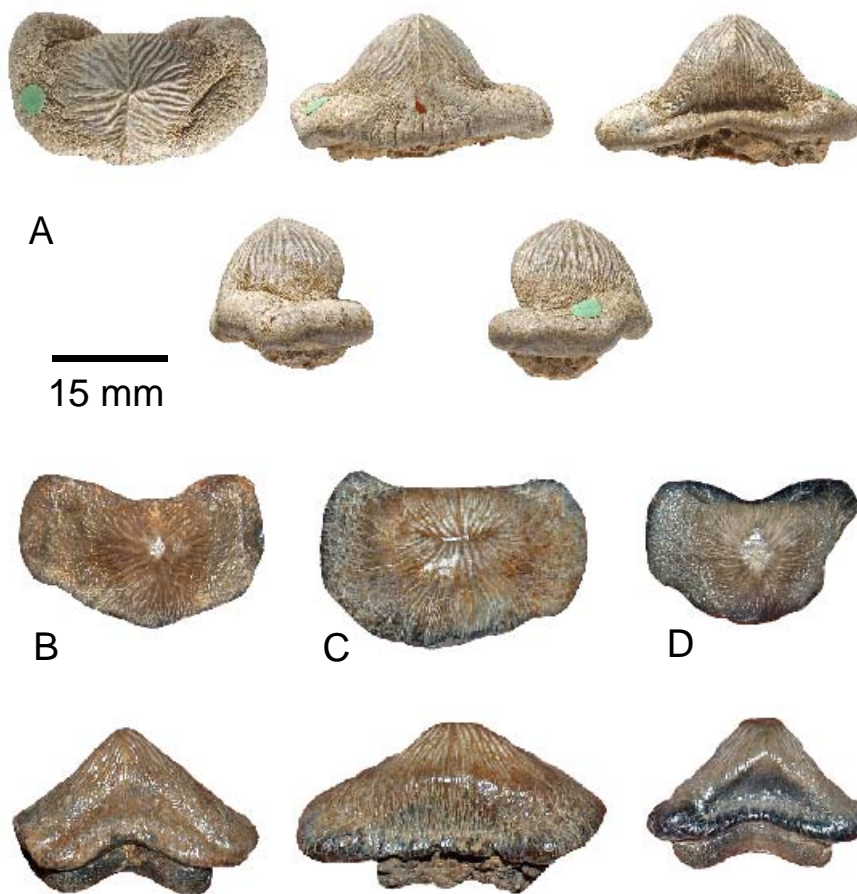
This interpretation is based on sample size and tooth morphologies present within Turonian through Santonian stratigraphic units. The sample size I have observed from the Turonian is very small, with only four specimens representing two very similar tooth morphologies (Antunes and Cappetta, 2002; Brito and Janvier, 2002; Mutter et al., 2005; Blanco

et al., 2007). Material referred to *P. cyclodontis* (Mutter et al., 2005) exhibit a similar pattern of occlusal and marginal ornamentation to *P. mortoni*; however the only two specimens known (AMNH 8031 and MNHN 1898-3) have a strongly homodont dentition. The dentition reported by Mutter et al (2005, p. 977, fig. 1) has relatively small teeth, 9mm in height x 10mm in width. Only three tooth files are preserved and the teeth are identical to a specimen of *P. mortoni* (SMU 78448) from the Atco Formation (Early Coniacian) of the Austin Group of Texas. Additional material is needed to validate *P. cyclodontis* as valid species.

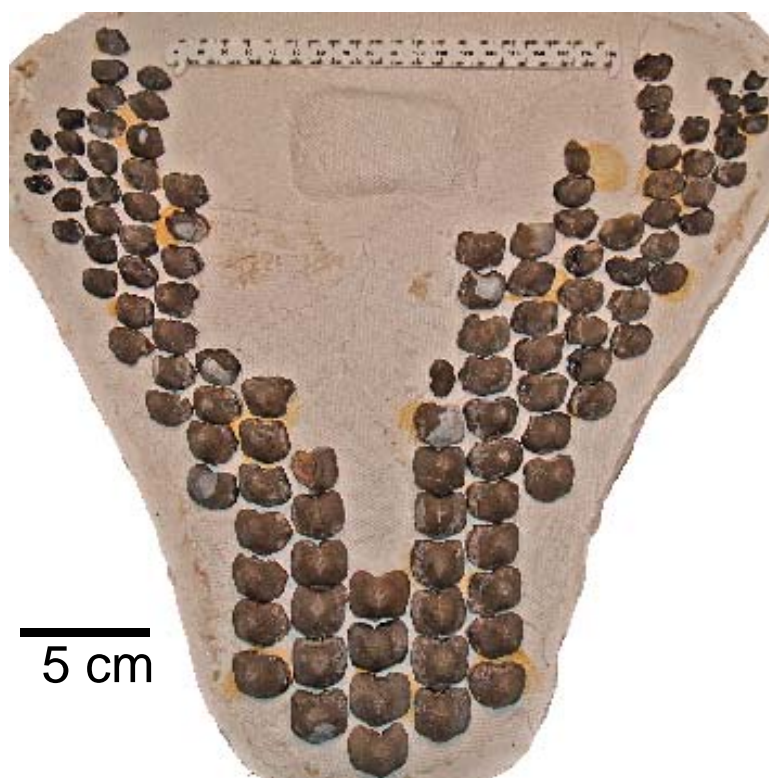
The pattern of occlusal and marginal ornamentation of teeth from the Turonian is also present within tooth sets from the Coniacian and Santonian. The paleogeographic and stratigraphic range of *P. mortoni* indicates there is little provinciality in its distribution (Reinhart, 1951; Williamson et al., 1991; Welton and Farish, 1993) although it appears to be more prevalent in the middle and southern end of the seaway. *P. mortoni* is a rare constituent among other selachian taxa, and most reports are isolated tooth specimens in faunal associations.

*P. mortoni* is one of the last surviving species of the genus. The youngest occurrences are from the Early Santonian in Kansas, the Late Santonian in Georgia and at the Late Santonian-Early Campanian boundary of Alabama (Schwimmer, 1994). *Ptychodus* has been reported to occur in Maastrichtian deposits (Cicimurri, 1998; Johnson et al. 2002; Johnson and Lucas, 2002; Williams and Lucas, 2005; Blanco et al., 2007) however there are no referable specimens to support this claim. These statements are likely due to confusion in Morton's reports in locality and stratigraphic horizon of the type specimen.

## PLATE 15A

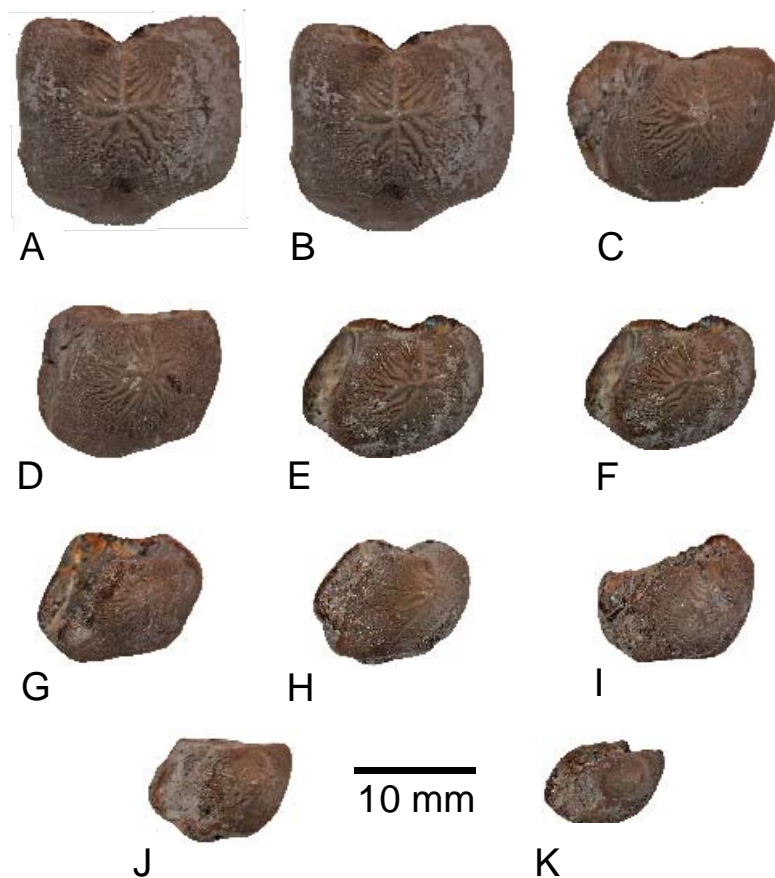
*Ptychodus mortoni*

**Figure A**, Type specimen, BMNH- 28394, 2<sup>nd</sup> file in anterior, posterior, labial and lingual views. **Figures B-D**, CSU-K-07-04 (1, 2, and 3), anterior files, all in occlusal and lingual views. All from the Blufftown Formation in Alabama.

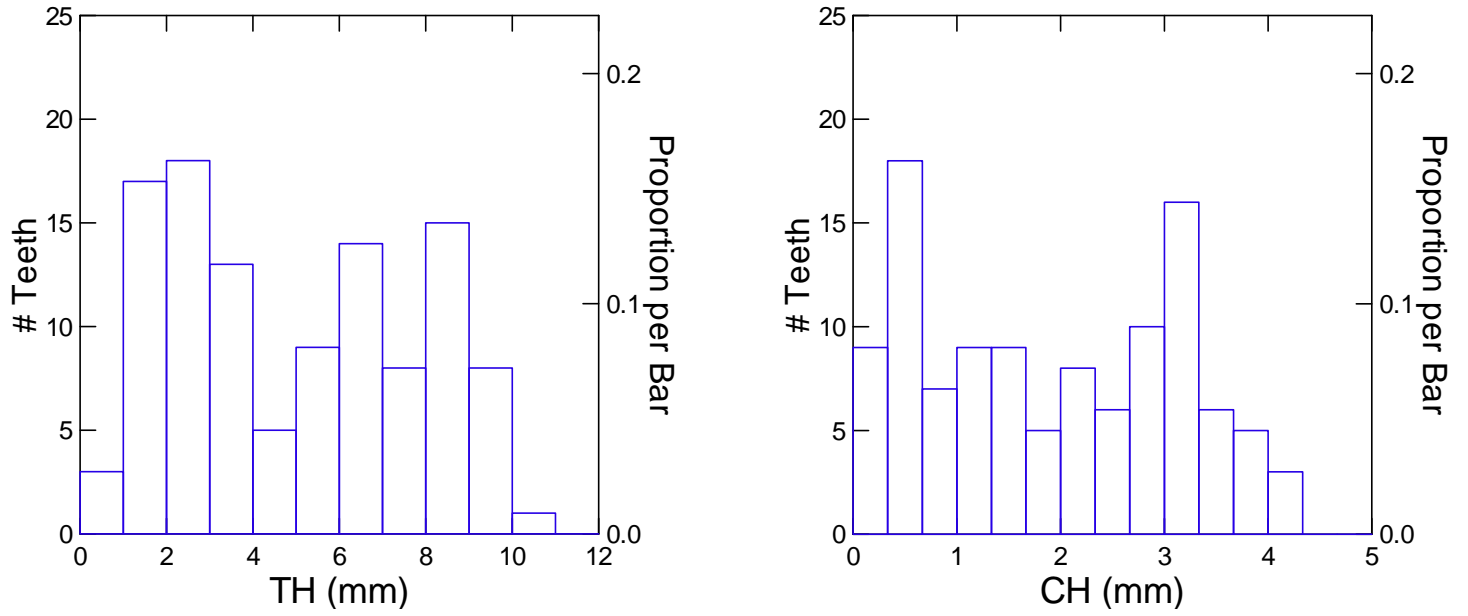
**PLATE 15B***Ptychodus mortoni* SMU 76278

Associated lower dentition from the Atco Formation (Early Coniacian) in Texas.

## PLATE 15C

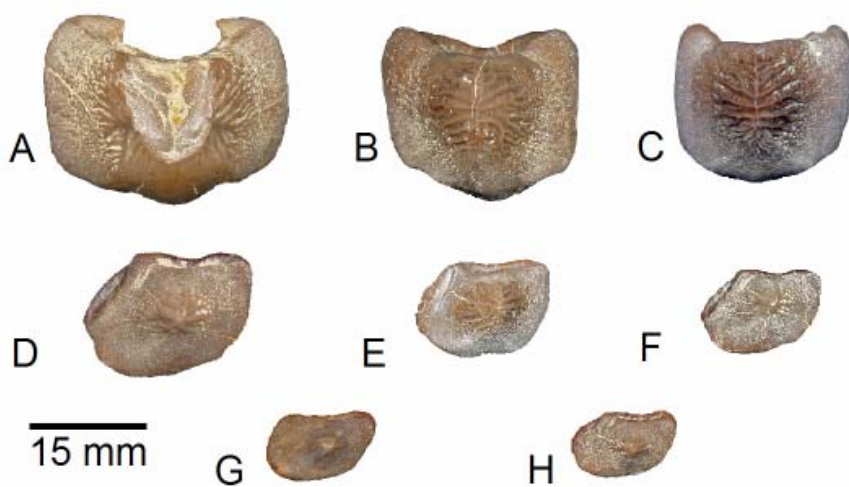
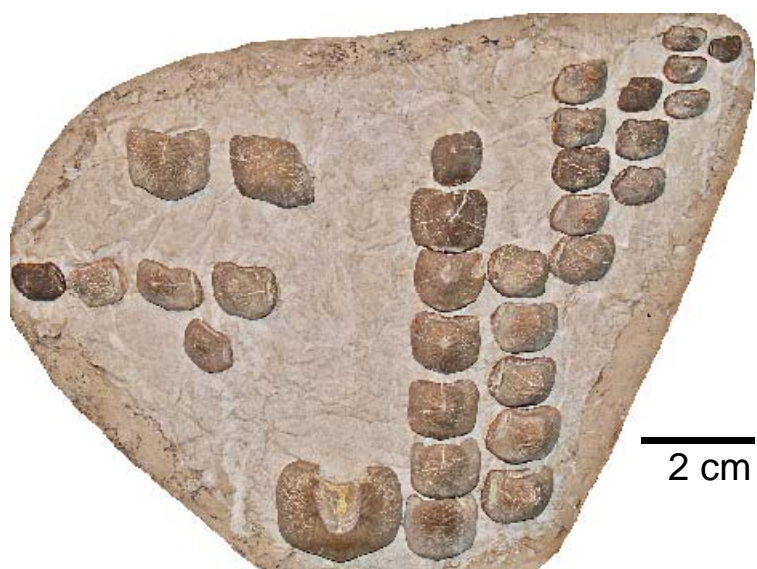
*Ptychodus mortoni* SMU 76278

Lower right tooth series. **Figure A**, medial; **Figure B**, para-medial; **Figure C**, 2<sup>nd</sup> file; **Figure D**, 3<sup>rd</sup> file; **Figure E**, 4<sup>th</sup> file; **Figure F**, 5<sup>th</sup> file; **Figure G**, 6<sup>th</sup> file; **Figure H**, 7<sup>th</sup> file; **Figure I**, 8<sup>th</sup> file; **Figure J**, 9<sup>th</sup> file; **Figure K**, 10<sup>th</sup> file. All in occlusal view.



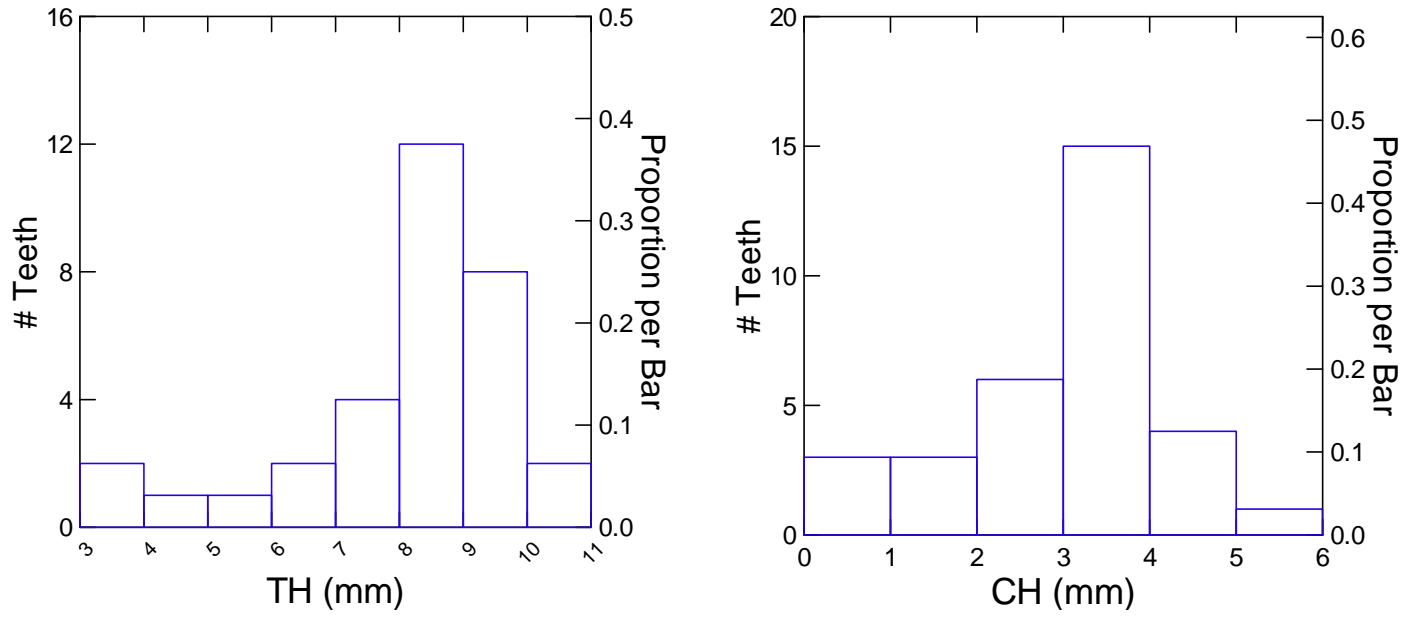
**Figure 46.** Tooth Height-Crown Height values for *P. mortoni* (SMU 76278).

## PLATE 15D

*Ptychodus mortoni* SMU 76359

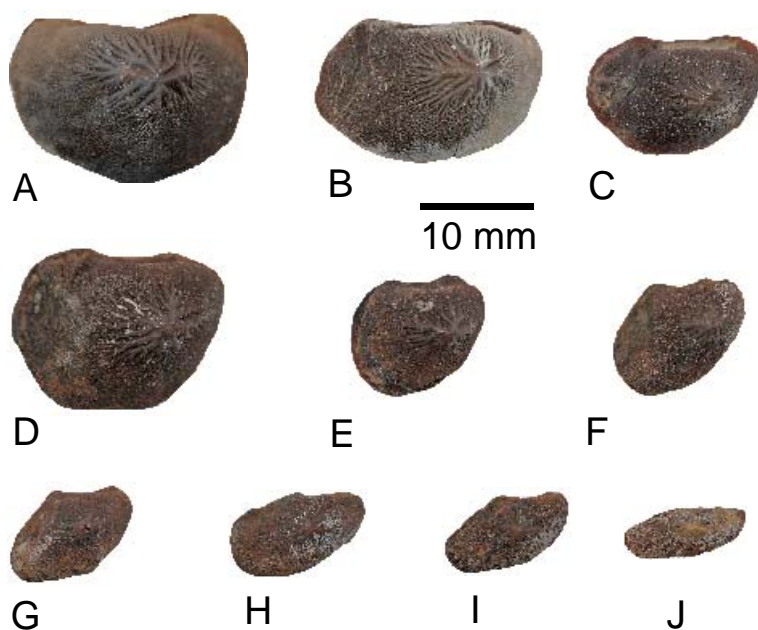
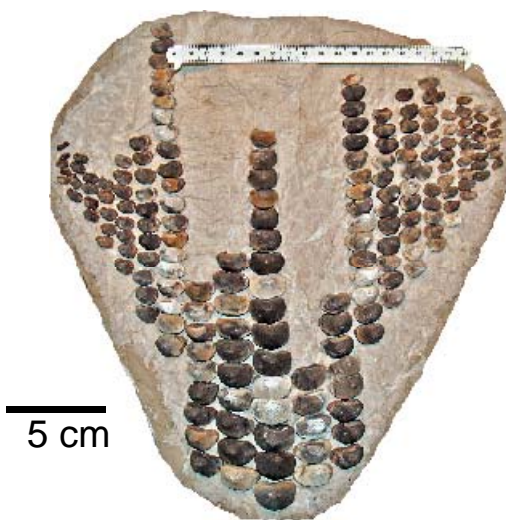
Lower right tooth series. **Figure A**, medial; **Figure B**, para-medial; **Figure C**, 2<sup>nd</sup> file; **Figure D**, 3<sup>rd</sup> file; **Figure E**, 4<sup>th</sup> file; **Figure F**, 5<sup>th</sup> file; **Figure G**, 6<sup>th</sup> file; **Figure H**, 7<sup>th</sup> file. All in occlusal view.



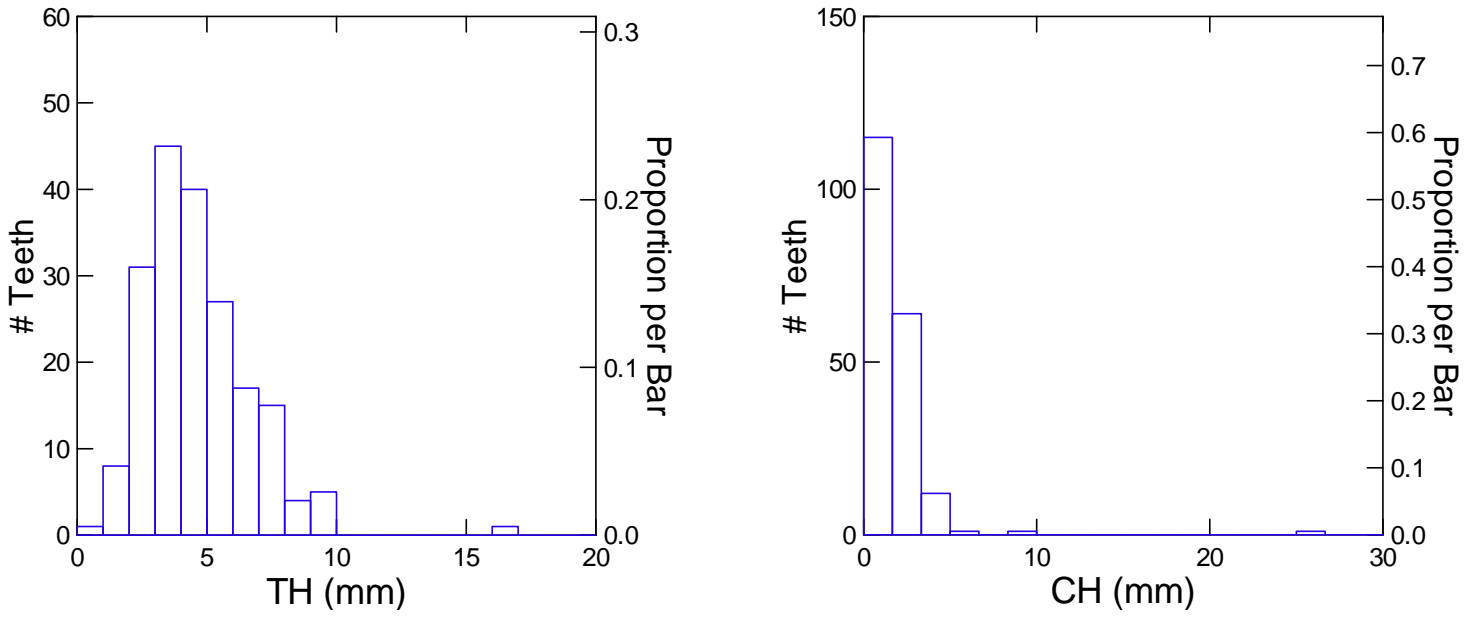


**Figure 47.** Tooth Height-Crown Height values for *P. mortoni* (SMU 76359).

## PLATE 15E

*Ptychodus mortoni* FHSM VP 15532

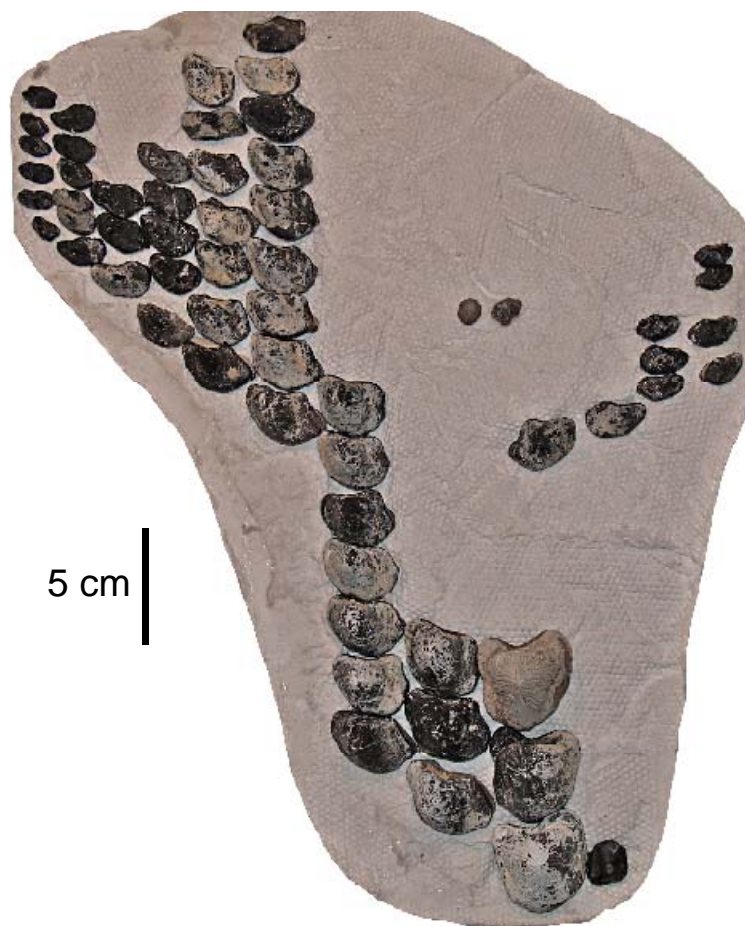
**FHSM VP 15532** upper right tooth series. **Figure A**, medial; **Figure B**, para-medial; **Figure C**, 2<sup>nd</sup> file; **Figure D**, 3<sup>rd</sup> file; **Figure E**, 4<sup>th</sup> file; **Figure F**, 5<sup>th</sup> file; **Figure G**, 6<sup>th</sup> file; **Figure H**, 7<sup>th</sup> file; **Figure I**, 8<sup>th</sup> file; **Figure J**, 9<sup>th</sup> file. All in occlusal view.



**Figure 48.** Tooth Height-Crown Height values for *P. mortoni* (FHSM VP 15532).

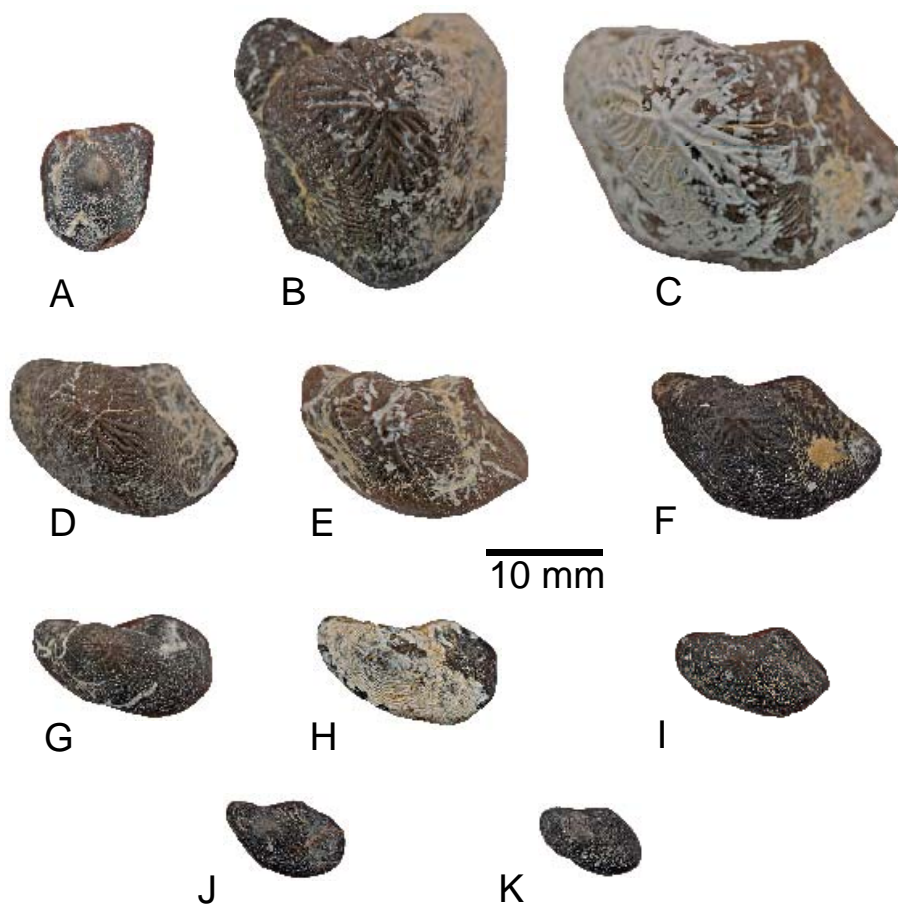
**PLATE 15F**

*Ptychodus mortoni* FHSM VP 16684

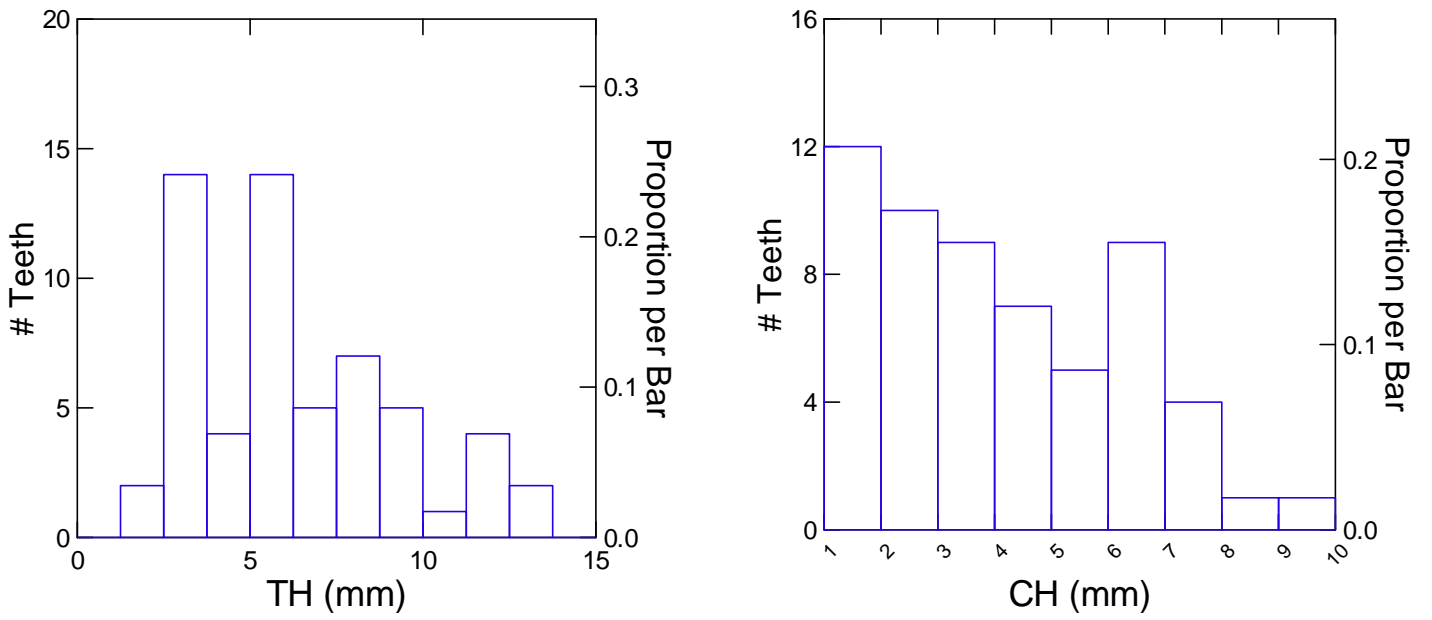


Associated upper left dentition from the medial through 9<sup>th</sup> file.

## PLATE 15G

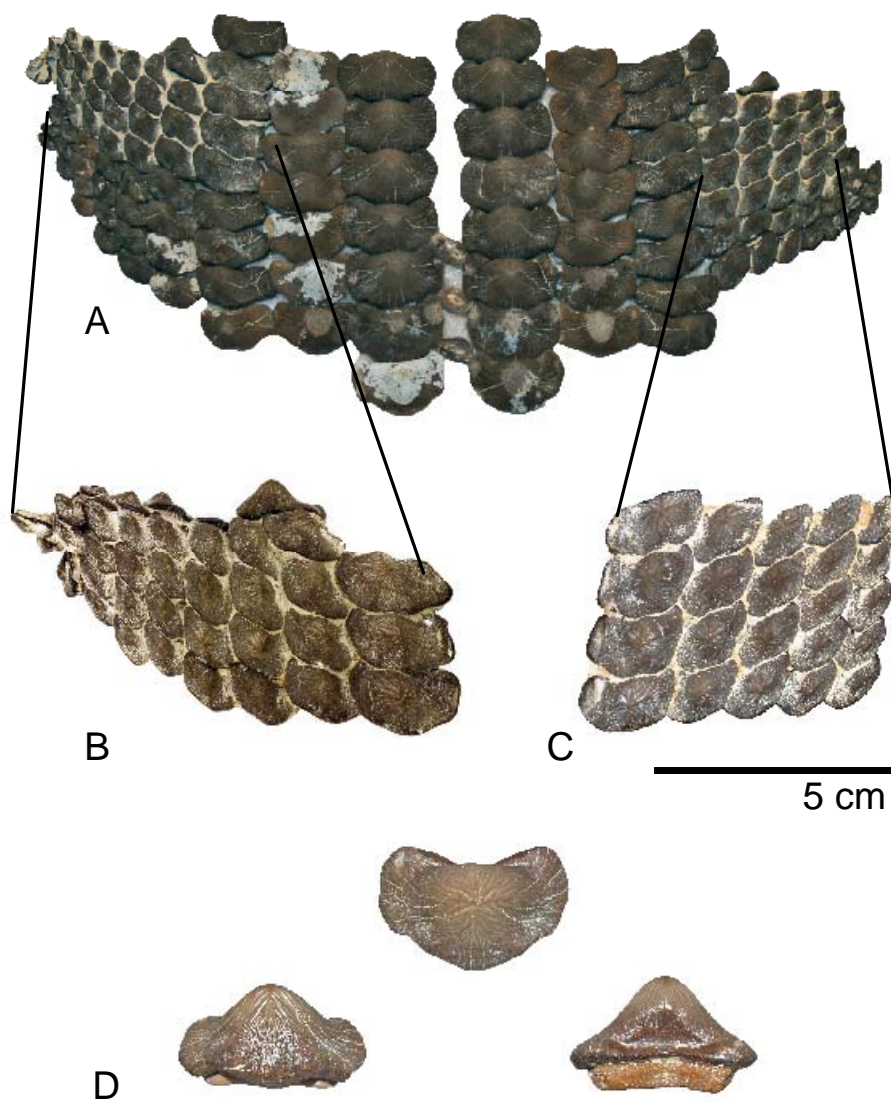
*Ptychodus mortoni* FHSM VP 16684

**FHSM VP 16684**, upper left dental series. **Figure A**, medial; **Figure B**, para-medial; **Figure C**, 2<sup>nd</sup> file; **Figure D**, 3<sup>rd</sup> file; **Figure E**, 4<sup>th</sup> file; **Figure F**, 5<sup>th</sup> file; **Figure G**, 6<sup>th</sup> file; **Figure H**, 7<sup>th</sup> file; **Figure I**, 8<sup>th</sup> file; **Figure J**, 9<sup>th</sup> file; **Figure K**, 10<sup>th</sup> file. All in occlusal view.

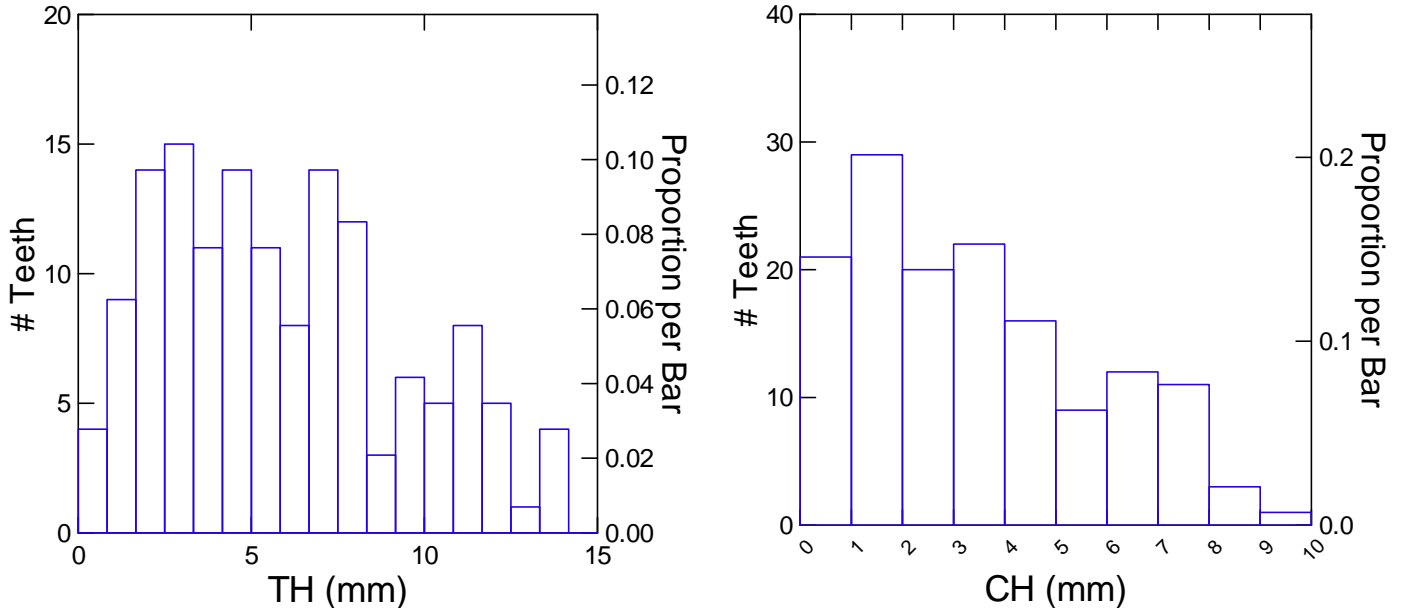


**Figure 49.** Tooth Height-Crown Height values for *P. mortoni* (FHSM VP 16684).

## PLATE 15H

*Ptychodus mortoni* FHSM VP 2238

**Figure A**, upper dentition. **Fig. B**, right articulated series, files 4-10. **Fig. C**, left articulated series, files 3-10. **Fig. D**, upper right para-medial in occlusal, anterior and posterior views.

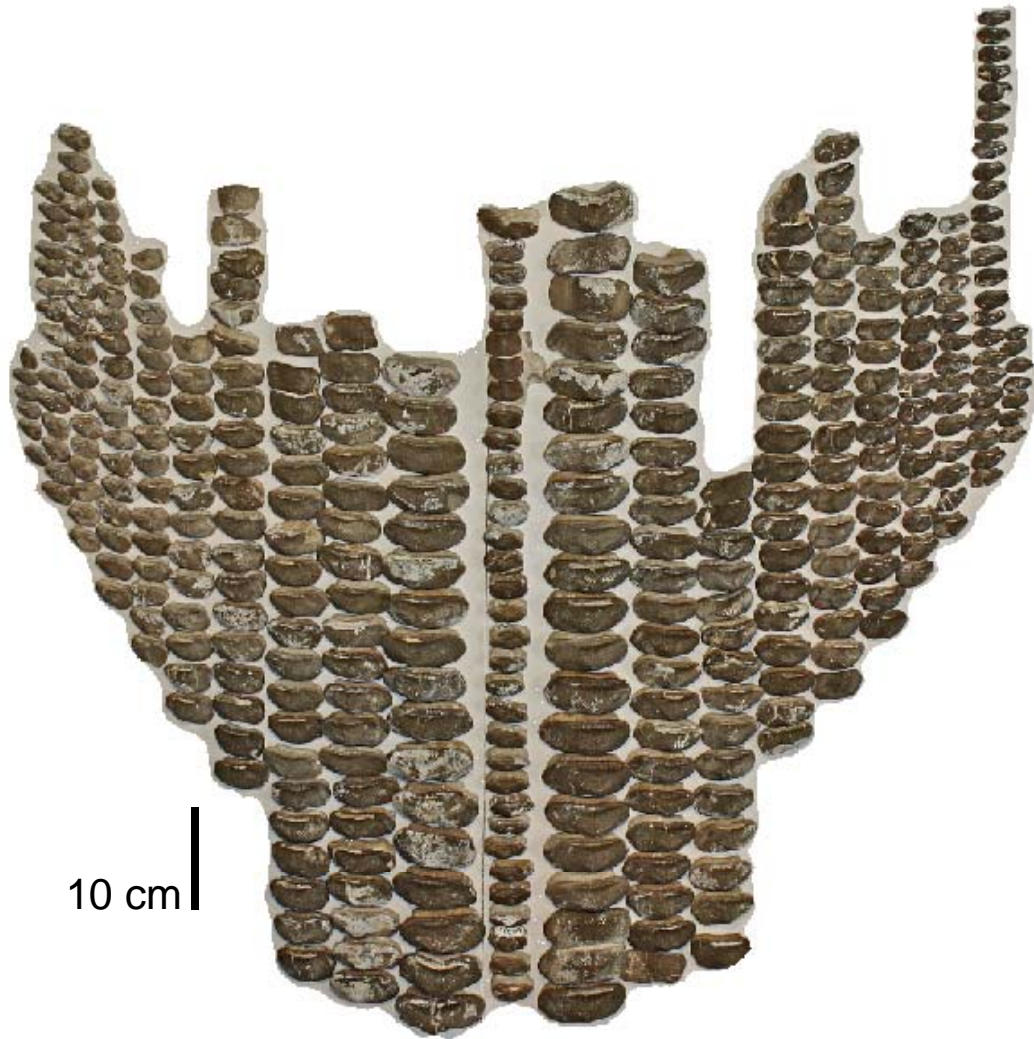


**Figure 50.** Tooth Height-Crown Height values for *P. mortoni* (FHSM VP 2238).



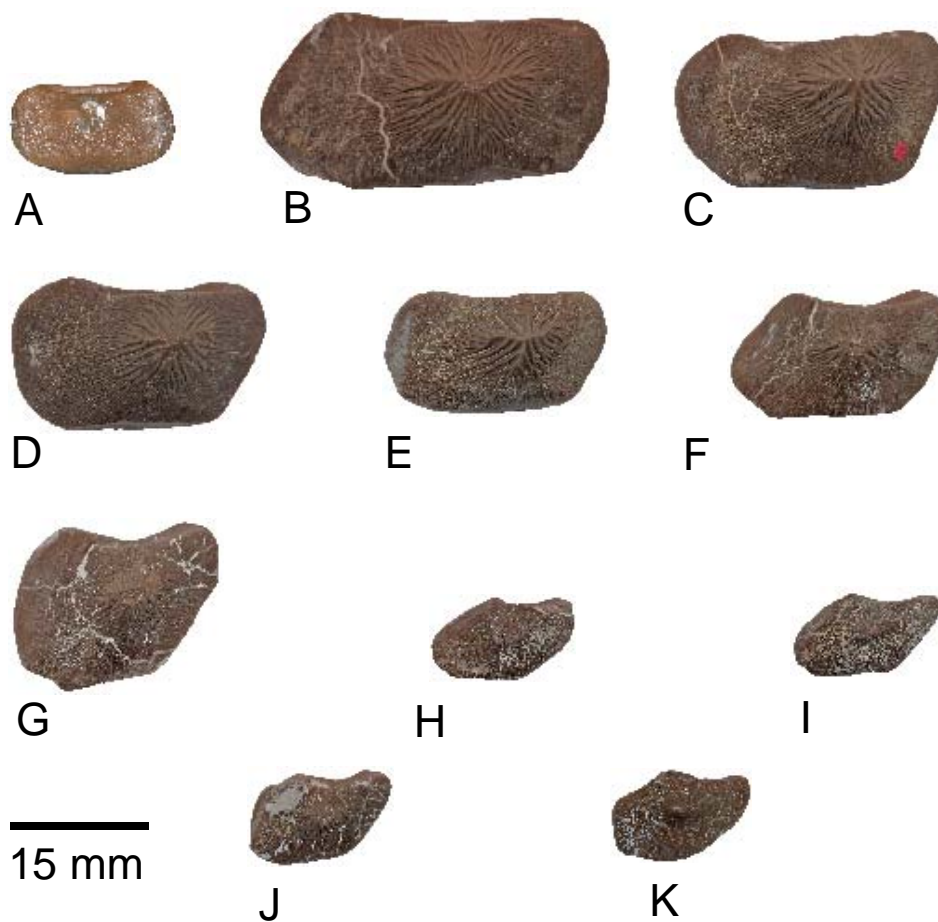
**PLATE 15I**

*Ptychodus mortoni* FHSM VP 335

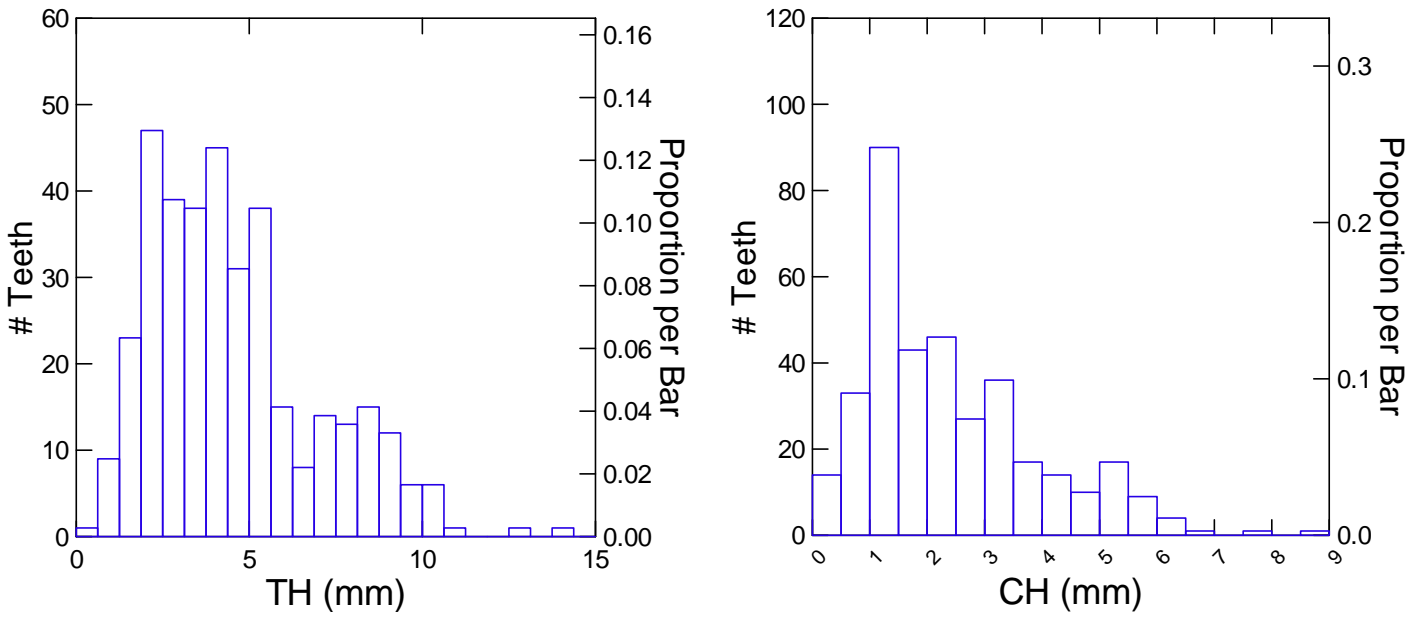


Upper dentition from the Smoky Hill Chalk Member of the Niobrara Formation.

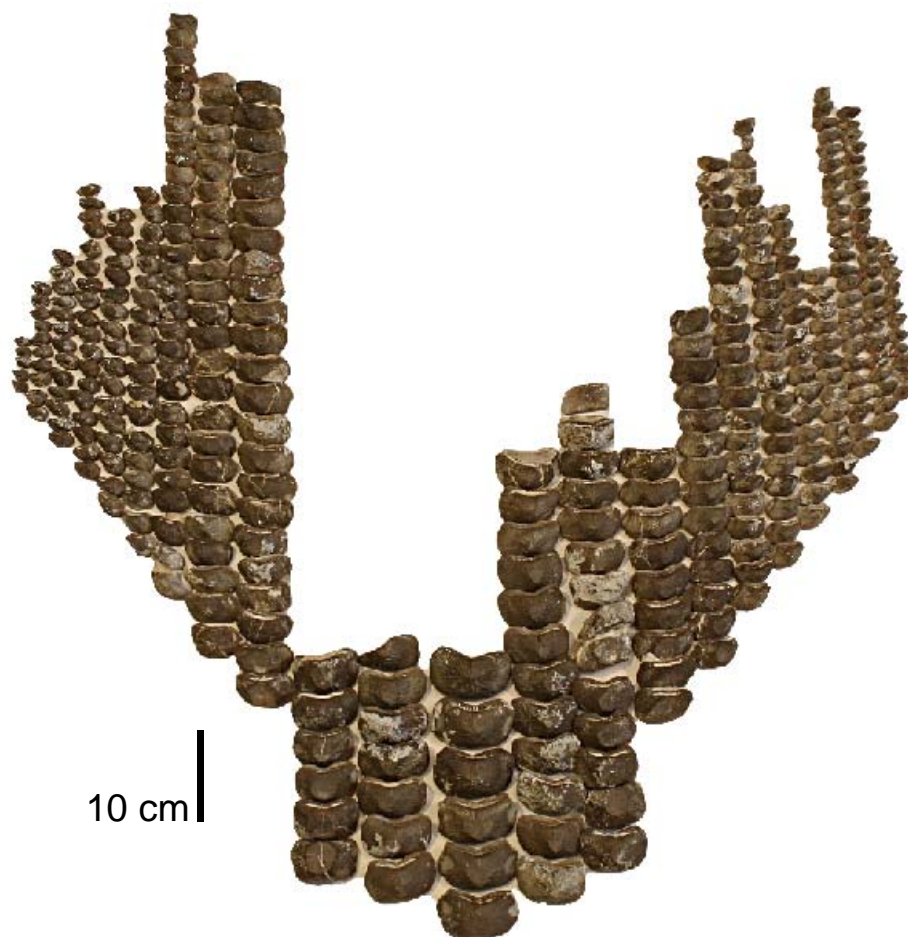
## PLATE 15J

*Ptychodus mortoni* FHSM VP 335

**FHSM VP 335**, upper right dental series. **Figure A**, medial; **Figure B**, para-medial; **Figure C**, 2<sup>nd</sup> file; **Figure D**, 3<sup>rd</sup> file; **Figure E**, 4<sup>th</sup> file; **Figure F**, 5<sup>th</sup> file; **Figure G**, 6<sup>th</sup> file; **Figure H**, 7<sup>th</sup> file; **Figure I**, 8<sup>th</sup> file; **Figure J**, 9<sup>th</sup> file; **Figure K**, 10<sup>th</sup> file. All in occlusal view.

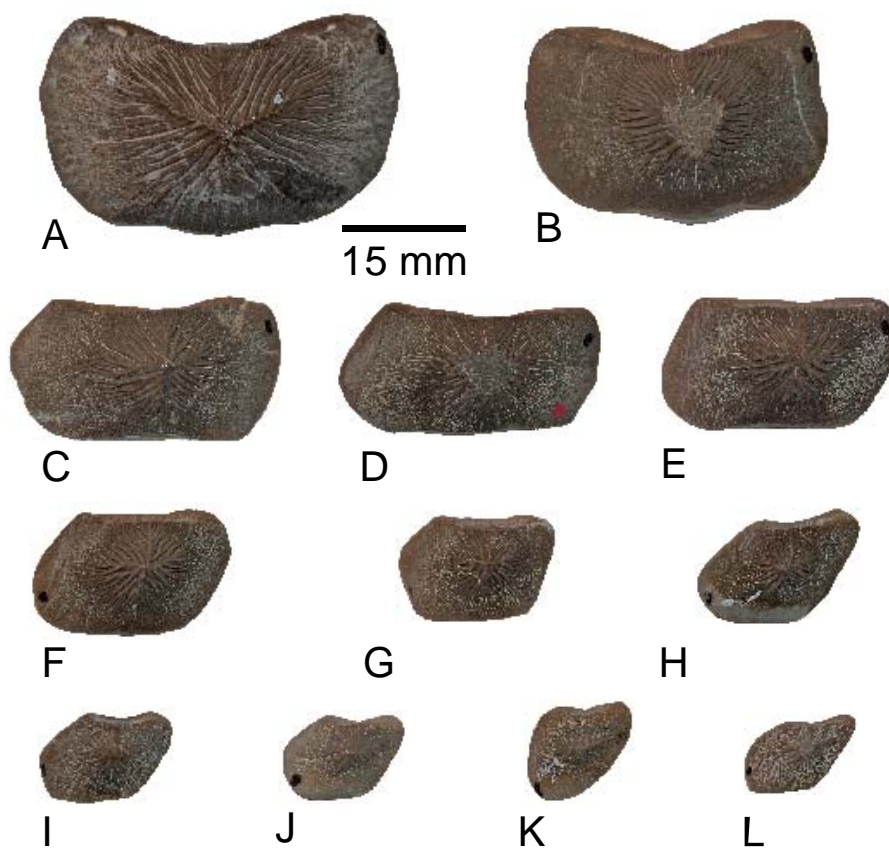


**Figure 51.** Tooth Height-Crown Height values for *P. mortoni* (FHSM VP 335).

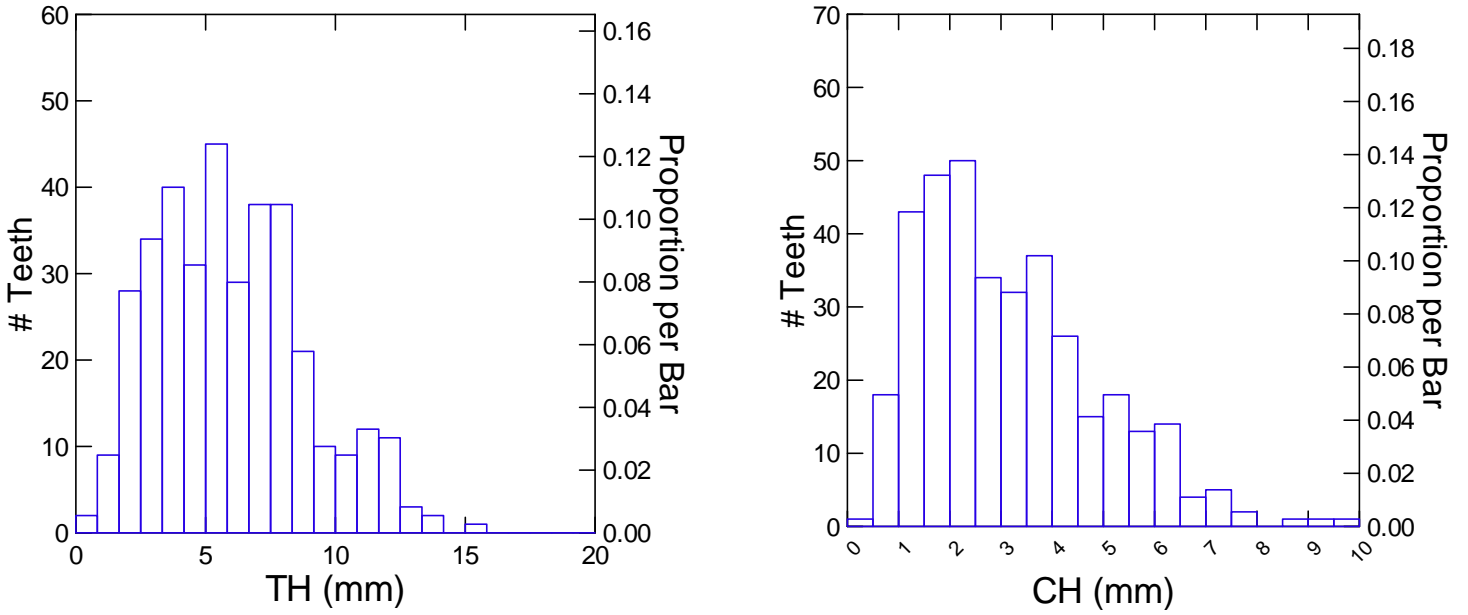
**PLATE 15K***Ptychodus mortoni* FHSM VP 335

Lower dentition from the Smoky Hill Chalk Member of the Niobrara Formation.

## PLATE 15L

*Ptychodus mortoni* FHSM VP 335

**FHSM VP- 335**, lower right dental series. **Figure A**, medial; **Figure B**, para-medial; **Figure C**, 2<sup>nd</sup> file; **Figure D**, 3<sup>rd</sup> file; **Figure E**, 4<sup>th</sup> file; **Figure F**, 5<sup>th</sup> file; **Figure G**, 6<sup>th</sup> file; **Figure H**, 7<sup>th</sup> file; **Figure I**, 8<sup>th</sup> file; **Figure J**, 9<sup>th</sup> file; **Figure K**, 10<sup>th</sup> file.

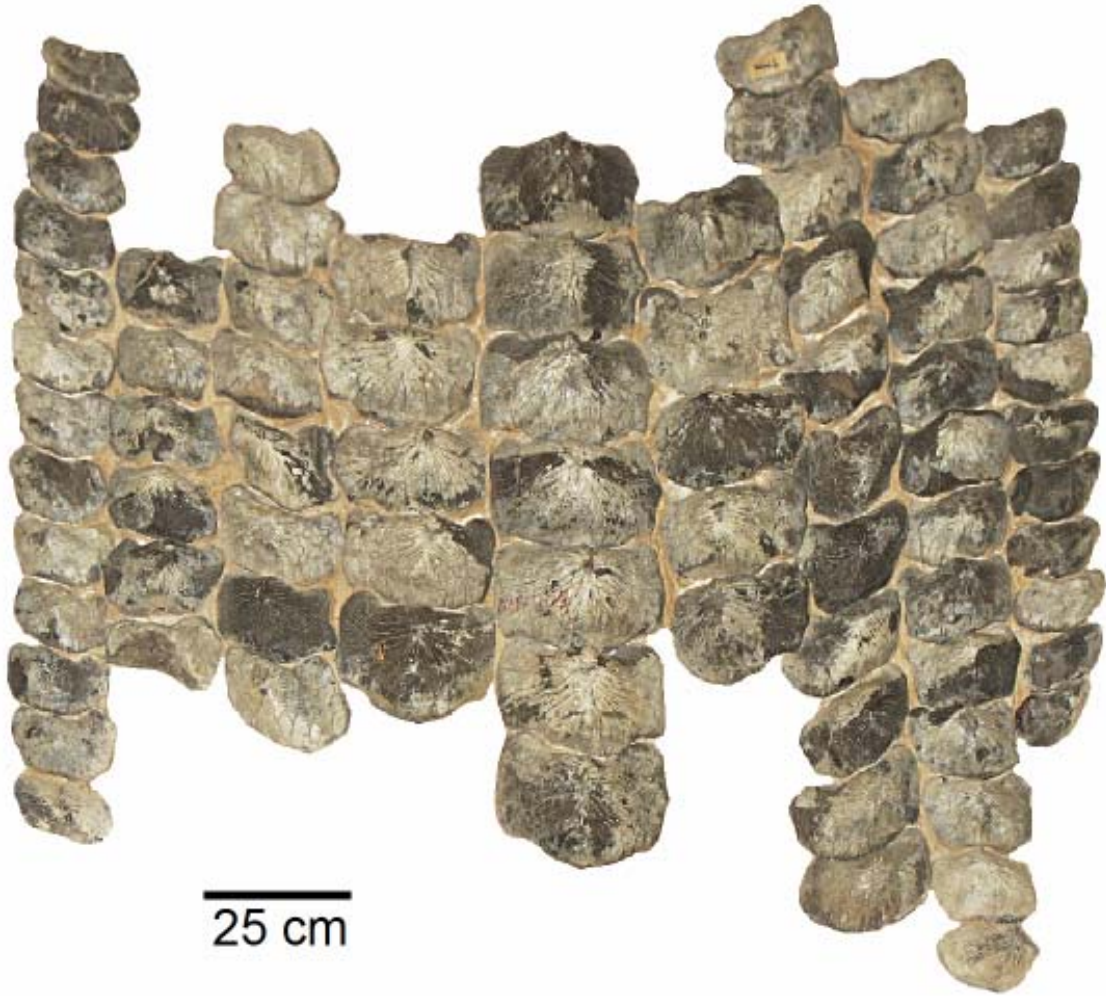


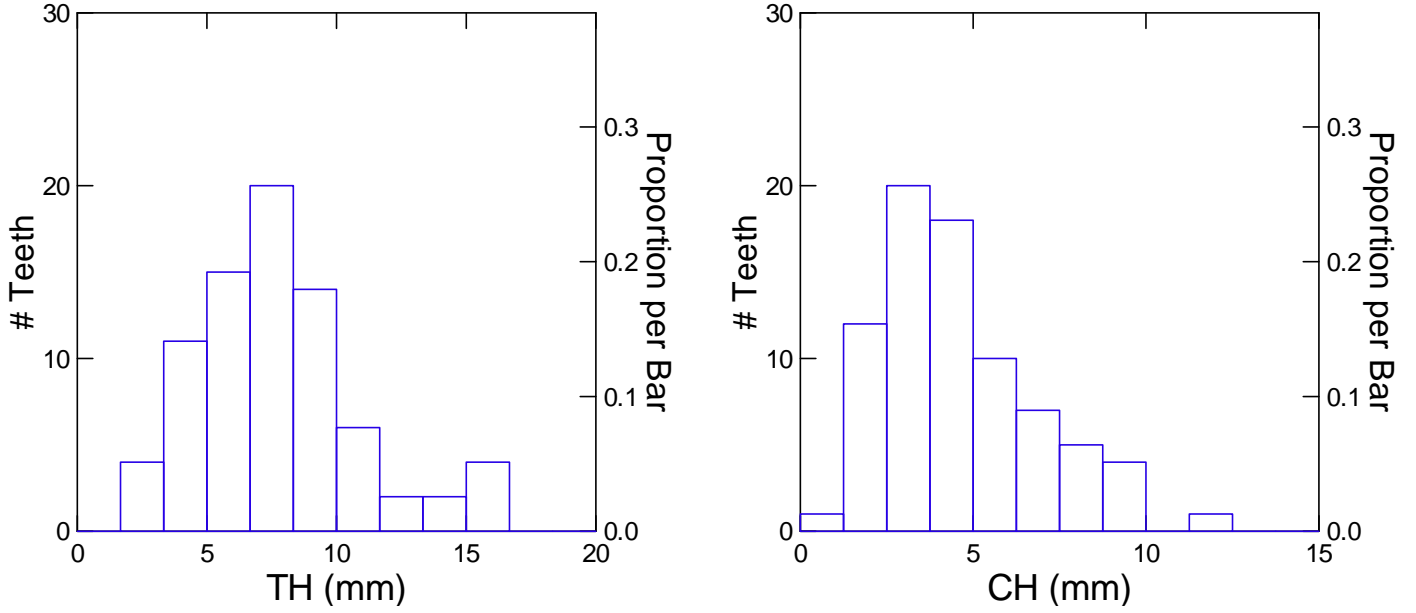
**Figure 52.** Tooth Height-Crown Height values for *P. mortoni* (FHSM VP 335).



**PLATE 15M**

*Ptychodus mortoni* KUVV 55269





**Figure 53.** Tooth Height-Crown Height values for *P. mortoni* (KUVP 55269).



## **CHAPTER 5**

### **SKELETAL ANATOMY**

Associated skeletal and dental elements are known in various cladodont-level and hybodont-level elasmobranchs (Maisey, 1882, 1983, 1987; Schaeffer, 1981; Young, 1982; Zangerl, 1981) and some modern-level Cretaceous forms (Shimada, 1994; Shimada and Cicumurri, 2005). The skeletal anatomy and body form of *Hylaeobatis*, *Heteroptychodus* and *Ptychodus* have been purely speculative because of the lack of post-cranial remains, and taxonomic assignment of these species has been based solely on dental characteristics.

Several skeletal elements of *Ptychodus* have been described, including vertebrae (Woodward, 1889a; Canavari, 1916; Stewart, 1980; MacLeod, 1980; Everhart and Caggiano, 2004), jaw elements (Woodward, 1889a; Shimada, 2007), and scales (MacLeod, 1980; Everhart and Caggiano, 2004; Shimada, 2007). A well preserved specimen of *P. mortoni* (KUVP- 59041) contains cranial and postcranial remains, including vertebrae, denticles, a pectoral fin and a dorsal fin. This specimen provides data on the skeletal anatomy of *Ptychodus* and offers better clues to the ordinal placement of the genus, and allows us to speculate on its paleobiology and paleoecological relationships.

#### **CHONDOCRANIUM**

##### **Neurocranium**

A large portion of the neurocranium and many of the detailed structures (like foramina) are not visible in KUVP- 59061 because it is dorso-ventrally flattened and mostly obscured by matrix, teeth, and denticles. However, the basal plate is exposed and it is box-like, antero-posteriorly elongated and measures 67 cm in length and 15 cm in width. There is no evidence of preservation of the occipital condyles or postotic fenestra located at the rear of the neurocranium. Unfortunately, the plaster jacket housing the specimen is too large to perform a CT scan (that could provide additional information regarding these or other cranial features).

### **Ethmoid region**

The ethmoid region includes the rostrum and nasal capsules (Schaffer, 1981). The rostrum overhangs the mouth and gives the shark an identifiable cranial portrait. A large section of the anterior portion of the chondocranium was either not preserved or was removed during excavation or preparation, as there are large sections of matrix and possible cartilaginous elements missing. However, there is a single piece of cartilage measuring 64 mm in width and 70 mm in length located anterior to the dentition. This piece is separated in the middle where the rostral keel would be located. It is wide and curved at the posterior end, tapering anteriorly where it terminates abruptly. The anterior-most section is missing, either due to taphonomy or preparation. Its occurrence at the anterior end of the chondocranium, along with its elongate and tapering appearance, suggests that it may be a section of the ethmoid or rostral cartilage. If true, *Ptychodus* may have had a subterminal mouth.

### **SPLANCHNOCRANIUM**

The splanchnocranium, or visceral skeleton, of extant sharks includes the visceral arches and five pairs of branchial arches. The branchial arches are composed of the pharyngobranchial, epibranchial, ceratobranchial or hypobranchial cartilages that support the gills. Most modern shark taxa have five pairs of gill slits in front of the pectoral bases, except for the hexanchids which have up to seven (Compagno, 1984). The number of branchial arches is unknown as they are not visible because their expected location is covered by the pectoral fin, matrix, and much of the lower dentition.

### **Mandibular Arch**

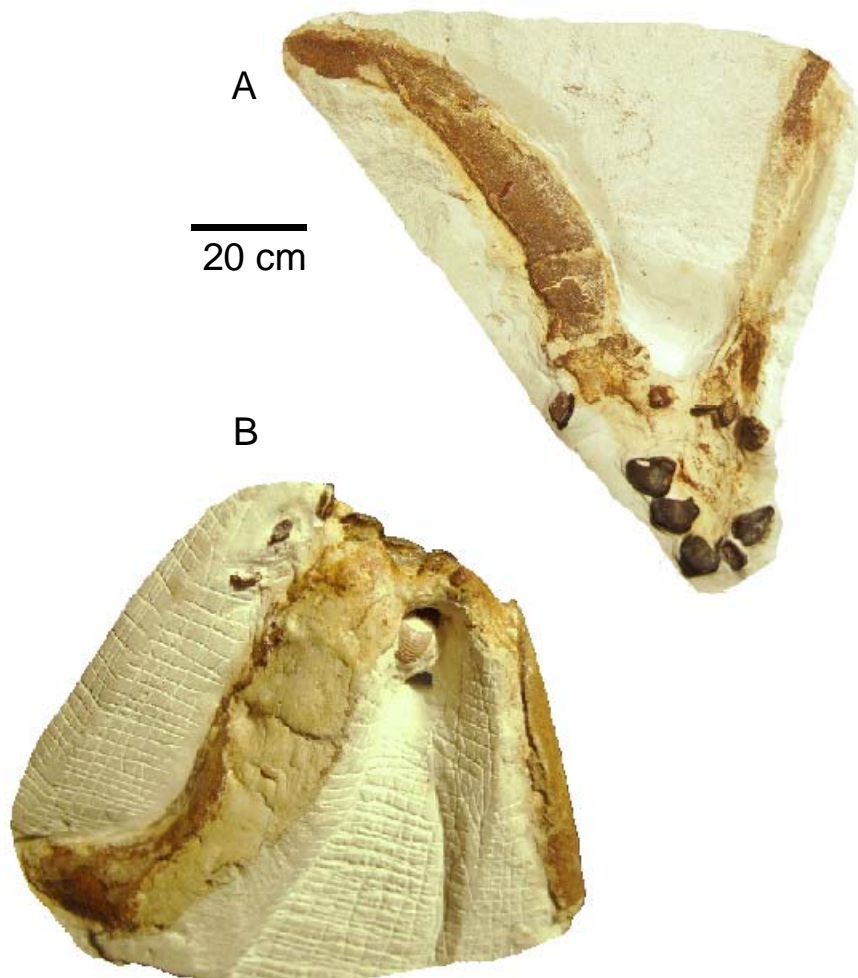
The mandibular arch of extant sharks is composed of the palatoquadrates (the upper jaws) and the Meckel's or mandibular cartilage (the lower jaws). Most taxa possess at least a pair of, but no more than three labial cartilages per side (Maisey, 1983). The labial cartilages project from the Meckel's cartilage and underlie the palatoquadrates and assist in feeding.

A single anterior end of Meckel's cartilage is exposed in KUV- 59061 (**Fig. 57 B**). It is loose and not attached to any of the surrounding cartilage elements, nor is any teeth attached. This item is rod-like, long, narrow (35 mm wide) and broken into three sections. All of the sections combined have a total length of 22.8 cm.

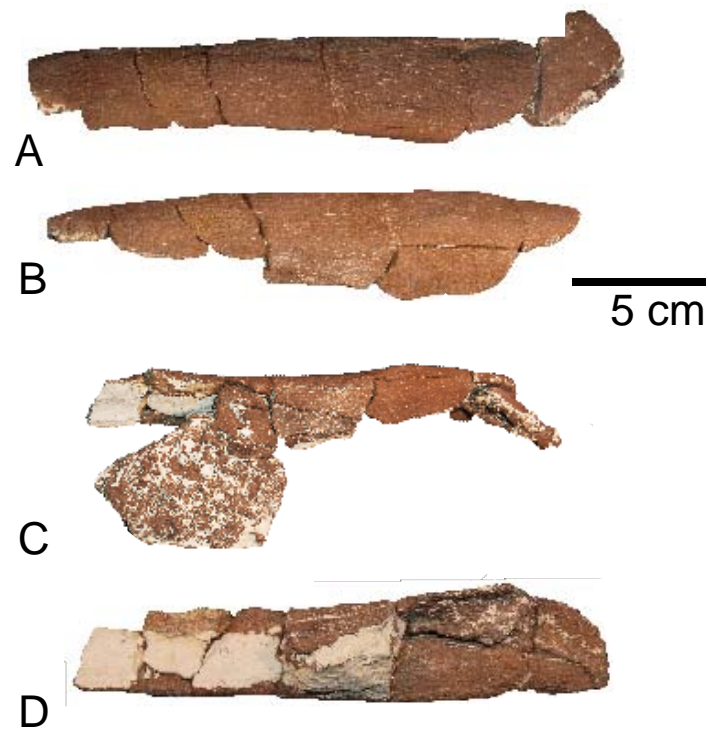
A specimen of *P. decurrens* from English Chalk Formation, BMM-8524 (**Fig. 54**) provides more information on the Meckel's cartilage. It consists of the left and right Meckel's cartilages and both palatoquadrates. The Meckel's cartilages and palatoquadrates are narrow, rod shaped and slender, with a flat dorsal edge and a gently rounded ventral edge. At anterior end of the jaw, the left and right Meckel's cartilage meet at an acute angle and appear to be fused at the symphysis (as observed by Woodward [1904]). A specimen of *P. marginalis* from the Greenhorn Formation in Kansas (KUVP 13525) preserves the anterior-most 65 mm of the palatoquadrates, which are fused together, with two medial and three large para-medial file teeth attached to it in their natural order (**Plate 11 B, fig. G**). In contrast, BMM -8524 has five tooth files preserved in their natural state, within the dental lamina at the anterior end of the cartilage. The lower dentition in KUVP- 59061 is estimated to be almost 56 cm in length and is very close in size to the dentition length of the largest *P. mortoni* specimen observed during this study FHSM-VP 335 at 58 cm in length. Based on tooth size and dental length, these two specimens are interpreted as being fully mature adult individuals.

The palatoquadrates in KUVP- 59061 are not preserved. All of the teeth from the upper files are detached and spread all over the remainder of the skeleton. A specimen of *P. mortoni* (FHSM VP-16684) from the Niobrara Chalk does preserve the upper right palatoquadrate (**Fig. 55**). It is also rod shaped, measuring 16 cm in length, and is morphologically identical to the Meckel's cartilage of KUVP- 59061 and BMM-8524. The dorso-ventral height of the cartilage is 30mm at both the anterior and posterior ends, but is 5 mm wider in the middle. The quadrate process is located at the posterior end and attached to the posterior end of the Meckel's cartilage in the lower jaw. Although fifty one teeth are associated with this specimen none are directly attached to it.

No labial cartilages are preserved in BMM- 8524 or FHSM VP-16684. They may be present within KUVP 59061 but are not visible and may still be covered in matrix.



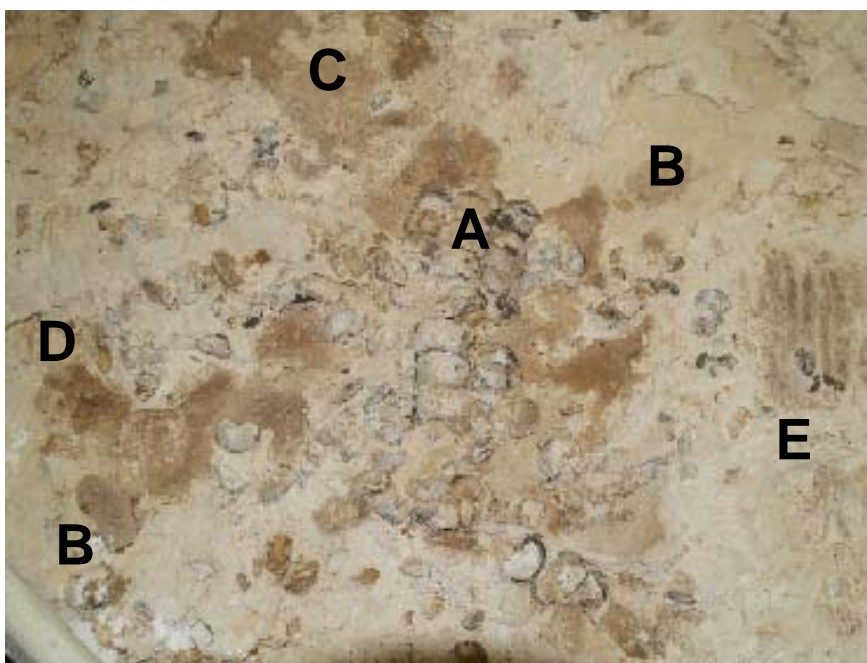
**Figure 54.** Mandibular Arch of BMM 8524. **A**, Palatoquadrates, apical view **B**, Meckel's cartilages, basal view.



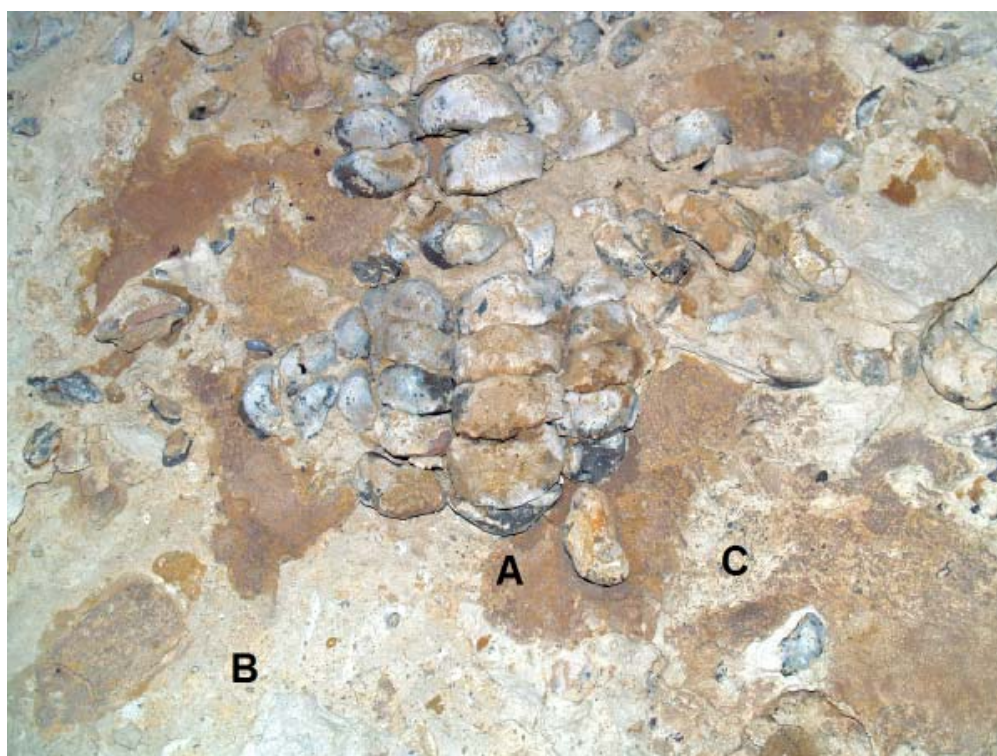
**Figure 55.** Palatoquadrate of FHSM VP- 16684. Upper right palatoquadrate in lateral (**A, D**) apical (**B**) and lingual views (**D**).

### Hyoid Arch

The hyomandibula extends from the otic area of the chondocranium and articulates with the ceratohyals. The ceratohyals abut the posterior ends of the palatoquadrates and Meckel's cartilage and extend ventrally where they articulate with the basihyal. The jaws are not connected directly to the chondocranium, rather they are held in place by small ligaments attaching to the palatoquadrates. The hyomandibular cartilage creates a loose jaw association and this condition is known as a hyostylic jaw suspension (Maisey, 1984).



**Figure 56.** Rostral View of the Chondocranium of KUVP 59061. **A**, lower dentition; **B**, left Meckel's cartilage; **C**, right ceratohyal; **D**, first five dorsal vertebrae; **Fig. E**, pectoral fin.



**Figure 57.** Close-up View of Anterior End of Chondocranium of KUVP 59061. **A**, lower dentition; **B**, right Meckel's cartilage; **C**, left ceratohyal.

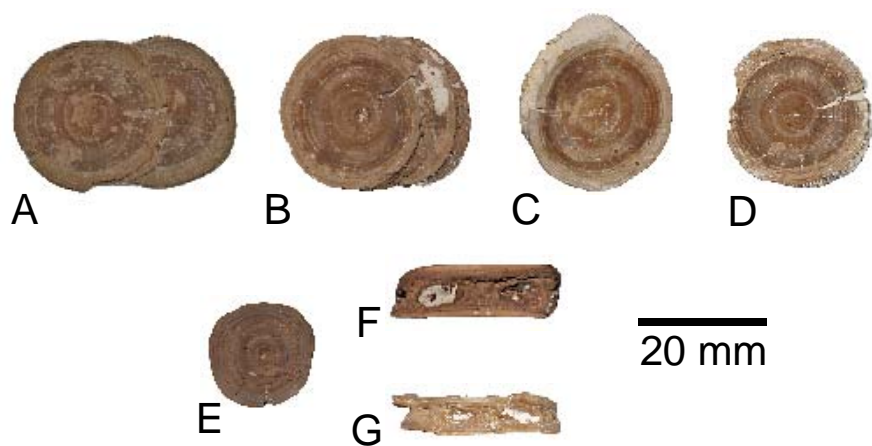
In KUVVP- 59061 the left hyomandibula is attached to the rear of the neurocrania at a 90 degree angle. It is only partially preserved, measuring 7 cm in length and 4.5 cm in width. The posterior section is broken off and the articulation with the ceratohyal cannot be confirmed. The left hyomandibula is not exposed; however, the left ceratohyal is. It is long, tabular and measures 48 cm in length and averages 25 cm in width. It is fused with the basihyal which is also a tabular structure and is 30.5 cm in length. The width cannot accurately be determined because the lateral portion is disintegrated and anterior portion is covered by matrix.

### **Vertebral Column**

Five specimens from the Western Interior have vertebrae associated with dental remains: AMNH- 19553 (5); SMU- 69007-69014 (7); KUVVP- 59061 (18); (FHSM VP- 16684 (44); and SMU- 76359 (1). Unfortunately, the spinal columns are incomplete and the total number of vertebrae for each species is unknown. Many of the vertebrae in each of these specimens suffer from taphonomic distortion; but some observations can be made. All of the centra in each specimen are circular and not dorso-ventrally compressed. They are well calcified and similar to lamniform vertebrae (sensu Applegate, 1967) because they have numerous concentric lamellae radiating around a primary double-cone, paired pits for the neural and haemal arches and articular surfaces that are shallowly concave and nearly flat (**Figs. 58, 59, 60**). There is no evidence of a synarcual (Stewart, 1988), a tubular shaped structure formed by the fusion of the first vertebrae. Instead, the vertebrae are attached directly to the rear of the neurocranium.

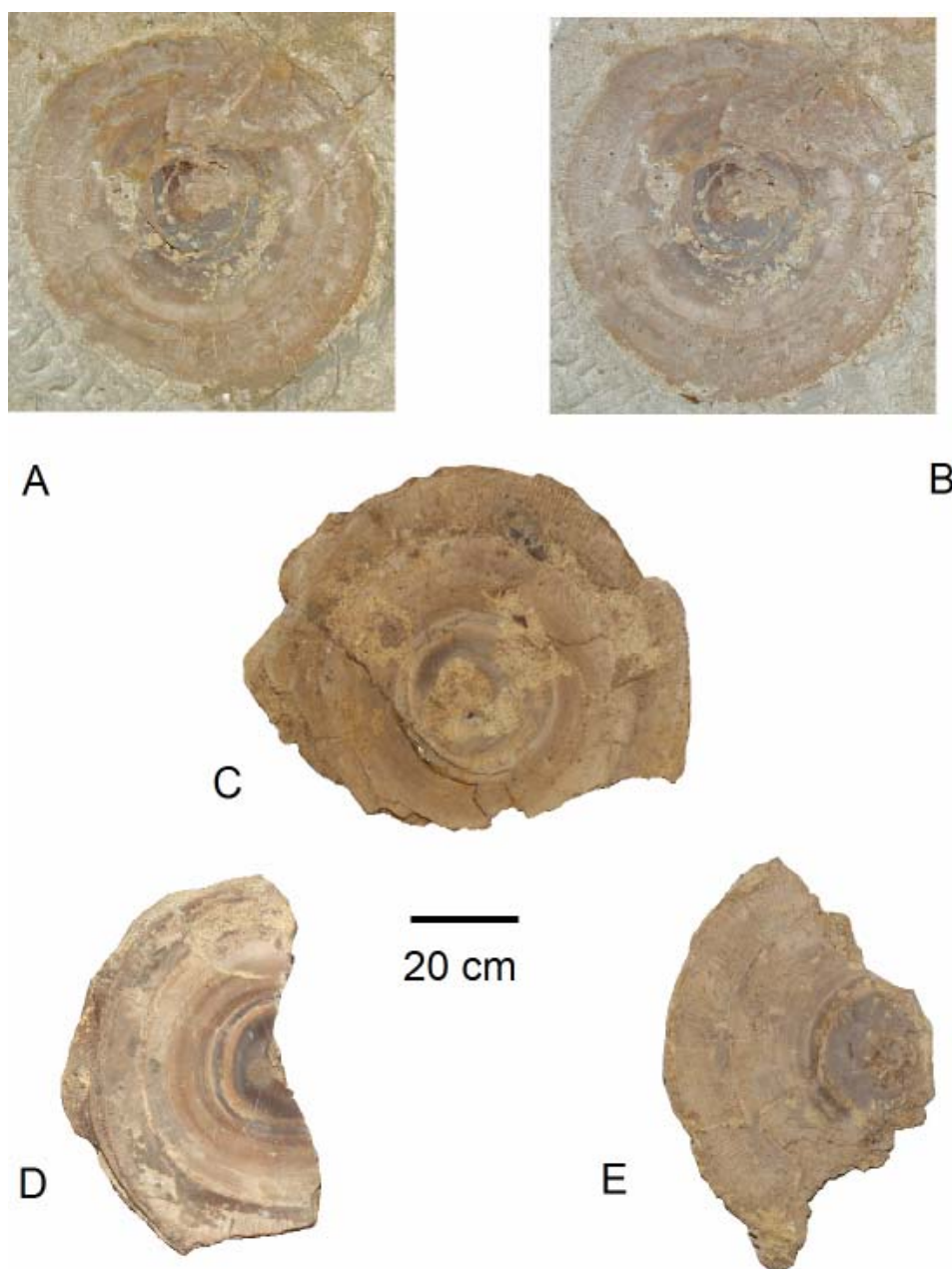
This vertebral morphology and neurocranial attachment is similar to the Cretaceous lamniform sharks *Cretoxyrhina* and *Squalicorax*. The presence of circular vertebrae associated with these taxa is suggestive of a spindle shaped body (Shimada, 1994; Shimada and Cicimurri, 2005). Modern pelagic sharks with fusiform bodies like *Carcharodon*, *Isurus* and *Carcharhinus* have circular centra, whereas true benthic sharks, like *Squatina* and *Myliobatis*, have dorso-ventrally flattened centra (Applegate, 1967; Compagno, 1977). The presence of circular centra in *P. mortoni* and *P. rugosus* indicates that these two species had an elongate, cylindrical fusiform body.



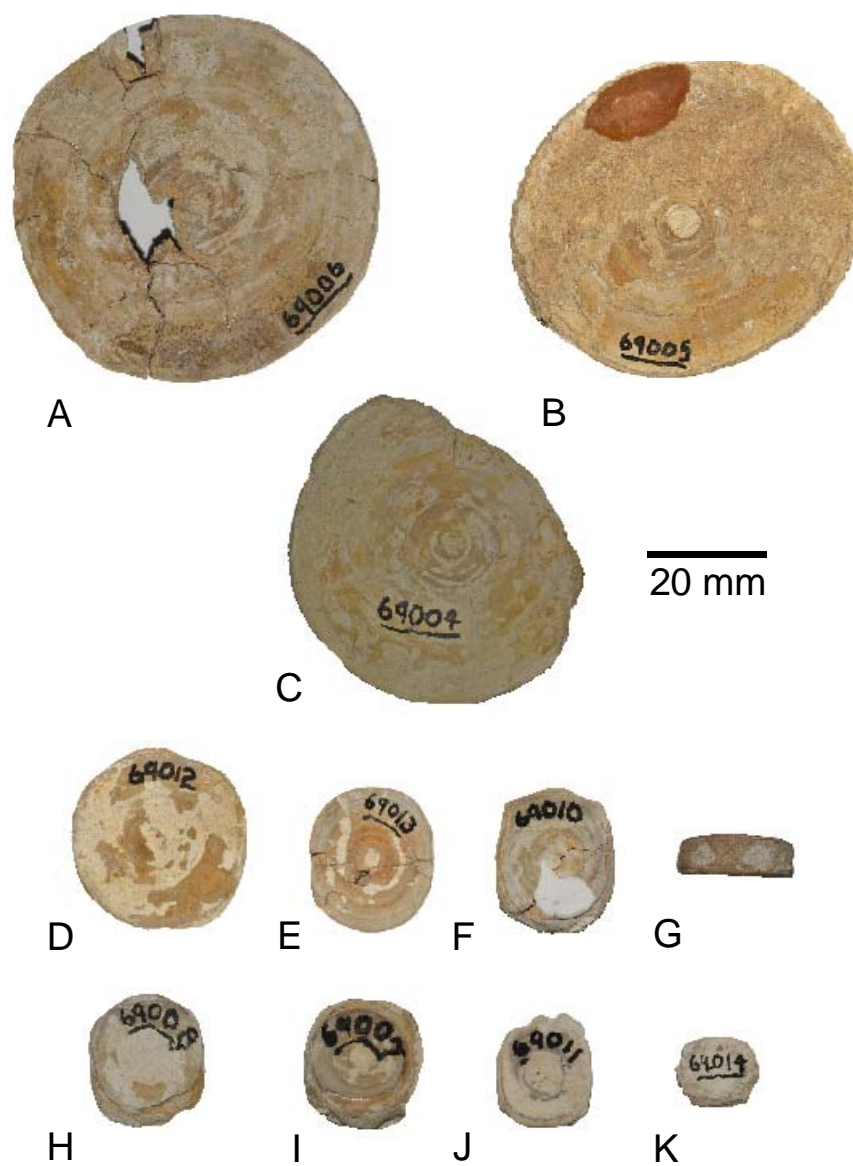


**Figure 58.** Vertebrae Associated with *P. mortoni* FHSM VP- 16684. **A-D**, trunk vertebrae; **E-G**, caudal vertebra showing neural arch (**F**) and haemal arch (**G**) insertions.





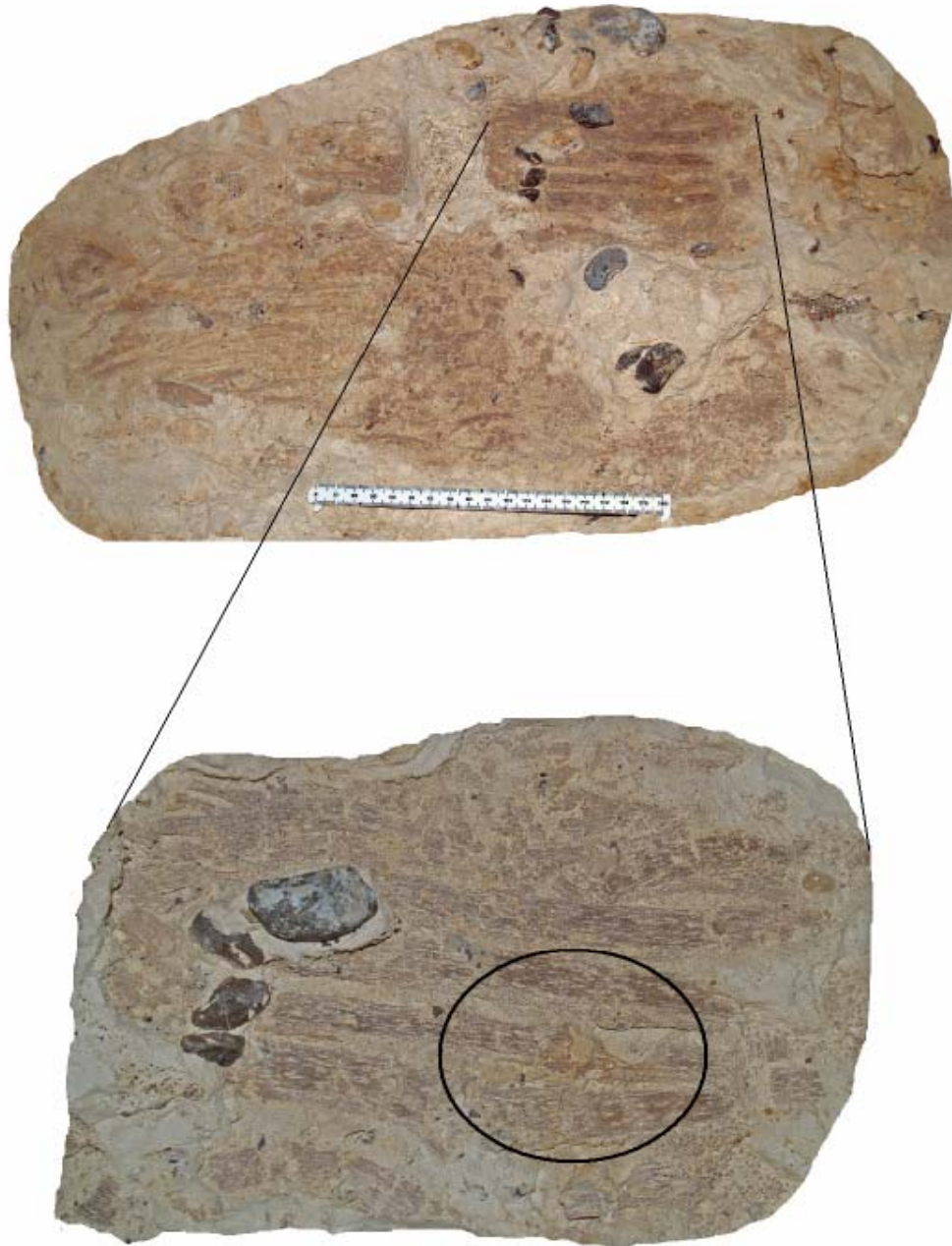
**Figure 59.** Trunk vertebrae associated with *P. mortoni* KUVF 59061.



**Figure 60.** Vertebrae Associated with *P. rugosus* SMU 69001-69002. **A-K**, trunk vertebrae; **D-K**, caudal vertebrae; **F, G**, caudal vertebrae showing neural arch insertions.

## **FINS**

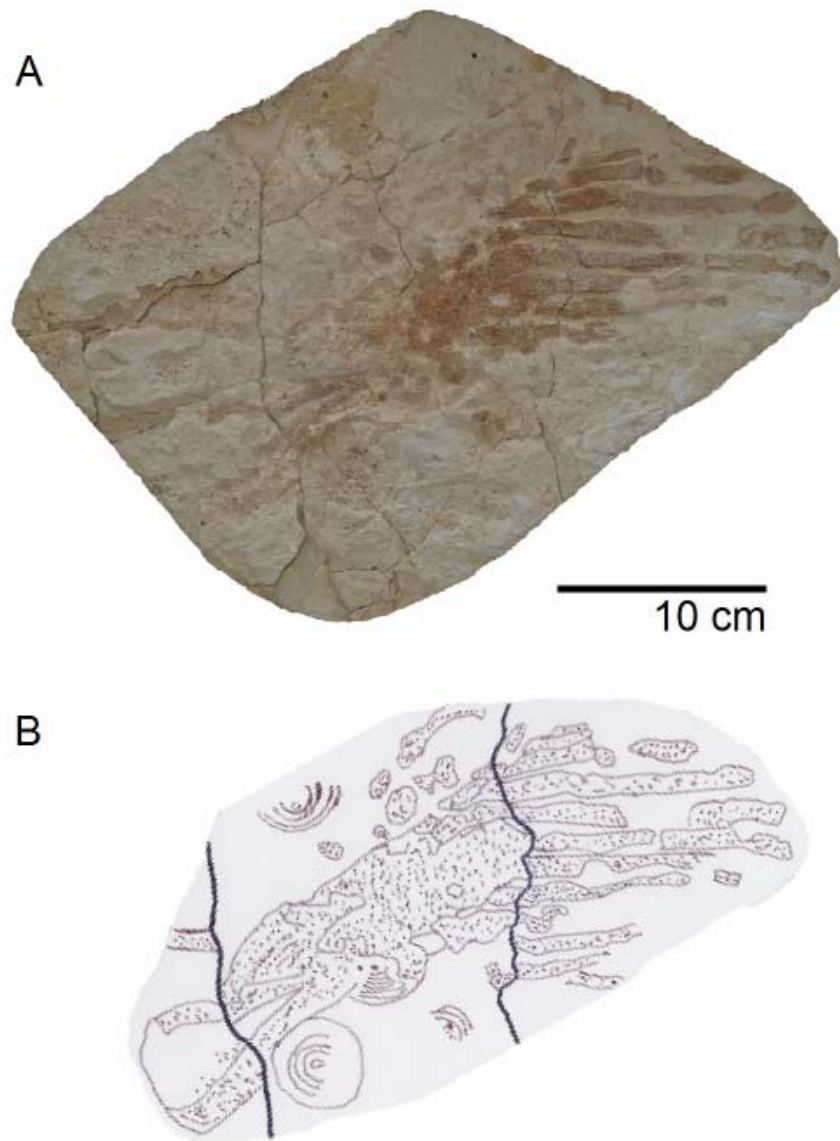
**Pectoral fins-** KUVVP- 59061 contains eight clearly delineated and parallel tabular plates of calcified cartilage prisms. The entire structure is 38 cm in length and 25 cm wide, with each radial averaging 13mm in width (**Fig. 61**). One conspicuous feature is present on one of the radials; there is a round section of cartilage measuring 11mm x 11mm in the middle of the radial and this may represent evidence of a previous injury or attack. The elongated nature and close spacing of the cartilages is suggestive of a plesodic pectoral fin like those seen in the contemporaneous taxa *Cretoxyrhina* and *Squalicorax*. The basal pterygiophores are not exposed because the fin is positioned near the neurocranium and partially covered by the dentition. This position indicates that the caudal end of the body is wrapped around near the cranium, and the skull is also be wrapped in the opposite direction in a c-shape, positioning the pectoral fin near the cranium prior to fossilization.



**Figure 61.** KUVV 59061 Pectoral Fin. Close-up showing individual radials and pathology (circled).

**Dorsal fin-** The skeleton of KUVV- 56041 was recovered within two plaster jackets. The main jacket is marked on one of the leading edges where the second jacket fit. Within the smaller of the two jackets is a cartilaginous structure that is 40.5 cm in length and 20 cm in width, and composed of nine parallel and rectangular cartilages that average 18 mm in width. This structure is interpreted as being the ceratotrichia of a dorsal fin (**Fig. 62**). Support for this contention is

that the radials appear to be attached to a pair of radial pterygiophores. It also passes along three of the largest exposed vertebrae (60-70 mm) preserved with this specimen. The association of this structure with large-diameter vertebrae indicates it is not a pectoral, anal or caudal fin. There is no evidence for the preservation of, or insertion of a cephalic spine at the base of the fin. Mueller (2008) reported a cephalic fin spine associated with a specimen of *P. decurrens* from the Late Cenomanian of Germany. The figured specimen shows no evidence or structures associated with dorsal fin that would support such a claim. The purported fin spine does not exhibit any features of a typical hybodontid cephalic fin spine and is here considered invalid.



**Figure 62.** KUVV 59061 Dorsal Fin. **A** specimen; **B**, line drawing showing details including radial pterygiophores and associated vertebrae.

**Caudal fin-** There are no skeletal elements posterior to the dorsal fin preserved in KUVV-59061. Given that *Ptychodus* may have had a fusiform body; it is presumable that it had a lunate caudal fin. Its association with the large predatory sharks *Leptostyrax*, *Cretodus*, *Cretalamna*, *Cretoxyrhina* and *Squalicorax*, which were capable of fast swimming (Shimada,

1994; Schwimmer, 2002; Shimada and Ciccimuri, 2005), and large mosasaur taxa suggest that *Ptychodus* was also a dynamic predator, capable of moving at fast speeds, enabling it to pursue other fast moving prey items while also avoiding being preyed upon.

## DERMAL SKELETON

**Calcified cartilage prisms**— The endoskeleton of fossilized sharks usually occurs as mineralized prismatic or fibrous cartilages (Zangerl, 1981). The cartilage present within KUV-59061 is represented by sheets of calcified prisms that are well fused, having a reticulated surface ornamentation.

**Scales**— The morphology of shark scales, also known as dermal denticles or placoid scales, varies from region to region along the body (Applegate, 1970; Reif, 1974; Welton and Farish, 1993). These scales serve various functions, including protection from predators and parasites, reduction of mechanical abrasion, frictional drag, and for the accommodation of bioluminescent and sense organs (Raschi and Tabit, 1992). Typically, scales consist of three parts: 1) the basal plate; 2) the pedicel; 3) and the crown. The basal plate (aka root) lies beneath the skin, and the pedicel rises above the basal plate and forms a neck between the basal plate and crown, and the crown caps the pedicel and may be expanded outward from it (Applegate, 1967).

Dense masses of scales are found *in situ* throughout the skeleton in KUV- 59061. Samples taken from three regions of the skeleton (around the dentition, on the pectoral fin and the dorsal fin) and from surrounding matrix indicate that the dermal skeleton of *P. mortoni* contained at least four types of denticles. These four scale morphologies are labeled Type A, Type B, Type C, and Type D; a convention employed by MacLeod (1982) and Shimada (1993). A lesser number of denticles are associated with AMNH- 19953 (**Fig. 63**); SMU- 69001 (**Fig. 64**) and FHSM VP-16684 (**Fig. 65**). They are also categorized in this manner.

**Type A** scales were recovered from close to the dentition and are interpreted as pharyngeal denticles. They are hourglass shaped and have a smooth polygonal crown. The root is smooth and possesses several large, oval foramina at the base. The pharyngeal and buccal cavities of many elasmobranchs are lined with denticles that function in feeding mechanisms by helping to grip prey or to grind up food (Applegate, 1967; Raschi and Tabit, 1992).

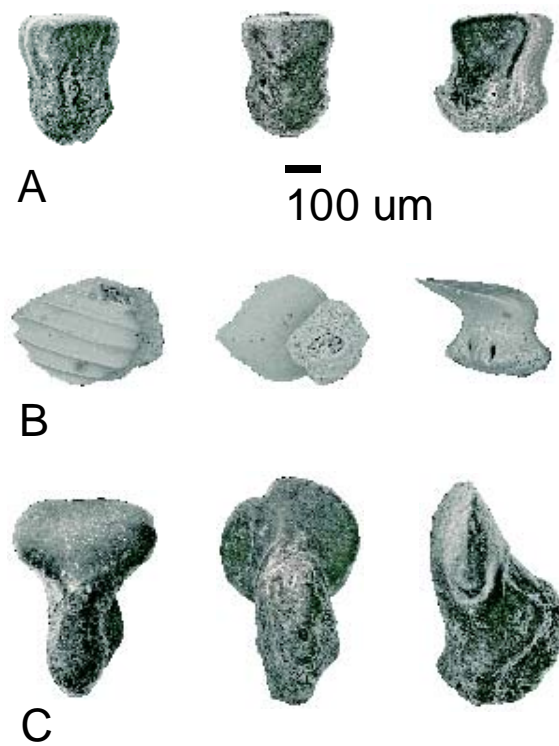
**Type B** scales have a thin and broad crown bearing posteriorly pointed projections and the root is expanded and rhombic shaped. There are five to six raised parallel ridges that run



from the anterior to posterior edges of the crown. These scales were not in association with any particular skeletal element, but they were abundant within the chalky matrix associated with the skeleton. This type of scale is interpreted as a drag reducing scale like those reduces the amount of drag on the ventral and dorsal sides of the body (Bechert et al., 1986; Raschi and Tabit, 1992) of fast-swimming sharks. These scales have a close morphology similar to the Type B scales of *Cretoxyrhina* (Shimada, 1994, p. 64, fig. 9) and the modern requiem shark genus *Carcharhinus* (Raschi and Tabit, 1992, suggesting that *P. mortoni* was capable of fast swimming).

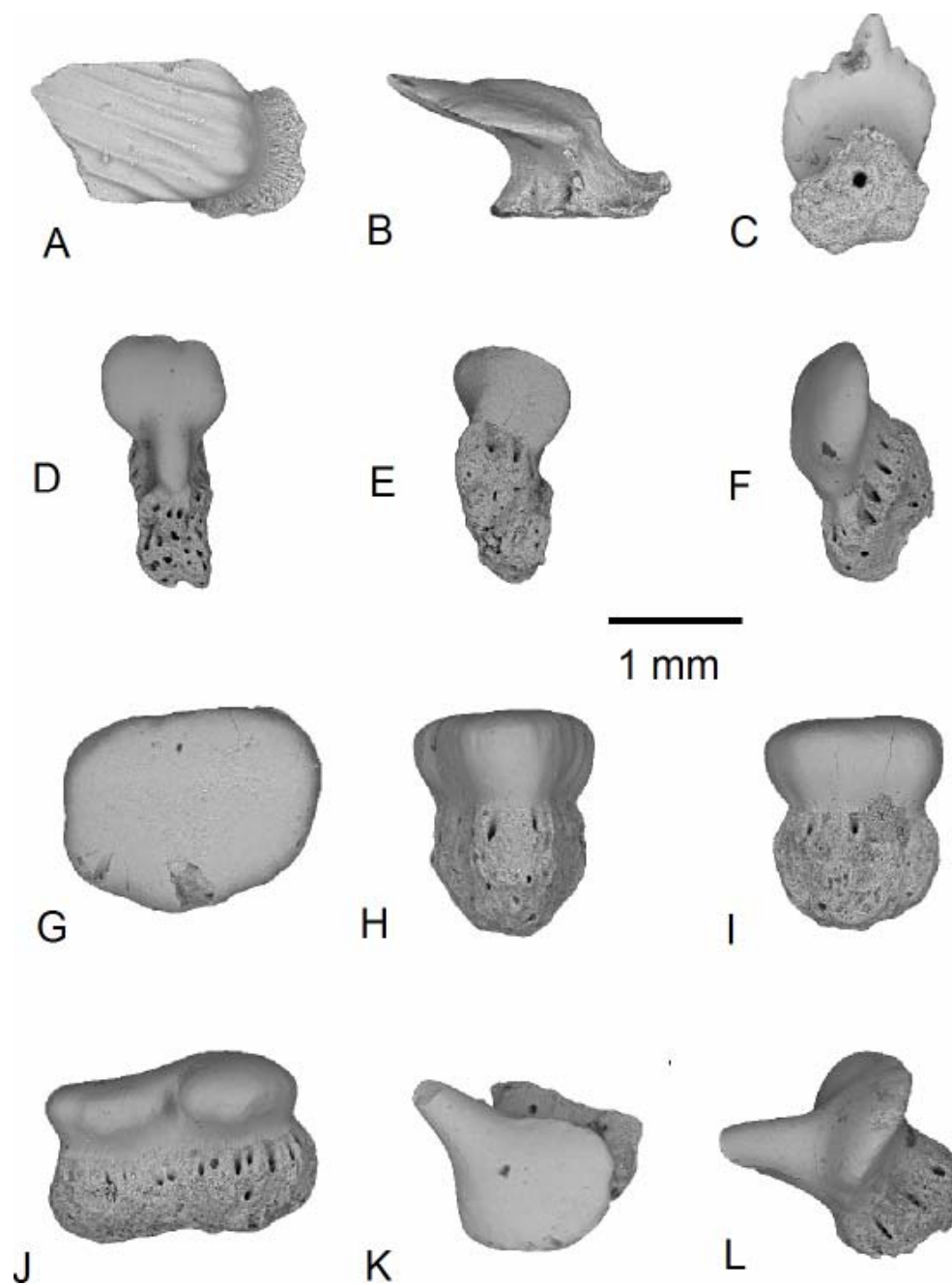
**Type C** scales have a large, broad and smooth crown, with a slightly rounded anterior projection. The crown tapers down to an elongated root that bears numerous foramina on all sides. This type was collected at and on top of both the pectoral pterygia and dorsal fin and may be abrasion resistant denticles. Reif (1978b) noted that this type of scale, located on the snout and anterior fin edge are always smooth in fast-swimming sharks.

**Type D** scales are similar to Type C scales except they have an extremely elongate and pointed anterior projection. This scale morphology was collected within the surrounding matrix and its exact position and function cannot be determined.

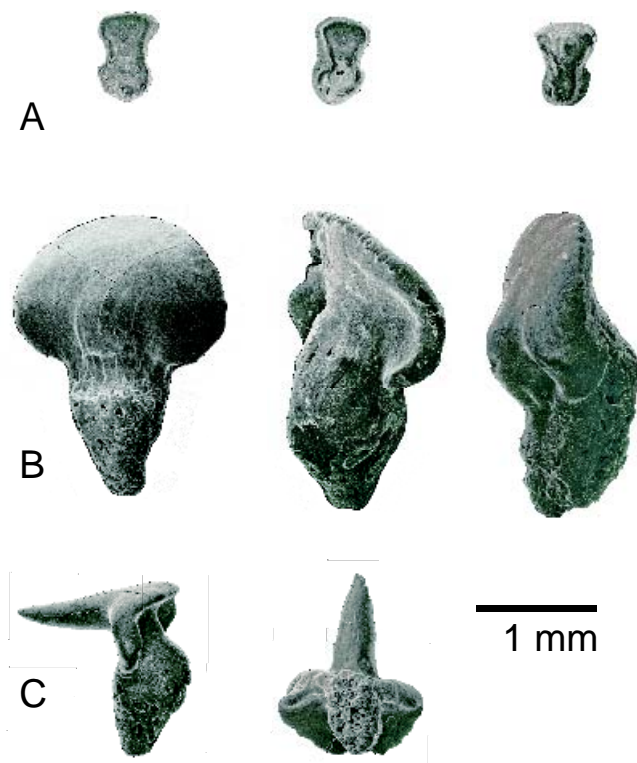


**Figure 63.** AMNH 19553 (*P. rugosus*) Denticles. **A**, Type A denticles; **B**, Type B denticles; **C**, Type C denticles. All in anterior, posterior and side views.

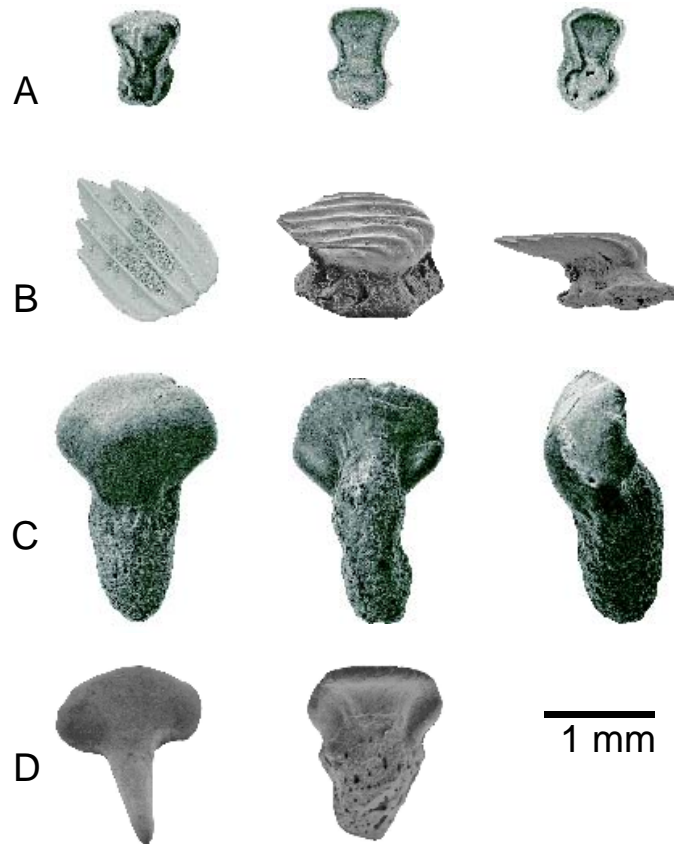




**Figure 64.** SMU 69001 (*P. rugosus*) Denticles. A-C, Type B; D-F, Type C; G-I, Type A; J-L, Type D.



**Figure 65.** FHSM VP- 16684 (*P. mortoni*) Denticles. **A**, Type A denticles in anterior, posterior and side views; **B**, Type C denticles anterior, posterior and side views; **C**, Type D denticles in side and basal view.



**Figure 66.** KUV 59061 (*P. mortoni*) Denticles. **A**, Type A denticle; **B**, Type B denticle; **C**, Type C denticles, all in anterior, posterior and side views. **D** Type D denticle in apical and posterior views.

### Body Form

Sharks generally occupy one of the highest trophic positions in any marine ecosystem (Hamm and Shimada, 2002), so paleobiological inferences such as the body form of any extinct taxa is important for the reconstruction of marine paleoecology (Shimada, 2005). Because shark skeletons are very rare in the fossil record, it has become common practice to assume that the body form of Late Cretaceous selachians resembled those of extant taxa having similar tooth morphology (Williamson, et al., 1989; Welton and Farish, 1993; Shimada, 1994). The earliest members of the Ptychodontidae probably had a weakly calcified skeleton. Because each taxon

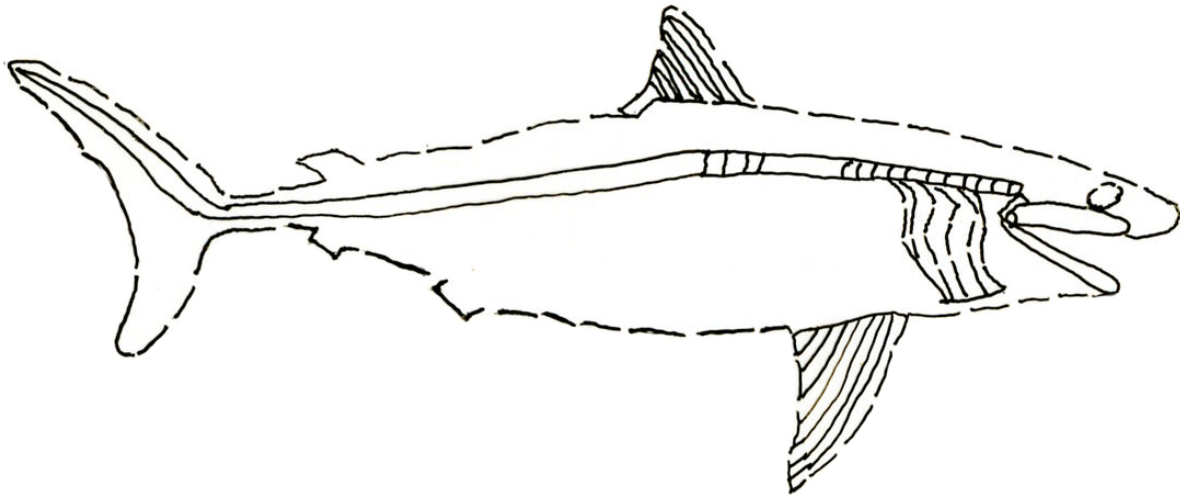
was independently derived and some widely separated geographically, it is difficult to ascertain the body form, and it is possible that each taxon had completely different body types.

Based on tooth morphology alone, *Ptychodus* was considered to be a “cestraciont” because it has a crushing dentition, and was assumed to have a dental arrangement similar to the modern bullhead shark *Heterodontus* (Agassiz, 1839; Owen, 1840; Casier, 1953). Woodward (1887) noted that the dentition of *Ptychodus* did not have small grasping anterior teeth like *Heterodontus* and suggested that the taxon was more closely allied to the batoids. *Ptychodus* has been grouped with the hybodonts (Patterson, 1966; Cappetta, 1987) but the teeth only possess one hybodont character, an anaulocorhizous root. Unlike other hybodont taxa, there is no evidence of cephalic spines or dorsal fin spines within the skeleton of KUVVP 59061. A dental arrangement of straight, parallel replacement files led Woodward (1889) to place *Ptychodus* within the Myliobatidae, the only other elasmobranch with this type of dental arrangement. However, *Ptychodus* does not share features of the mandibular arch as the palatoquadrates and Meckel’s cartilages are narrow and elongate, nor does it share a polyaulachorize tooth root or synarcual structure found in modern Myliobatiformes (Maisey et al., 2004; Stewart, 1988).

The presence of a plesodic pectoral fin, large dorsal fin, and differentiated dermal scales within KUVVP 59061 indicates that at least *P. mortoni* had a lamniform type body and was a dynamic predator capable of fast swimming (**Fig. 67**). Assuming this, it may be possible to determine body length by comparing vertebral size with co-occurring lamniform taxa. If one assumes that *Ptychodus* has similar anatomical proportions to one of the largest co-occurring shark taxa, *Cretoxyrhina mantelli*, including morphometric relationships between the total length and vertebral size; and 2) if one assumes that the vertebrae are from a similar region of the vertebral column, (i.e. within the trunk region) then the total length may be calculated. The largest vertebrae known to date are from *P. mortoni* (KUVVP- 59061) and *P. rugosus* (SMU-69005), measuring 64 and 62.5 mm respectively, and both are interpreted to be from the trunk region. These sizes correlate with trunk vertebra v-114 through v-129 from a *C. mantelli* individual (FHSM VP 2187) that measured about 500 cm TL (Shimada, 1997b) which suggests that *P. mortoni* and *P. rugosus* attained similar body sizes.

*Ptychodus mortoni* (FHSM VP 335) and *P. rugosus* (FHSM VP 2121) possessed large dentitions, up to 64 cm in length. This also suggests that the body must have been large in order to accommodate a massive and heavy dentition. The length of the neurocranium, hyomandibula

and dentition in KUVV 59061 are comparable to the largest and best preserved *Cretoxyrhina mantelli* skeleton, FHSM VP 2187, which measures 4.5 meters in total length (Shimada, 1994).



**Figure 67.** Tentative Body Reconstruction of *Ptychodus*.

### Feeding Dynamics

The Meckels cartilages in KUVV- 59061 are fused anteriorly, and teeth within the dentition are closely fitted together so that there is little to no movement between both sides of the jaw within the dentition. Comparisons with modern taxa show that the mandibular arch of *Ptychodus* is close in morphology to the modern bullhead shark *Heterodontus*, and the dental arrangement was close to the rhinobatid *Rhina ancylostoma*. *Heterodontus* possesses a unique dentition, with clutching and grasping teeth in the anterior region of the jaw, and flattened crushing teeth at the back (Summers et al., 2004). *Rhina ancylostoma* has a differentiated upper and lower dentition, with small upper medial file teeth and large lower medial file teeth. The tooth wear patterns of *Ptychodus* indicate that they used their anterior files much like *Rhina* to process food items. This is unlike *Heterodontus* which uses the posterior teeth, or the batoids, which processes prey at the center of a flat dentition.

Along with its body type and ability for fast movement, *Ptychodus* probably used a combination of suction and grasping techniques when pursuing prey items. Although *Ptychodus* had a subterminal mouth and a hyostylic jaw suspension, the degree of jaw protrusion is unknown. Most modern sharks with hyostylic jaws protrude the upper jaws to some degree

while feeding (Wilga, 2002). The great white shark, *Carcharodon carcharius* and rhinobatids exhibit extensive upper jaw protrusion (Tricas and McCosker, 1984, Wilga, 2002), whereas the Carcharhinids have moderate to little upper jaw protrusion (Ferry-Graham, 1998b) and *Heterodontus* has little to no jaw protrusion (Pretlow-Edmonds, 1999).

Protrusion of the upper jaws in sharks is an important element in feeding behavior (Wilga, 2002). “Protrusion shifts the upper jaw away from the cranium exposing the teeth and increasing the suction and grasping ability, providing for nearly simultaneous closure of both the upper and lower jaws” (Wilga, 2002, p. 496). High-crowned species of *Ptychodus* were most likely open ocean pelagic taxa and not benthonic, and it was probably advantageous to have elevated tooth crowns in order to utilize a grasping technique to feed on fish and cephalopods (i.e. squids and ammonites). Unfortunately the body form of the low-crowned species of *Ptychodus* is purely speculative as there are no postcranial remains associated with any of these species and it is possible that they had a very different skeletal anatomy altogether. Their dental arrangement is more pavement-like (Canavari, 1916), similar to *Mustelus* and convergent to myliobatiform dental morphology (Slaughter, 1980). They may have utilized more of a suction feeding strategy, as is utilized in modern myliobatiforms that are adapted to a benthic lifestyle feeding on small fishes and echinoids (Compagno, 1999),

## CHAPTER 6

### DENTAL HISTOLOGY AND TAXONOMY

“The radiation of the Neoselachii during the Jurassic and Cretaceous have been attributed, in large part, to the evolution of complex hunting and feeding strategies in response to an increase in prey abundance and diversity” (Gillis and Donaghue, 2007, p. 42). These feeding strategies rely upon a number of derived anatomical features, including a segmented and calcified notochord with calcified vertebrae for quicker maneuverability. The pelvic and pectoral fin articulation is modified for greater maneuverability, and modifications to the jaw suspensorium (Moss, 1972, 1977; Maisey, 1980, 1986). Many neoselachians also possess sharp cutting and gouging teeth that are shed rapidly and replaced continuously (*polyphyodonty*) throughout life (Moss, 1967; Luer et al., 1990) unlike the multi-cuspid teeth of most basal neoselachians, which were retained beneath the skin of the outer jaw margin, rather than being shed, following replacement (Williams, 1990, 2001). Differences in dental histology and microstructure are thought to be adaptive innovations in feeding strategies among the neoselachians (Thies and Reif, 1985) through functional adaptation to resistance forces during predation. “Neoselachian sharks often employ predatory techniques such as biting in conjunction with lateral headshakes to gouge flesh from prey, placing the teeth under tremendous bending stress” (Gillis and Donaghue, p. 42). Functional morphological studies have demonstrated that triple layered enameloid in neoselachian teeth prevents the development of cracks in the teeth and provides tensile strength and resistance to compressive forces during feeding (David, 1996).

Modern sharks are classified into two clades: the Galea and the Squalea (Shirai, 1996). Cladistic analysis of morphological features from extant sharks place *Heterodontus* at the base of the Galea and *Chlamydoselachus* at the base of the Squalea (Shirai, 1992, 1996; Gillis and Donaghue, 2007). The dentition of *Heterodontus* is very different when compared with other modern taxa. The anterior teeth are sharp and pointed and are used for grasping, while the posterior teeth are flattened and better suited for crushing (Summers et al., 2004). Histologically, the anterior teeth of *Heterodontus* have fully differentiated triple-layered enameloid (SCE, PFE,

and TFE), while the posterior teeth only has a thin layer of TFE underlying a thick layer of SCE (Reif, 1977; Cuny et al., 2000, Gillis and Donoghue, 2007). Reif (1977) proposed that the reduction of the enameloid layer in the back teeth of *Heterodontus* was an adaptation to durophagy. Maisey et al. (2004) suggested that the batoids (skates and rays) are not derived squaleans, but are the sister group to all other neoselachians (i.e. the Galea and Squalea). “This phylogenetic placement of the batoids disagrees with the view that the most primitive neoselachian teeth possessed triple-layered enameloid; however, it does not conflict with the argument that a triple-layered enameloid fabric was a preadaptation to the neoselachian cutting and gouging tooth function, as batoids are durophagous” (Gillis and Donoghue, 2007, p. 44).

Offered here is a discussion regarding the inter-relationships between each genus within the Ptychodontidae and each species of *Ptychodus* based solely on dental characters. This can best be explained by looking at the dental histology and morphology of *Hylaeobatis* Woodward (1916), *Heteroptychodus* Yabe and Obata (1930) and *Parapterychodus n. gen. n. sp.* Each share morphological features with *Ptychodus*, but are symplesiomorphic as they share the typical hybodontid tooth root characters.

## HYBODONTIDAE

### *LISSODUS*

*Lissodus* Brough (1935) is a cosmopolitan taxon comprised of twelve species that extend stratigraphically from the Scythian, Early Triassic to the Albian, Early Cretaceous (Rees and Underwood, 2002). Remains of *Lissodus* have been found worldwide in sediments deposited in a wide range of palaeoenvironments, with most species living in areas with some marine influence. Its teeth are small with deep crowns, a labial protuberance that is an extension of the base of the crown in some instances, and a hybodontid bilobed tooth root with simple and large vascular foramina.

Cuny et al. (2001) report the presence of two-layered enameloid—an outer layer of compact SCE, and an inner layer SCE organized into parallel bundles lying perpendicular to the enameloid–dentine junction in the hybodontids *Acrodus* and *Polyacrodus* (members of the Lonchiididae). These taxa may represent precursors to the neoselachian triple-layered fabric. The teeth of these Hybodontiformes are rather flat and low-crowned, and were not likely subject to excessive bending forces (Patterson, 1966).



## PTYCHODONTIDAE

### *HYLAEOBATIS*

*Hylaeobatis*, found only from near shore and marginal marine sediments from the Barremian in England, is thought to be closely related to the Lonchididae (Patterson, 1966; Rees and Underwood, 2002). The tooth crown of *Hylaeobatis* consists primarily of osteodentine, capped by a thin layer of SLE. There are irregularly spaced vascular canals that arise from the osteodentine oriented perpendicular to the outer layer of SLE. Patterson (1966) considered *Hylaeobatis problematica* Woodward (1916) to be synonymous with *Acrodus ornatus* Woodward (1916), however, Rees and Underwood (2002) did not agree with this and included *Hylaeobatis* within the Lonchidiidae. Patterson (1966) and Cappetta (1987) suggested that *Hylaeobatis* is an ancestral form of the Ptychodontidae and establishes a link between it and the Hybodontidae. Patterson (1966, p. 342) discussed the transition from *Lissodus* to *Hylaeobatis*, noting that by “increasing the size of the width of the tooth crown would make more vascular canals and an increase in the depth of the crown without increasing the thickness of pallial dentine, allowing the core of the crown to be formed by osteodentine on top of and around the vascular canals”.

Given the similarities in histology, *Hylaeobatis* does possess several more specialized characters than *Vectiselachos* and *Lonchidion*. The anterior teeth are much wider and have a greater amount of surface area that is covered by a complex pattern of reticulated enameloid folds and lack lateral cusplets. The crown surface in the lateral and posterior files are also wider and flatter with a single cutting ridge that extends across the entire width of the crown. The wide and flat tooth crown is typical of a crushing-type dentition rather than the clutching-type dentition as seen in members of the Lonchididae. A weak labial protuberance and lingual sulcus is present which helps with the interlocking of adjacent teeth within the dentition, and although the patterning of enamel folds and ridges in *Hylaeobatis* is more primitive, they become more developed in all other species of *Ptychodus*.

### *HETEROPTYCHODUS*

*Heterotpychodus* is another representative of the Ptychodontidae found in near shore (Aptian-Albian) deposits in Asia. The taxon may share a common ancestor with *Lonchidion* (Cuny, 2003, Cappetta et al., 2006) and was once considered to be a junior synonym of

*Ptychodus* (Cappetta, 1987) based on a single tooth published by Yabe and Obata (1930).

Although it was known by very few specimens, a larger sample of strongly heterodont teeth with well-differentiated anterior and lateral files (representing more than one tooth position) has been recovered from the lower Cretaceous of Thailand, confirming that *Heteroptychodus* is a valid genus (Cappetta et al., 2006).

The teeth of *Heteroptychodus* are meso-distally elongate, with a tooth crown crossed by parallel transverse ridges and a marginal area ornamented with fine, radiating, branched ridges. The tooth root is anaulacorhizous with only three to four foramina located at the base of the root rather than at the crown root boundary as in *Ptychodus*. Despite this difference, all of the other dental features are similar to those seen in the low crowned species of *Ptychodus*, suggesting that these taxa are closely related. The current data suggests an origin of the low crowned forms of the Ptychodontidae from the Early Cretaceous of Asia, possibly in near shore freshwater or estuarine environments (Cuny, 2003). Although the micro structure and tooth histology in *Heteroptychodus* has not been studied, and assuming that the dentition was of the same general type as that observed in *Ptychodus* (Cuny per. Comm. 2007), all that would be needed to transition from *Heteroptychodus* to *Ptychodus* would be to expand the dimensions of the crown (which would increase the surface area), while at the same time increasing the thickness of the transverse ridges, enabling it to feed on larger prey items in the marine realm.

#### ***PARAPTYCHODUS* N. GEN.**

*Paraptychodus washitaensis* n. gen. n. sp. is found within fully marine deposits of the Washita Group of Texas. It is considered to be a basal ptychodontid because it possesses characters of both *Lissodus* and *Ptychodus*. The dental characters *Paraptychodus* possesses is more specialized than all members of the Lonchididae as the anterior teeth are more developed with a high crown and distinct pattern of occlusal ornamentation. However, it does retain some primitive heterodont characters. In each tooth file represented, the labial protuberance and lingual sulcus are features of the tooth root, not the crown as in other ptychodontids. The most distinctive character is seen within the posterior teeth, which have a sharply raised, flat and anteriorly pointed tooth crown that is devoid of transverse ridges or marginal ornamentation. The histology of *Paraptychodus* has not yet been studied. As in *Heteroptychodus* and *Hylaeobatis*, there are few representative specimens, and all of the material observed during this

study has been complete teeth. The histology will be studied further when an incomplete or broken tooth is recovered so a complete tooth does not have to be “sacrificed”. The morphology present in the anterior most files indicates a close relationship with the “high crowned” varieties of *Ptychodus*.

### ***PTYCHODUS***

The dentition of *Ptychodus* is highly specialized for durophagy in a marine environment. The largest and most diagnostic are located medially on or near the fused mandibular symphysis. Each tooth within the dentition exhibits a labial protuberance, or extension of the crown and a lingual sulcus, or and indentation. These structures are features of the crown, not the tooth root. These features are used as interlocking structures for each tooth within a file front to back. The mesial and distal tooth edges are alternately angled acutely and obtusely allowing teeth from the previous file to interlock with each other distally creating a hard yet flexible dental battery. The tooth files are arranged antero-posteriorly with each tooth file as they progress distally from the symphysis they also retreat posteriorly along the jaw ramus (**Fig. 13**). The posterior teeth are typically featureless have no diagnostic features for species identification.

The tooth histology of *Ptychodus* consists of osteodentine with a thin layer of pallial dentine, bunched tubules of which arise from the terminal portion of the vascular canals of the osteodentine, (a condition known as osteodont histology). Osteodont teeth have osteodentine filling the core of the crown and there is no large pulp cavity. Osteodentine is covered by three distinct layers of enameloid; 1) triple-layered enameloid made of an internal tangled-fibred enameloid (TFE); 2) a central parallel fibred enameloid (PFE); 3) external shiny-layered enameloid (SLE). Among these layers, the PFE is considered an autapomorphy of the Neoselachii (Reif 1977; Thies 1982; Maisey 1984a, b, 1985; Thies & Reif 1985; Gaudin 1991). Contrary to Cuny (2008), David (1994) studied the histology of *P. decurrens*, and *P. mortoni*, and discovered that PFE and SLE are present in *P. decurrens*. *Ptychodus mortoni* was shown to possess TFE, SLE and an intermediate layer of enameloid. Additional analysis on the histology of each species of *Ptychodus* is needed which may provide information regarding the in-family relationships.

## CHAPTER 7

### PHYLOGENETIC ANALYSIS

Morphological trends within the Ptychodontidae demonstrate constant specialization in tooth crown morphology (**Fig. 69**) due to ever-evolving prey species. Diagnosing individual taxa to species level is accomplished by identifying a combination of unique characters, or a single unique character—an evolutionary novelty or *apomorphy*. This study is the first attempt to define species of the Ptychodontidae based on apomorphic characters. The basic hypothesis is that in order for a new species to be distinguished, there must be at least one character (preferably a set of characters) possessed by members of that “species” that is not possessed by closely related species. A “character” refers to a feature in an organism that can be noticed, understood, recognized, or established as separate element (Bang et al., 2000). The identification of this character (or set of characters) allows for the differentiation of species. It is possible that similar characters might have originated independently (*homologues*) in two or more of the various species. If so, then they would not be homologies, rather *homoplasies*. The characters would therefore not indicate a close evolutionary relationship. Although the fossil record is incomplete, there is no evidence that the evolving morphological feature(s) within each species did not cease to exist when being modified through evolutionary time and then reappear in full as a morphological whole in differing geographic locations.

The purpose of any phylogenetic analysis is to determine the monophyly, or relatedness of a group of organisms in question. Two questions arose during this study; 1) what are relationships between each genera and species within the Ptychodontidae and 2) what is the ordinal placement of the family Ptychodontidae within the Elasmobranchii. This is the first phylogenetic analysis to attempt to answer these questions. Both analyses and phylogenetic trees were performed using PAST ver. 1.81 (Hammer et al., 2008) using heuristic searches. All characters were analyzed having equal weight and were unordered.

### In-family Analysis

The data matrix for the in-group analysis consists of 20 dental characters and contains sixteen taxa; the four genera within the family, *Hylaeobatis*, *Heteroptychodus*, *Paraptychodus*, 12 species of *Ptychodus* and the hybodont genus *Lissodus* as the outgroup taxa (**Appendix I**). The analysis produced 17 most parsimonious trees (MPT) with a consistency index (CI) of .72 and a retention index (RI) of .9449 (**Fig. 68**). The strict consensus tree (**Fig. 69**) groups each species of *Ptychodus* based on a single event nested with *P. anonymus* that indicates either a development of a high crown and an event of reversal or crown loss due to the retention of a primitive condition. There is a homologous relationship between those species having similar tooth crown morphologies (i.e. low and high crowned forms), transverse ridge pattern and tooth margin ornamentation. Unfortunately, the clade of taxa exhibiting a high tooth crown shows multiple polytomies, suggesting that this character arose multiple times within *Ptychodus* and is not an indicator of relationships between taxa. However, with the known stratigraphic and geographic occurrences some assumptions can be made.

In the earliest *Ptychodus* species, the tooth crowns are relatively low with a low and thin transverse ridges and a narrow marginal area. Through time, crown height increases, the number of ridges decreases but become thicker, and the marginal area becomes much wider and shelf-like. The low crowned species are more basic in design and the morphological changes between taxa are simple. In the earliest species the ridges are relegated to the center of the crown and the marginal area is wide with fine ornamentation. Later species have ridges that extend further to the lateral margins and the marginal area is reduced but with coarser ornamentation. The diversification of the genus was most likely in response to changing environmental conditions and the appearance of new and varied invertebrate taxa including the ammonites and other cephalopods.

The first species of *Ptychodus* in the fossil record are *P. anonymus*, *P. occidentalis*, *P. decurrens*, *P. mortoni* and *P. marginalis*. They appear during the Greenhorn Cyclothem (Cenomanian-Turonian) in North America and Europe. Taking into account the similarities in tooth morphology, stratigraphic range and geographic occurrences *Paraptychodus* and *Heteroptychodus* overlap each other stratigraphically, and it is more parsimonious that the earliest North American taxa, *P. anonymus*, *P. decurrens*, *P. occidentalis* and *P. mortoni* share a common ancestor with *Paraptychodus*. The oldest species of *Ptychodus* in Europe are *P.*

*decurrens* and *P. marginalis*. *Ptychodus marginalis* also shares a common ancestor with *P. anonymus* and the presence of a low crown may represent the reappearance of an ancestral character, or reversal, as a result of the loss of an advanced (apomorphic) character. These taxa were not very widespread geographically; instead they were endemic and generally restricted to their individual geographic locations (Asia, Europe and the Western Interior Seaway).

By the Turonian there is an explosion of species, predominately throughout the Western Interior Seaway and Gulf Coast in North America. *Ptychodus occidentalis*, a relatively short lived species that becomes extinct the earliest Turonian, has a greatly raised crown with radiating ridges, and is likely shares a common ancestor with *P. mortoni*, a taxon that appears in the fossil record in the lower Turonian and is widely distributed from North America, South America, Africa and Europe. *Ptychodus anonymus* developed a wider and more elevated crown by the Turonian, and it is possible that *P. whipplei* shares a common ancestor with *P. anonymus*, developing an even higher crown by the Middle Turonian. This early form *P. whipplei* has similar marginal ornamentation and clearly distinguishable transverse ridges as in *P. anonymus*. *Ptychodus occidentalis* and *P. whipplei* are widely distributed geographically throughout the Western Interior Seaway, but are endemic to this region of the globe. By the Middle Turonian, *P. decurrens*, *P. anonymus* and *P. marginalis* are widely distributed, but this also marks the last occurrences of each throughout the Western Interior Seaway. The only new species to appear during the Late Turonian is *P. mammillaris*. This species is morphologically similar to *P. anonymus* and has a very limited temporal range from the Late Turonian through the Earliest Coniacian. Having a larger and wider crown, *P. mammillaris* most likely shares a common ancestor with *P. anonymus*.

There is a reduction in the number of species by the Niobrara Cyclothem (Coniacian to Santonian) and only 6 taxa remain worldwide: *P. latissimus*, *P. whipplei*, *P. mortoni*, *P. rugosus*, *P. atcoensis* and *P. martini*. The Early Coniacian marks the last occurrence of *P. whipplei* and marks the first appearance of *P. martini* and *P. latissimus* within the seaway. *Ptychodus marginalis* was a very common species during the Turonian and most likely a sister taxa to *P. martini*. *Ptychodus martini* has a long stratigraphic and geographic range, being found in Late Coniacian to Early Santonian deposits in Kansas, Early Coniacian and Early Campanian deposits in Texas and Early Coniacian South America. *Ptychodus latissimus* is common in Europe and Asia, and the species is very rare in North America, only being found in Early Coniacian

deposits. The Late Coniacian marks the final occurrence of *P. whipplei* and *P. latissimus* in the fossil record. It is also the first appearance of *P. atcoensis* and *P. rugosus* (in North America and Europe), species that share a common ancestor with *P. anonymus* and independently deriving homologous features including a high tooth crown and concentric marginal ornamentation. *Ptychodus mortoni* becomes larger, more abundant and widely distributed throughout the seaway into South America, Cuba, Africa and Europe. *Ptychodus polygyrus* is only found in Late Santonian-Early Campanian deposits in Europe. All species of *Ptychodus* become extinct worldwide by the Early Campanian.

### Ordinal Analysis

Mutter et al., (2005) note that no synapomorphy has been identified for the Ptychodontidae. The preserved skeletal elements in *P. mortoni* (KUVP 59061) and *P. rugosus* (SMU 69001-69018) have allowed for the identification of synapomorphic characters for use in phylogenetic analysis. The data matrix used to determine the possible ordinal placement of the family consists of 32 characters consisting of both dental and the known skeletal elements found with *Ptychodus* (**Appendix II**). Five orders representing extinct and modern taxa were chosen for the analysis including the “primitive” Hybodontiformes (Agassiz, 1837), the modern Bullhead shark *Heterodontus* (Blainville, 1816), the modern rays *Rhinobatiformes* (Link, 1790) and *Myliobatiformes* (Cuvier, 1817), and the modern Lamniformes (Garman, 1885). Modern ray taxa were chosen based on the similarities in tooth form, function and dental arrangement while *Heterodontus* and the Lamniformes were chosen for similarities in skeletal anatomy.

Early observations suggested that *Ptychodus* was closely allied with the Myliobatiformes (Woodward, 1889; MacLeod, 1982; Cuny, 2008). However, the ordinal analysis produced only one MPT with a CI of .6818 and a RI of .5625 and indicates that *Ptychodus* has a closer relationship, being a sister taxa to the modern Lamniformes rather than the Myliobatiformes (**Fig. 70**).

The jaw suspension in *Ptychodus* is hyostylic (#1), in which the hyomandibula attaches the jaws to the cranium, whereas the Myliobatiformes have a euhyostylic jaw suspensorium, where the mandibular arch is suspended solely by the hyomandibula with no palatoquadrate-cranial ligaments or articulations (Maisey et al, 2004). Although the hybodontids also share a hyostylic jaw suspension (Wilga, 2002), the symphyseal fusion of the palatoquadrates (seen in

KUVP 13525) and Meckel's cartilage (#6) is an independently derived character (synapomorphy) found in the neoselachians, whereas its absence in hybodonts is primitive (Maisey et al, 2004). Some species of myliobatids also share a fused mandibular arch (Nishida, 1990), however, there is not an expansion or wing-like process (#7) preserved on the mandibular arch in any of the *Ptychodus* remains observed during this study. The only character *Ptychodus* shares with the Myliobatiformes is a similar pattern of dental arrangement (#9). However, *Ptychodus* still retains a plesiomorphic hybodont character, an anaulachorizous tooth root (#17).

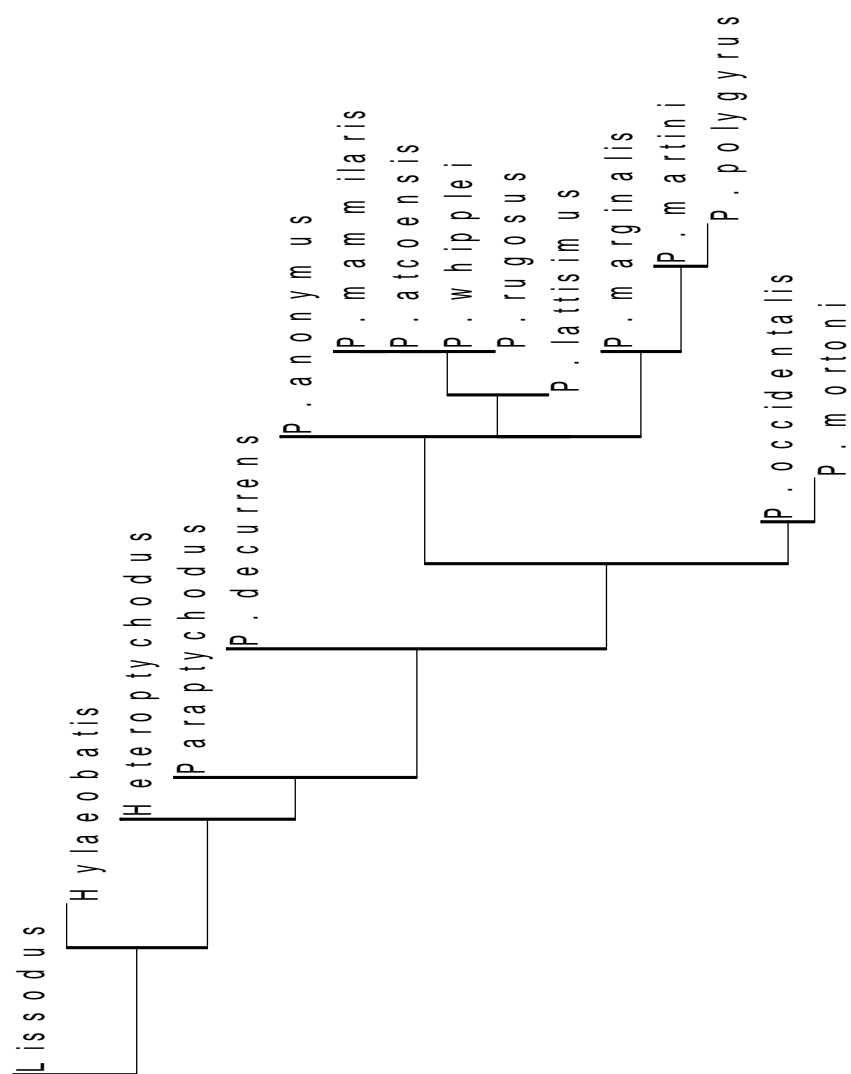
The axial skeleton of KUVP 59061 preserves circular vertebral centra (#20) with developed primary calcifications (#21) and secondary calcifications (#22). Stewart (1980) suggested that "...that all living sharks and rays (including *Heterodontus*) are members of the monophyletic Neoselachii, united by synapomorphies including the presence of calcified centra". The presence of calcified centra found in association with more than one species of ptychodid (i.e. *P. mortoni* and *P. rugosus*) is another reliable synapomorphy indicating that *Ptychodus* should be included with the Neoselachian sharks. MacLeod (1982 and Everhart and Caggiano (2005) reported vertebral centra associated with dental remains, however they did not discuss any relationships or possible skeletal articulation with these specimens (Mutter et al., 2005). The cranial-vertebral connection in KUVP 59061 does not show evidence of fused cervical vertebrae, or synarcual (#19) a feature only found within the myliobatids (Nishida, 1990), but instead are attached directly to the rear of the neurocranium as in modern lamniforms.

KUVP 59061 has a partially exposed plesodic pectoral fin (#26) with rectangular fin radials (#27) and the propterygia directed postero-laterally (#28). The first dorsal fin is preserved; also exhibiting a plesodic state (#29), composed of rectangular and elongate basal cartilages (#30). There is no evidence of insertion for, or preserved cephalic spines (#31). Its absence may represent a secondarily lost hybodontid character. Four distinct and differentiated dermal denticles (#32) were found from various regions of the skeleton in KUVP 59061. Multiple differentiated dermal denticles are not present in hybodonts (Maisey, 1980) or within the Myliobatidae (Compagno, 2001). These features prohibit the inclusion of *Ptychodus* within the Myliobatiformes.

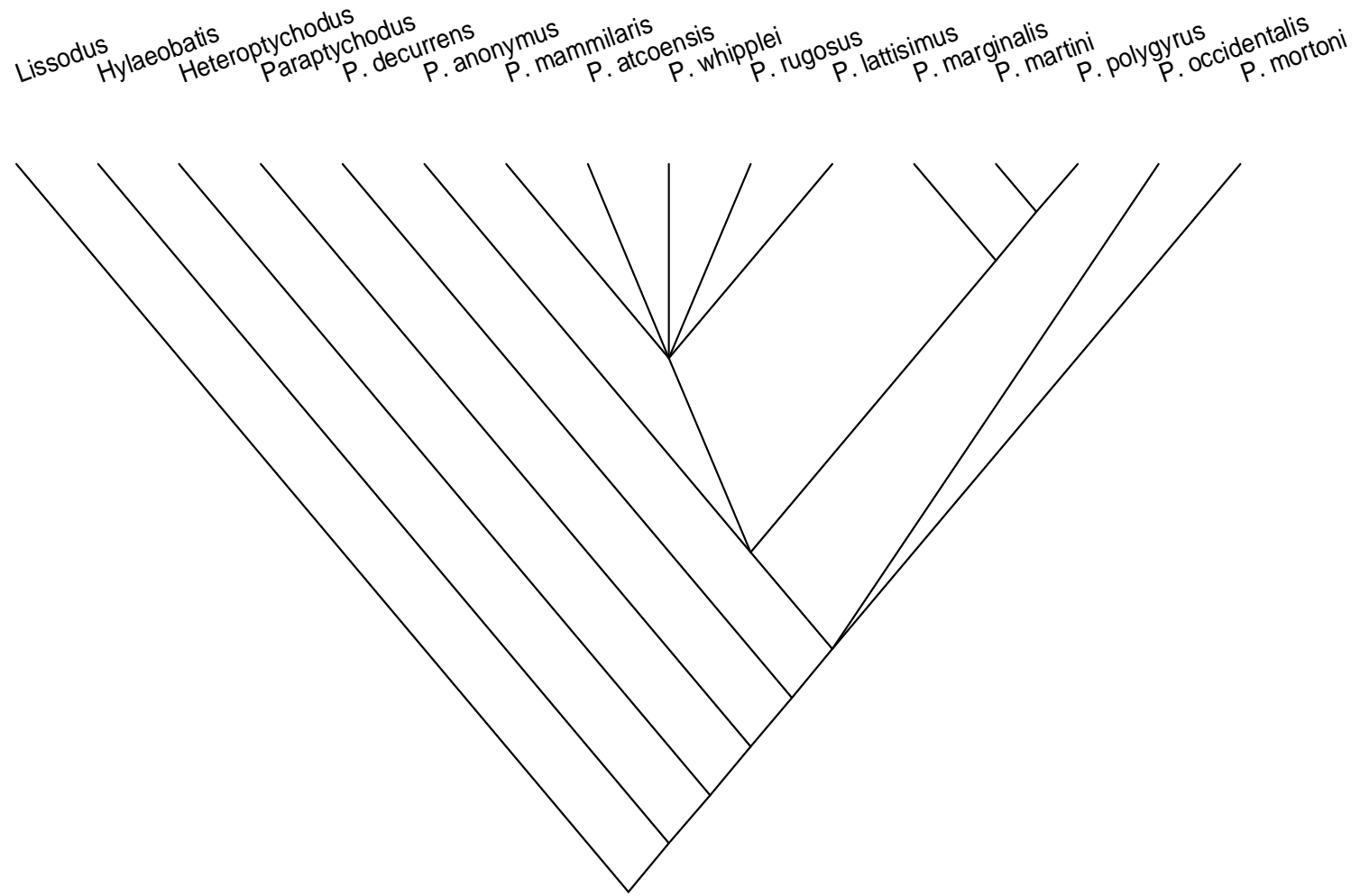
With these known skeletal elements, the strict consensus tree (**Fig. 71**) indicates an ordinal position nested high within the Neoselachii. I suggest that family Ptychodontidae is not



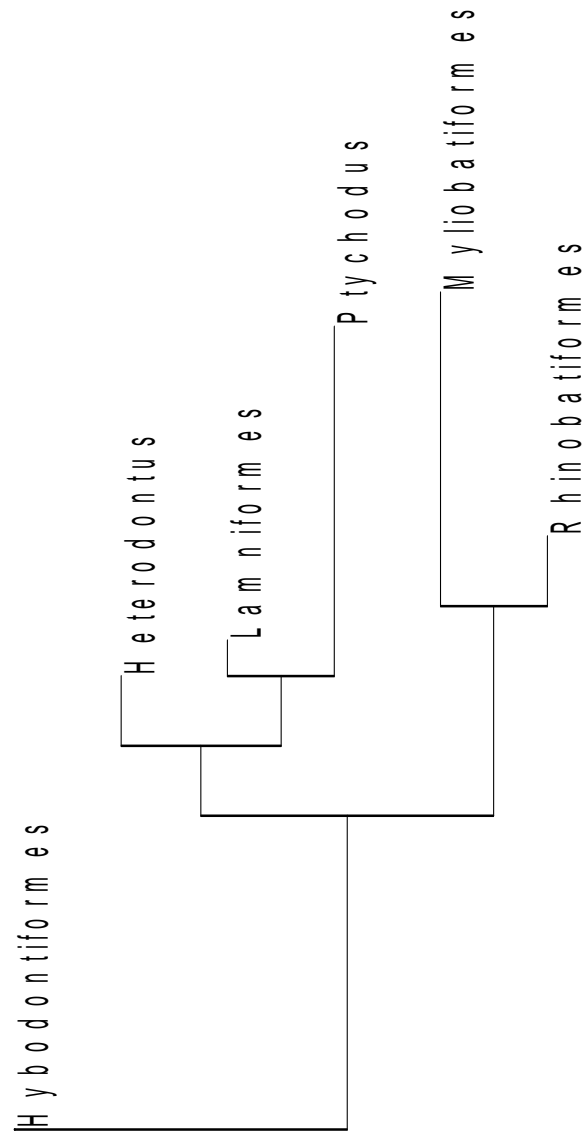
related to the Hybodontiformes and should be placed within its own order, the Ptychodontiformes within the superorder Galea.



**Figure 68.** In-family Phylogenetic Analysis. One of 17 MPT's; (CI) .72, RI .9449.

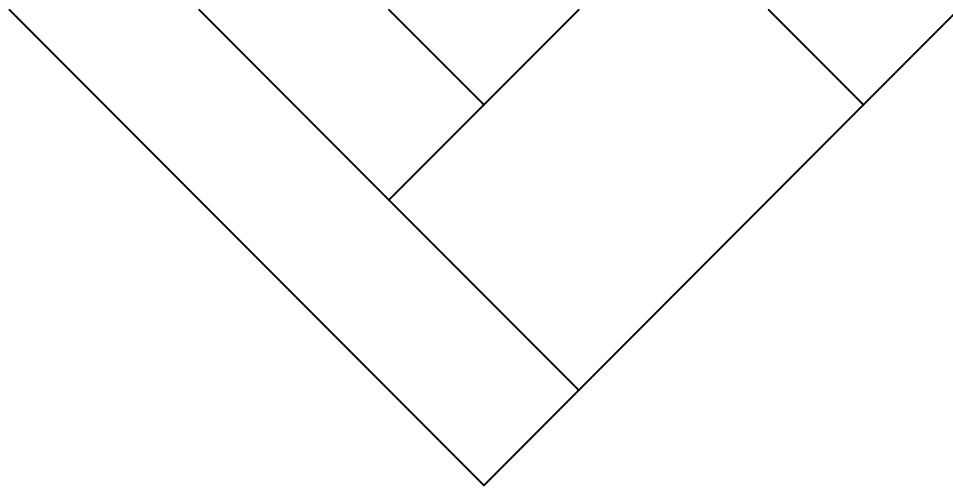


**Figure 69.** In-family Strict Consensus Tree



**Figure 70.** Ordinal Phylogenetic Analysis. MPT; CI .6818, RI .5625.

Hybodontiformes Heterodontus Lamniformes Ptychodus Myliobatiformes Rhinobatiformes



**Figure 71.** Ordinal Analysis Strict Consensus Tree.

## CHAPTER 8

### PALEOECOLOGY

The environments that *Ptychodus* inhabited are based on lithology and associations with other marine taxa. Most specimens I observed during this study were found alongside other invertebrate and vertebrate remains. Studies of these associations and the use of index fossils are important in reconstructing the specific environments and locating stratigraphic horizons that each species of *Ptychodus* occurred in as well as correlating their geographic distributions throughout the Western Interior Seaway.

**Albian** –The first and only occurrence of the genus *Paraptychodus washitaensis* n. gen n sp. is within the *Inoceramus comancheanus* zone, Duck Creek Formation (Middle Albian), of the Washita Group in Texas. The Duck Creek Formation consists of interbedded limestones and calcareous shale beds. The contacts between are silty, containing bivalves such bivalves as gryphaeids and plicatulids, echinoids, ostracodes, planktic and benthic forams and a vertebrate fauna consisting of fish bones and shark teeth including *Paraptychodus washitaensis*, *Leptostyrax macrorhiza* and *Squalicorax volgensis*. The limestone beds contain abundant trace fossils, including *Planolites* and *Thalassinoides* burrows (Scott et al., 1978) as well as four types of ammonites, some of which are large and distinctive including the genera *Eopachydiscus*, *Craginites*, *Idiohamites* and *Mortoniceras* (Kennedy et al., 1999). These species ranged widely into nearshore littoral and offshore shelf environments in the Western Interior Seaway (Blatt, 1989; Scott et al., 2002). The low diversity of hedbergellid and heterohelicid planktonic forams suggests water depth of 50-100m (Baker, 1976; Scott et al., 2002). The biofacies succession within the Washita Group “suggests southwestern encroachment of basinal clay muds followed by northeastward progradation of carbonate ramp environments in the Gulf Coast” (Scott et al. 2002, p. 295). Environmental trends indicate increasing then decreasing water turbidity and clay deposition during the middle and upper Duck Creek Formation. The shallow carbonate shelf of the Central Texas Platform first retreated then expanded and prograded into the North Texas basin (Scott et al., 2002).



**Figure 72.** Albian Geographic Distribution.

**Cenomanian**—The Greenhorn Cyclothem initiated rapid southward flooding of the seaway in response to latest Albian eustatic sea level rise. The transgression progressed over the Western Interior Basin due to convergence of the southerly transgressing Arctic Boreal Ocean from the north and northerly transgressing Atlantic-Tethyan Sea from the south and Gulf of Mexico (Kauffman and Caldwell, 1993). The merger resulted in the alteration of water circulation and the mixing of water masses, resulting in a shift from an oxygen-stratified basin to a normal marine condition in a “Warm Temperate zone” (Kauffman and Caldwell, 1993). Lithologic units from the Cenomanian include the Greenhorn Formation of Kansas, Colorado, South Dakota and the Eagle Ford Group in Texas (**Figs. 2, 3, 4, and 5**). These units are composed of fine-grained, thinly bedded calcareous silts and silty limestones, with thick black shale interbeds, suggestive of deep water in inner to outer sublittoral environments. *Ptychodus* becomes more numerous and geographically widespread during the Cenomanian. *Ptychodus marginalis*, *P. occidentalis*, and *P. anonymus* appear suddenly in the fossil record and are distributed throughout the seaway from the Gulf Coast to South Dakota and Canada (Cicimurri, 1994, 2001; Welton and Farish, 1993; Murphy et al., 2007). The first occurrences of *P. anonymus* and *P. occidentalis* are found within the Tarrant Sandy Formation in Texas, the Greenhorn Limestone in Colorado and Kansas, and the Belle Fourche Shale in South Dakota and Canada. The earliest record of *P. marginalis* (with accurate stratigraphic information) is a single specimen (SMU 76441) from the *Desmoceras scotti* subzone of the *Sciponoceras gracile* zone (Late Cenomanian) in north central Texas. A single specimen (KUVVP 13525) is labeled as being from the Greenhorn Formation in Kansas, but the exact horizon and locality information is not given. Each of these species occurs with the lamniform sharks *Cretoxyrhina mantelli*, *Squalicorax volgensis*, and *S. curvatus*, and these are thought to have been offshore pelagic sharks (Shimada, 1997; Siverson, 2005; Shimada and Cicimurri, 2005).

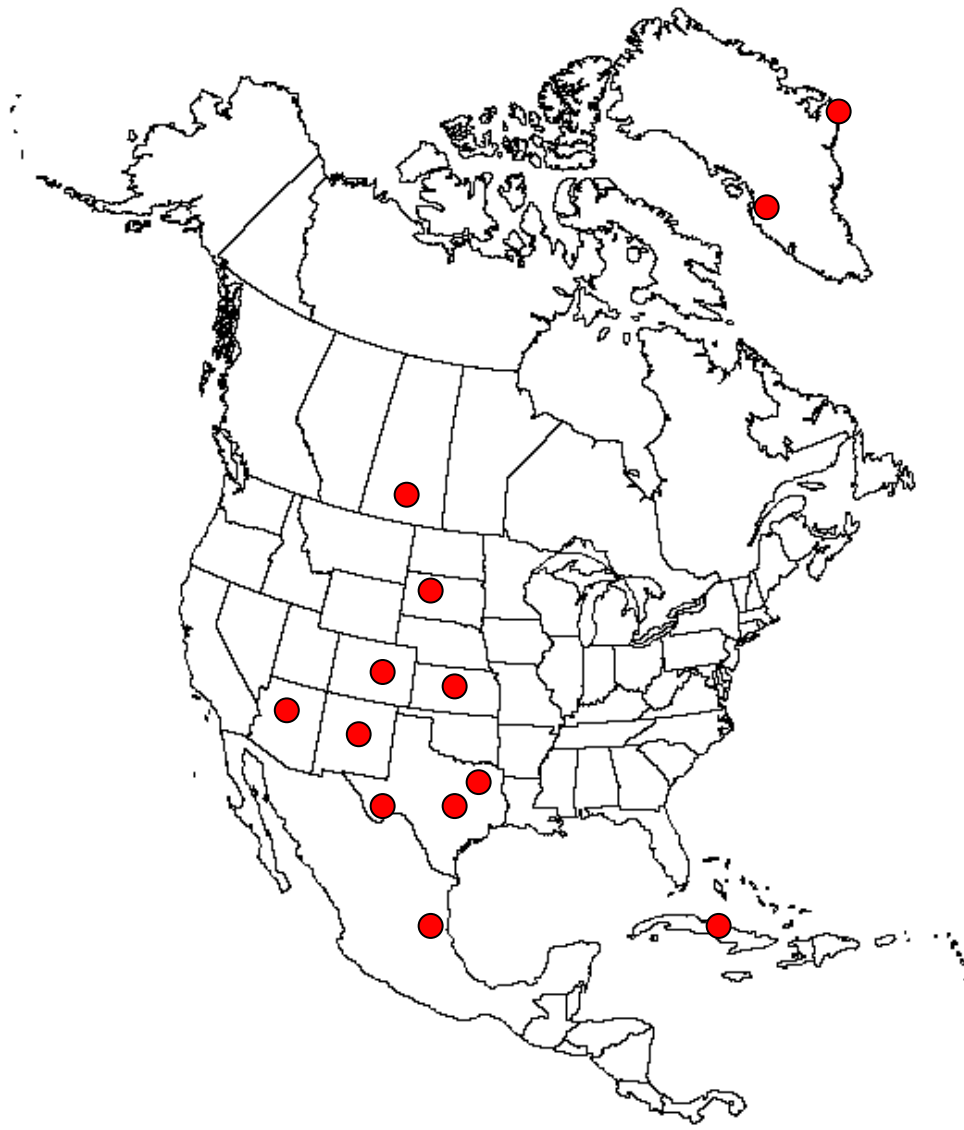


**Figure 73.** Cenomanian Geographic Distribution.



**Turonian--** A major extinction event during the Early Turonian recorded in a shift in oxygen isotope values, could have been the result of a major drop in salinity and severe stratification of the water column, eventually leading to an oxygen crisis in the seaway reflecting a global anoxic event known as the Bonarrel event (Kauffman, 1984; Nebregic, 2006).

During this interval, *P. mortoni* is first found within the *Watinoceras coloradoense* (Early Turonian) zone of Mexico (Blanco et al., 2007) along with *P. martini* (formerly *P. chappelli* Reinhart, 1951) in Colombia. *Ptychodus decurrens* has a narrow stratigraphic range in the Western Interior, and is restricted to the Middle Turonian *Collignoniceras woollgari* Zone. *Ptychodus occidentalis* is found more commonly within the Belle Fouche Shale and basal Greenhorn Formation in South Dakota with *P. decurrens* in Colorado and New Mexico and the Kamp Ranch Formation in North Texas. *Ptychodus marginalis* is found most commonly in the Kamp Ranch Formation, which is interpreted as storm deposit that formed during a short period of lowered sea level on the shelf of the southeastern part of the Western Interior Seaway (Jacobs et al., 2005). During the Middle Turonian these species are found in association with the lamniform sharks *Cretoxyrhina mantelli* and *Squalicorax falcatus*. The Middle Turonian also marks the final stratigraphic occurrence of *P. marginalis* worldwide. *Ptychodus whipplei* and *P. mammillaris* are first found within the *Prionocyclus hyatti* zone (Late Turonian) are found abundantly throughout the Western Interior Seaway and are associated with the lamniforms *Cretoodus semiplicatus* and *Squalicorax falcatus*.



**Figure 74.** Turonian Geographic Distribution.

**Early Coniacian**--The Niobrara Cyclothem started in the middle Early Coniacian and continued through the Late Coniacian, Santonian, and into the Early Campanian stages of the Late Cretaceous. Transgression and flooding of the Western Interior Basin during the early Coniacian resulted in facies changes from limestone and shale to chalk and marl deposits that were rich in organic carbon (Kauffman and Caldwell, 1993). By this time, *Ptychodus* was restricted to the middle and southern end of the seaway within the Smoky Hill Chalk Member of the Niobrara Formation in South Dakota and Kansas, the basal Atco, Ector and Roxton Members of the Austin Group in Texas, the Tombigbee Sand Member of the Eutaw Formation in Georgia, and the Mooreville Chalk in Alabama (**Fig. 6**). A reason for this distribution may be that *Ptychodus* preferred warmer subtropical to tropical environments.

Except in the Atco Formation, which was deposited in an open, offshore, shallow shelf environment, the Austin Group is a deep-water deposit that has a very fine textural composition throughout its range in Texas (Hovorka and Nance, 1994). Lithologically, the Atco Formation is a coarse-grained facies with alternating beds of chalky marls, chalky limestone and shale stringers with abundant phosphatic nodules (Young, 1985). Pessagno et al. (2005) noted that the base of the Coniacian occurs above the first appearance of *Marginotruncana sigali s.s.*, *Marginotruncana helvetica* and *Pessagnoella ectorensis*. The inoceramids, *Cremonoceras deformis erectus* is found in the Atco Formation (Kauffman et al. 1993; Lamolda and Hancock, 1996; Walaszczyk and Cobban, 2000) and the Fort Hays Limestone (Hattin and Siemers, 1987), and is a primary marker taxa for the Early Coniacian designated by the International Subcommission on Cretaceous Stratigraphy (2004). The presence of the foraminifera *Marginotruncana pseudolinneiana* allows for the correlation of the Ector Chalk and the Atco Formation with the Fort Hays Limestone Member of the Niobrara Formation in western Kansas (Frerichs and Deiss, 1987; Alshuaibia, 2006).

The shallow marine tropical environment that existed in Texas at this time was an ideal environment for many selachians, including the large lamniform sharks *Cretodus semiplicatus*, *Cretalamna appendiculata*, *Scapanorhynchus raphiodon*, *Squalicorax falcatus*, *Pseudocorax laevis*, as well as the sclerorhynchids *Ischyrhiza texana*, *Onchopristsis dunklei*, *Sclerorhynchus sp.*, *Ptychotrygon triangularis*, the dasyastid, *Dasyatis sp.*, orectolobids like *Cantioscyllium decipiens*, and *Chiloscyllium greeni*, the heterodontiform *Heterodontus canaliculatus*, and six species of *Ptychodus*, (*P. mammillaris*, *P. whipplei*, *P. latissimus*, *P. mortoni* and *P. martini*).

Modern sawfish, dasyatids, orectolobids, and heterodontids inhabit warm temperate and tropical waters on the continental shelf (Compagno, 1999). *Ptychodus latissimus* and *P. mammillaris* are common occurrences within Coniacian deposits in Europe. The presence of these taxa at the southern end of the seaway during the Early Coniacian represents the earliest record of these species in North America. These taxa along with *P. martini* may have migrated northward from Europe and South America.

**Late Coniacian to Santonian**--The youngest species of *Ptychodus* are found in Late Santonian and Early Campanian deposits in Kansas and the Gulf Coastal plain. *Ptychodus* species were less diverse at this time, being represented only by three species, *P. mortoni*, *P. martini*, and *P. rugosus*.

The Smoky Hill Chalk Member (Late Coniacian-Santonian) of the Niobrara Formation is predominately light-olive gray to olive gray chalky shale that is speckled by nearly white spheroidal, calcareous fecal pellets that are composed exclusively of coccoliths (Hattin, 1975). The chalk is evenly laminated, and scattered throughout the member are thin bentonite seams that have been used to construct stratigraphic composite sections (Hattin, 1982; Hattin and Seimers, 1978). The Smoky Hill Chalk Member was deposited over a large area on the eastern shelf of the epicontinental sea (Hattin 1982), several hundred miles from the nearest land and at a depth of over 500 feet, from late Coniacian through the Santonian (87 to 82 mya). The bottom conditions were dysoxic as indicated by numerous inoceramids and radiolitids that are covered with ostreid bivalves because of the lack of hard-ground and soft oozy substrate, which was perfect for the preservation of fossil vertebrates. The Smoky Hill Chalk Member contains a rich vertebrate fauna consisting of at least 16 chondrichthyan and 54 osteichthyan fish taxa (Shimada and Fielitz, 2006), as well as various tetrapod taxa, including at least 6 marine turtles, 10 squamates (one dolichosaur and nine mosasaur species), 4 plesiosaurs, 3 pterosaur, 7 bird, and 3 non-avian dinosaurs (Russell, 1988; Stewart, 1990; Carpenter, 2003; Shimada and Bell, 2006). However, it must be noted that the 'Niobrara fauna' is a time-averaged assemblage, and not all of the listed taxa coexisted at any given point during deposition of the unit (Stewart, 1990; Shimada and Fielitz, 2006). Stewart (1990) developed a scheme of biostratigraphic zonation of vertebrate remains, that also utilizes stratigraphically significant inoceramids and rudist bivalves and incorporating Hattin's (1982) Marker Units (M.U.), which are comprised of distinctive bentonite seams. Coeval ptychodontid species found in the Smoky Hill Chalk include *P. mortoni*, *P.*

*martini* and *P. rugosus*, and these also occur with *Cretoxyrhina mantelli* and *Squalicrax falcatus*. These species are found within Stewart's (1990) zone of *Protosphyraena pernicioisa* and Hattin's (1982) M. U. 1-3 and the zone of *Spinaptychus* consisting of M. U. 4 and 5 (**Fig. 7**).

The Tombigbee Sand Member of the Eutaw Formation represents a lag deposit containing a mixture of Santonian and Early Campanian ammonite and chondrichthyan taxa across the eastern Gulf of Mexico Coastal Plain (Case et al, 2001). Lithologically, the member consists of clean sandstones; argillaceous, marly, sandstone; and sandy, marly mudstones. Lag deposits are created by sea-level fluctuations and characteristically occur in shoreface to shelf environments (Becker et al., 1996b). The presence of the Early Campanian anacoracid shark *Squalicorax kaupi* (Schwimmer, 2007) and the ammonites *Pseudoschloenbachia mexicana*, *Boehmoceras arculus*, *Glyptoxoceras sp.*, *Baculites capensis* (Kennedy and Cobban, 1995) are indicative of an early Campanian age. The presence of *P. mortoni* indicates that the Tombigbee Sand Member is no older than the Late Santonian and no younger than the earliest Campanian as *Ptychodus* is not found in younger than the earliest Campanian worldwide.



**Figure 75.** Coniacian and Santonian Geographic Distribution.

**Campanian** -- The Roxton Member of the Gober Chalk is a skeletal limestone rich in *Inoceramus balticus* and ammonite remains (Fisher, 1965). The presence of the ammonites *Menabites delawarensis* and *Scaphites hippocrepis*, in combination with the planktonic foraminifera *Globigerinelloides multispina* and *Rugoglobigerina tradinghousensis*, dates the Roxton Member as Early Campanian in age (Thompson, 1991; Cobban and Kennedy, 1992; Alshuaibi, 2006). The occurrence of *P. martini* within the Roxton Member (Slaughter, 1980; Hamm, 2002; Hamm and Shimada, 2004) is the youngest record from Texas.

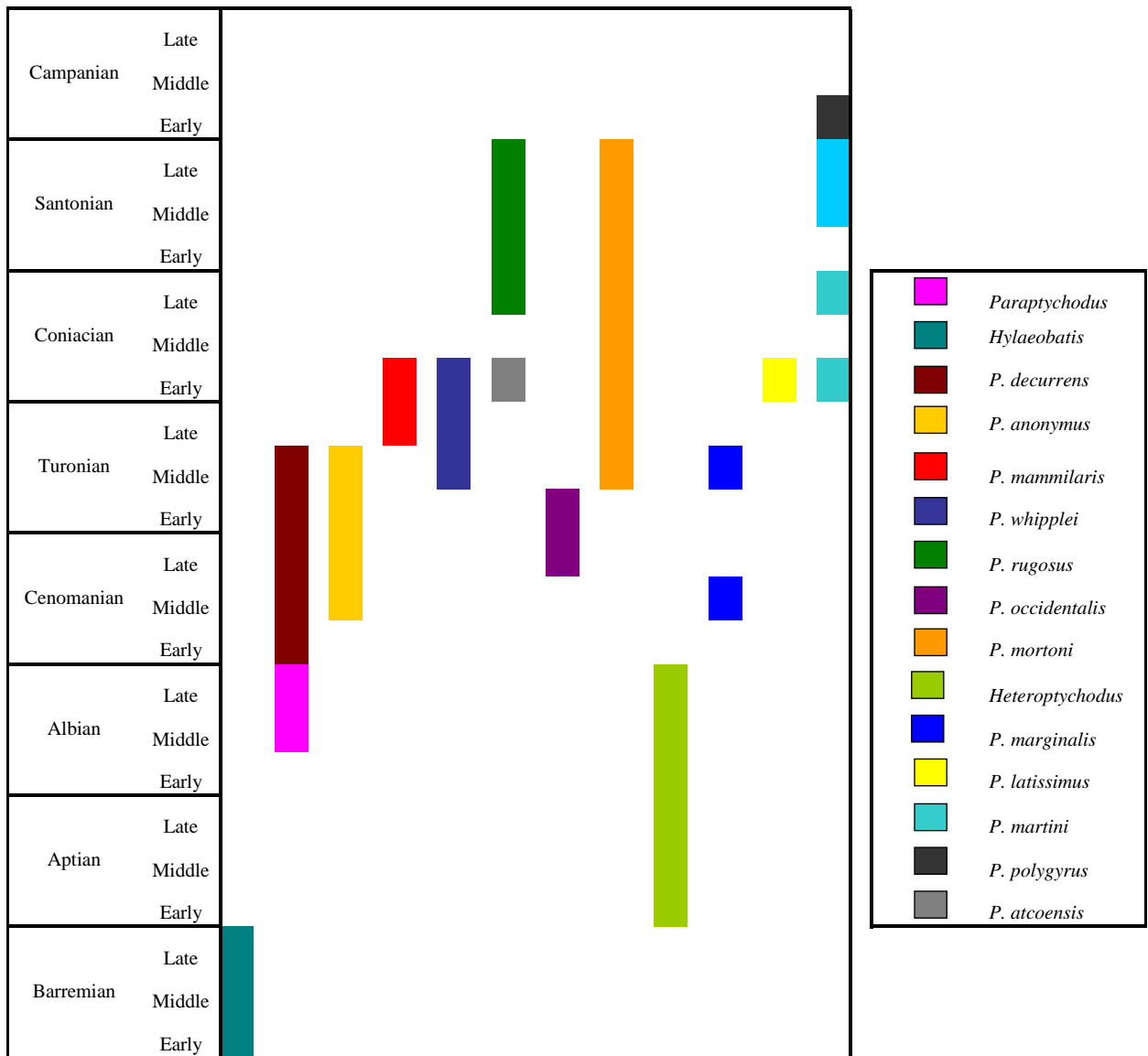
The Blufftown Formation (Early Campanian) of the Mooreville Chalk is composed of tests of the foraminifera *Calculites ovalis* and *Calculites obscuris*. Phosphate nodules consisting of worm coprolites, inoceramids prisms and ostreid bivalves occur in vast numbers (Applegate, 1970). The invertebrate, vertebrate, and lithologic composition is consistent with the Smoky Hill Chalk, and it is highly probable that the ocean bottom conditions were very similar with an oozy and dysoxic seafloor at a depth of about 600 feet of water (Applegate, 1970). *Ptychodus mortoni* and *P. rugosus* are here reported for the first time within the Blufftown Formation, and these species are associated with *Squalicorax kaupi*, *S. yangaensis*, and *Cretoxyrhina mantelli*.

Elsewhere, the only other reported Campanian ptychodontid worldwide is *P. polygyrus* from the *Actinocomax quadratus* zone (Early Campanian) in northern France (Dibley, 1911), and is the youngest European record of the genus. There are reports of *Ptychodus* being found in Maastrichtian deposits (Cicimurri, 1998; Johnson *et al.*, 2002; Johnson and Lucas, 2003; Alvarado-Ortega *et al.*, 2004; Williams and Lucas, 2005; Blanco *et al.*, 2007) but, there are no referable specimens and these claims cannot be verified. These statements are likely due to confusion in early reports regarding the locality and stratigraphic horizon of the type specimen of *P. mortoni*.



**Figure 76.** Campanian Geographic Distribution.





**Figure 77.** Stratigraphic Distributions of each member of the Ptychodontidae.

**Worldwide Geographic Distribution Remarks**—Comparisons of specimens reported within the Western Interior Seaway with established type specimens indicates that many species of *Ptychodus* had a greater worldwide geographic distribution than any other Cretaceous shark taxa. Species of *Ptychodus* thought to be endemic to Europe (*P. rugosus*, *P. marginalis*, *P. latissimus* and *P. decurrens*) have been recovered from deposits in northern Africa, Mexico and the Western Interior (MacLeod, 1982; Williamson et al., 1990; Welton and Farish, 1993; Gonzalez-Rodriguez and Applegate; Antunes and Cappetta, 2002; Blanco et al., 2007). Likewise, some Western Interior taxa, namely *Paraptychodus washitaensis*, *P. anonymus*, *P. martini* and *P. occidentalis* have not been found in deposits outside of the Western Interior and Gulf Coast. *Ptychodus mortoni* had one of the widest geographic distributions, being found in deposits from the Western Interior and Gulf Coast to Mexico, Africa and Europe.

The available data indicates that the extinction of *Ptychodus* coincides with the final occurrence of other large contemporaneous sharks *Cretoxyrhina mantelli* and *Cretodus semiplicatus*. The reason for its extinction is unclear; perhaps changes in climate or oceanic circulation patterns during the Late Santonian and Early Campanian affecting prey items could be attributed. It is possible that the presence of more derived taxa also developing a durophagus diet, i.e. the mosasaur *Globidens* and myliobatid sharks *Brachyrhizodus*, *Myledaphus* and *Myliobatis* during the Campanian became more prolific and out-competed *Ptychodus* who was already on the decline feeding on similar prey items.

## PALEOECOLOGICAL RELATIONSHIPS

Throughout its entire stratigraphic range, *Ptychodus* is found in association with other large lamniform shark genera like *Leptostyrax*, *Cretoxyrhina*, *Cretodus* and *Squalicorax*. The current anatomical data indicates that *Ptychodus* was itself a large pelagic predator with a fusiform body. This suggests that it was large and fast enough to compete with co-existing sharks in the same environments. *Ptychodus* occurs with the same frequency as, or is more abundant than other contemporary taxa within late middle to early late Turonian deposits (*Collignonoceras woolgari* zone).

Based on the arrangement of teeth in the dentition, *Ptychodus* was a specialized durophagus shark that preyed upon ammonites and benthic invertebrates like inoceramids, rudists and epizoal bivalves (Kauffman, 1972, 1977; Kirkland, 1983; Stewart, 1988). Evidence for this includes marks on inoceramid shells that bear a strong resemblance to the shape of *Ptychodus* teeth (Kaufmann, 1977) and rudistids (Hattin, 1982), oblong nodules from the late Turonian of Greenland containing inoceramid fragments (Hoch, 1991), and cirripid regurgitate from the Smoky Hill Chalk Member of the Niobrara Formation in western Kansas (Hattin, 1996).

Elongate and ovoid structures composed of fragmented *Pseudoperina*, inoceramid and cirripid plates have been reported from between Hattin's (1982) Marker Units 4 and 5 (Late Coniacian) in the lower Smoky Hill Chalk (Everhart, 1992; Hattin, 1996). The structures average 42 mm in length by 26 mm in width and are less than 10 mm thick at the center. One side of the structure is convex and smooth, whereas the other is rough showing the conglomeration of crushed shells. It is possible that both sides at one time were smooth, but during weathering the outer layer of the structure eroded. Hattin (1996) interpreted these structures as regurgitate rather than coprolites because they contain an abundance of coccolithic skeletal matter and cirripid plates. These taxa are found abundantly within the substrate on the ocean floor and their presence within these structures is indicative of ingestion through bottom feeding. Most modern durophagus elasmobranchs (i.e. Myliobatiformes and Rajiformes) ingest small amounts of substrate when feeding, indicating that they forage at or near the bottom.

*Ptychodus* inhabited a range of water depths and probably was not dependant on inoceramids as a major food source, but could feed on a variety of prey items. Durophagus rays

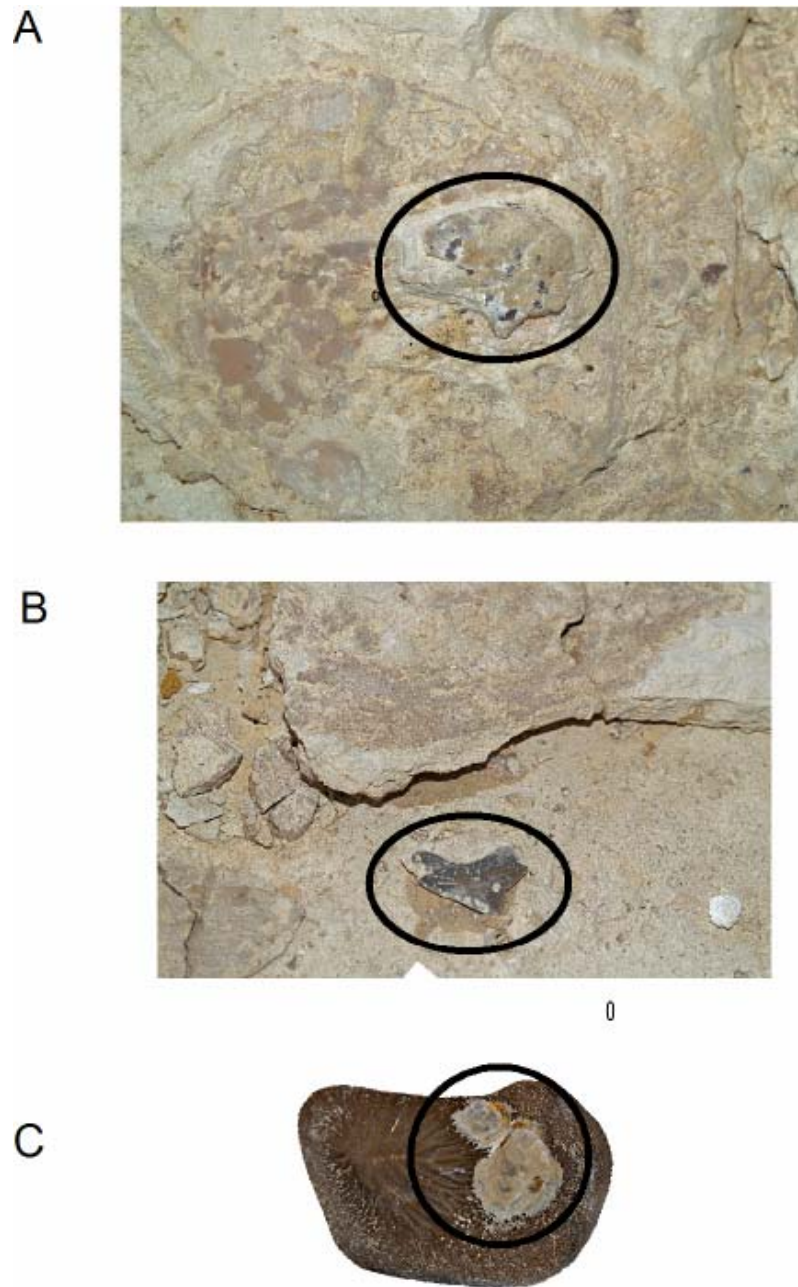
found on the continental shelf and in epipelagic environments are not dependent on bottom dwelling organisms; instead they feed upon fish and cephalopods (Compagno, 1999).

It is possible that *Ptychodus* also feed on ammonites, bony fishes and squids. Ammonites were one of the most common invertebrates of the period, and as such, would have represented a readily available food source. Although they cannot be directly correlated, other coprolite remains from the Smoky Hill Chalk Member contain the remains of tethuid squid tests and fish vertebrae.

There is evidence that *Ptychodus* itself was preyed upon. Shimada (1997) reported the occurrence of a *Ptychodus* tooth (FHSM VP 13325) encased within a coprolite from the Blue Hill Shale Member (middle Middle Turonian) of the Carlile Shale in Kansas. The coprolite measures 21 mm in the long and 15 mm wide. The crown surface of the tooth is smooth and featureless, which is likely due to etching through digestion. It is possible that this tooth could have been accidentally swallowed by the shark, as extant sharks occasionally swallow their own shed teeth (Stransberg, 1963; Uchida et al., 1996). However, the coprolite does not contain any other remains of its proposed diet or spiral features indicative of the intestinal structure of chondrichthyans. It seems likely that the tooth was neither a self-ingested tooth nor ingested by another shark. With the coprolite being small and featureless, it is possible that it was expelled by another large predator (i. e. shark or mosasaur) and the fecal mass surrounding the tooth is all that was preserved.

Only a single *Ptychodus* specimen is directly associated with another vertebrate and invertebrate taxa. KUVVP 59061 (*Ptychodus mortoni*) is a partially articulated specimen that has an anterior tooth of *Squalicorax falcatus* located at the front of the neurocranium (**Fig. 78 B**) and three other teeth were recovered near the specimen. It is unclear if the *Squalicorax* teeth were shed during an attack or during opportunistic feeding on an already dead carcass or could have previously been on the substrate. One segment of cartilage on the pectoral fin exhibits an interesting pathology (**Fig. 61**). This segment is rounded and pronounced, measuring 11mm in diameter, and is located in the middle of an otherwise perfectly formed radial; no other radials are affected. It could represent a re-growth of tissue from a previous injury or attack or an injury sustained during mating. Documenting specimens with bite marks and/or embedded teeth, as in KUVVP 59041 is important, because such specimens represent solid evidence for the coexistence of the two organisms; and because they provide a glimpse into their ecological interactions.

It is also interesting to note that the cartilaginous elements of the skeleton are intact and encrusted by the bivalve *Pseudopernea congesta* (**Fig. 78 A**), indicating that the remains were exposed on the ocean floor long enough to be colonized by the bivalves prior to fossilization. None of the teeth in KUVP 59061 are encrusted with these bivalves; however, a single tooth from the upper 4<sup>th</sup> tooth file in FHSM VP 355 does have a *Pseudoperna congesta* attached to the labial tooth edge (**Fig. 78 C**). None of the teeth in the remainder of the dentition of FHSM VP 335 show evidence of colonization. Presumably, the enamel on the tooth surface is not conducive for invertebrate colonization due to the lack of a frictional surface (De Beer and Kuhl, 2001).



**Figure 78.** Paleoeological Associations. **A**, *Pseudoperna congesta* attached directly to vertebral centra in KUVV 59061; **B**, *Squalicorax falcatus* tooth lying anterior to left hyomandibula in KUVV 59061; **C**, *Pseudoperna congesta* attached directly to tooth in the upper left tooth file in FHSM VP 335.

## CONCLUSIONS

One of the most widely recognized groups of Cretaceous sharks is comprehensively revised for the first time. This study names a new genus and species of primitive ptychodont, *Paraptychodus washitaensis* and one new species of *Ptychodus*, *P. atcoensis*. The family Ptychodontidae consists of four genera *Hylaeobatis*, *Heteroptychodus*, *Paraptychodus n. gen.* and *Ptychodus*. *Hylaeobatis*, *Heteroptychodus* and *Paraptychodus* are considered to be successive sister taxa to *Ptychodus*. Twenty six species of *Ptychodus* were previously described, most based on single tooth taxonomy. Comparisons of these taxa with designated type specimens, along with a larger sample of teeth for each species demonstrating the amount of variability within the dentition, confirms that *Ptychodus* has been an overly split taxon. The following 14 species are synonymized and are considered invalid: *P. altior*, *P. janewayii*, *P. chappelli*, *P. depressus*, *P. multistriatus*, *P. oweni*, *P. mammillaris-mammillaris*, *P. anonymus-mammillaris*, *P. chappelli*, *P. connellyi*, *P. paucisulcatus*, *P. schlotheimi*, *P. dixonii* and *P. mediterraneus*, establishing 12 valid species of *Ptychodus*, 11 of which are recognized in North America.

Morphological trends within the Ptychodontidae demonstrate constant specialization in tooth crown morphology. The strict consensus tree groups each species of *Ptychodus* based on a single event nested with *P. anonymus* and indicate the development of a high crown or crown loss due to the retention of a primitive condition. There is a homologous relationship between species having similar tooth crown morphologies; however, the clade of taxa exhibiting a high tooth crown indicates multiple polytomies, suggesting this character arose independently within multiple taxa.

Within the Western Interior Seaway the earliest member of the family, *Paraptychodus washitaensis* appears at the southern end of the seaway during the Middle Albian. The worldwide stratigraphic ranges for each species of *Ptychodus* are as follows: *P. anonymus*, Cenomanian-Middle Turonian; *P. marginalis*, Middle Cenomanian-Middle Turonian; *P. mammillaris*, Late Turonian-Early Coniacian; *P. whipplei*, Middle Turonian-Early Coniacian; *P.*

*atcoensis n. sp.*, Early Coniacian; *P. latissimus*, Early Coniacian; *P. martini*, Early Coniacian-Late Santonian; *P. rugosus*, Late Coniacian-Late Santonian; *P. mortoni*, Turonian-Santonian.

The tooth histology differs from the hybodontids, *Heterodontus* and modern myliobatids, as it possesses a triple-layered enameloid microstructure. Based on the skeletal anatomy *Ptychodus* possesses a hyostolic jaw arrangement. The presence of a fused mandibular symphysis, circular vertebral centra, plesodic pectoral fin and large dorsal fin indicates *Ptychodus* had a spindle shaped body. These features are characteristics found in modern neoselachians, in particular, the lamniform sharks. Because of its unique mandibular arch and dental arrangement, *Ptychodus* should be placed within its own order, the Ptychodontiformes nested within the Super Order Galeomorpha.

*Ptychodus* preferred warm to temperate waters in near shore to deep marine environments. With large dentitions, upwards of 60+ cm in length, and vertebral sizes comparable to contemporaneous taxa, and its co-occurrence with other large lamniform sharks, suggests that *Ptychodus* was a large bodied shark and attained lengths up to and possibly exceeding 6 meters in length. The presence of differentiated, three-rayed dermal denticles also indicates it was an active and fast moving predator. Its inferred diet therefore consisted of more than inoceramids and ammonites, most likely feeding on fishes and squids as well.

The use of 3-D morphometric data capture is an objective tool that can be used to quantify and establish specific dental characters that can aid in dental reconstructions and phylogenetic analysis. Nine landmark data points are recognized and are consistent among all tooth files. Analysis of the distances between landmarks and the planar relationships between them indicates that it is possible to determine the placement of individual tooth specimens to a specific tooth file within a dentition. Additional work with the statistical data obtained during this study will provide even greater resolution for dental reconstructions.



## APPENDIX I

### List of characters used for in-family phylogenetic analyses.

1. Osteodont (0) vs. Orthodont (1) tooth histology: (Maisey, 1982).
2. Teeth with three-layered enameloid: absent (0); present (1). (David, 1999)
3. Medial tooth height to crown height ratio: Low crown-1.0-.6 (0), Intermediate crown-.60-.40 (1), High crown-.40-0 (2).
4. Transverse ridge pattern: parallel (0); radiating (1); none (2). (Welton and Farish, 1993).
5. Transverse ridges: # ridges/CW > .5, thick (0); # ridges/CW < .5, thin (1); none (2).
6. Number of ridges on medial file, low crowned teeth > 10: no (0); yes (1).
7. Number of ridges on medial file, high crowned teeth >5: no (0); yes (1).
8. Transverse ridges cover entire apex of the crown in high crown forms: no (0); yes (1).
9. Transverse ridges cover entire apex of the tooth crown in low crown forms: no (0); yes (1).
10. Transition from ridges to margin: sharp (0); gradual (1); none (2).
11. Transverse ridges bifurcate at margin: no (0); yes (1). (Woodward, 1911; Welton and Farish, 1993).
12. Transverse ridges loop at margin: no (0); yes (1). (Woodward, 1911).
13. Transition from crown to margin: sharp (0); gradual (1); none (2).
14. Tooth margin: .5 CW/TW ratio, wide (0); < .5 CW/TW ratio, narrow (1); 1:1 CW/TW ratio, absent (2).
15. Marginal ornamentation: concentric (0); radiating (1); absent (2). (Welton and Farish, 1993).
16. Marginal ornamentation: thin (0); coarse (1); absent (2). (Welton and Farish, 1993).
17. Labial protuberance: feature of crown (0); feature of root (1); absent (2). (Rees and Underwood, 2002).
18. Lingual sulcus: feature of crown (0); feature of root (1); absent (2). (Rees and Underwood, 2002).
19. Tooth root structure: anaulacorhizous (0); polyaulachorizous (1); holoaulochorizous (2) (Maisey, 1982).
20. Nutrient foramina located: at crown root junction (0); at base of root (1). (Maisey, 1982; Cuny et al., 2006).

**In-family Character Data Matrix.**

<b>Taxa</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>
<i>Hylaeobatis</i>	1	?	0	1	1	0	?	?	1	2	1	0	2	2	1	1	1	1	0	1
<i>Heteroptychodus</i>	1	?	?	0	1	1	?	?	1	2	1	0	2	2	1	0	1	1	0	1
<i>Paraptychodus</i>	1	?	1	0	1	?	0	?	?	2	1	0	2	2	1	0	1	1	0	0
<i>P. decurrens</i>	1	1	1	0	1	1	?	?	1	1	1	0	1	0	1	0	0	1	0	0
<i>P. anonymus</i>	1	1	1	0	1	?	1	1	?	0	0	0	0	0	0	0	0	0	0	0
<i>P. occidentalis</i>	1	1	2	1	1	?	1	1	?	1	1	0	1	0	1	0	0	0	0	0
<i>P. mammillaris</i>	1	1	2	0	0	?	0	1	?	0	0	0	0	0	0	1	0	0	0	0
<i>P. atcoensis</i>	1	1	2	0	0	?	0	1	?	0	0	0	0	0	0	0	0	0	0	0
<i>P. whipplei</i>	1	1	2	0	0	?	0	1	?	0	0	0	0	0	0	0	0	0	0	0
<i>P. rugosus</i>	1	1	2	0	0	?	0	1	?	0	0	0	0	0	0	0	0	0	0	0
<i>P. marginalis</i>	1	1	0	0	1	1	?	?	1	2	0	1	0	0	0	0	0	0	0	0
<i>P. latissimus</i>	1	1	1	0	0	0	?	?	0	0	0	0	0	0	0	1	0	0	0	0
<i>P. martini</i>	1	1	0	0	1	1	?	?	1	2	0	0	2	2	0	2	0	0	0	0
<i>P. polygyrus</i>	1	1	0	0	0	1	?	?	1	2	0	1	2	2	0	2	0	0	0	0
<i>P. mortoni</i>	1	1	2	1	1	?	1	1	?	1	1	0	1	0	1	0	0	0	0	0

## APPENDIX II

### List of characters used in ordinal phylogenetic analyses.

1. Jaw suspension type: Hyostylic: (0) no, (1) yes (Wilga, 2002).
2. Hyomandibular accessory cartilages present: (0) no, (1) yes (Shirai, 1996).
3. Angular cartilages present: (0) no, (1) yes (Shirai, 1996).
4. Palatoquadrates narrow and elongate: (0) no, (1) yes.
5. Meckel's cartilage narrow and elongate: (0) no, (1) yes.
6. Symphysial fusion of right and left Palatoquadrates and Meckel's cartilage: (0) no, (1) yes. (Modified from Shirai's 1996 character 24): State 1 present in mobuline rays Nishida (1990).
7. Wing-like process on mandibular cartilages: (0) no, (1) yes (Shirai, 1996 character 25. State 1 present in myliobatid rays Nishida (1990).
8. Teeth formed in dental lamina within jaw cartilage: (0) no, (1) yes (Maisey, 1982).
9. Teeth in upper and lower dentitions arranged (0) diagonally; (1) linearly and imbricated; (2) linearly without imbrication (Shirai 1996 characters 96, 97).
10. Dentition type: (0) grinding, (1) clutching-grinding, (2) crushing (Cappetta, 1987).
11. Heterodonty: (0) strongly monognathic, (1) gradient monognathic, (2) dignathic (Cappetta, 1987).
12. Tooth replacement: (0) singularly, (1) synchronously by tooth row (Maisey, 1982).
13. Osteodont (0) vs. Orthodont (1) tooth histology (Maisey, 1982).
14. Teeth with three-layered enameloid: (0) absent, (1) present (Gillis and Donoghue, 2007).
15. Dominant median tooth file: (0) absent, (1) present.
16. Crown root junction: (0) tooth root narrower than tooth crown, (1) tooth root larger.
17. Anaulacorhizous (0); Polyaulachorizous (1); Holoaulochorizous (2); Hemiaulacorhizous (3) root structure (Welton and Farish, 1993).
18. Secondary tooth cusplets: (0) absent, (1) present (Welton and Farish, 1993).
19. Fusion of the first four cervical vertebrae (synarcual): (0) absent, (1) present (Stewart, 1980; character 72 of Shirai, 1996).

20. Circular vertebral centra: (0) absent, (1) present (Compagno, 1977).
21. Primary calcification of vertebrae: (0) reduced or absent, (1) restricted terminally, (2) developed (character 75 of Shirai, 1996).
22. Secondary calcification of vertebrae: (0) absent or poorly developed, (1) with endochordal radii radiating from notochordal sheath, (2) well developed solid intermedialia and diagonal calcified lamellae (character 76 of Shirai, 1996).
23. Paired pits for neural arches: (0) absent, (1) present (Compagno, 1977).
24. Paired pits for haemal arches: (0) absent, (1) present (Compagno, 1977).
25. Calcified vertebral ribs: (0) absent, (1) present (Maisey, 1982; Nishida, 1990; character 74 of Shirai, 1996).
26. Pectoral fin: (0) plesodic, (1) aplesodic (Compagno, 1977; Shirai, 1996).
27. Pectoral fin radials: (0) radial, (1) non-radial (Shirai's 1996 character 66).
28. Pectoral fin propterygia: (0) directed posterolaterally, (1) extending anteriorly (Compagno, 1977; Shirai, 1996).
29. First dorsal fin radials (0) plesodic, (1) semiplesodic (character 83 of Shirai, 1996).
30. Dorsal fin composed of: (0) elongate and rectangular basal cartilage, (1) radials only (Compagno, 1977; character 81 of Shirai 1996).
31. Cephalic fin spines: (0) absent, (1) present (Compagno, 1977; Shirai, 1996).
32. Differentiated dermal denticles: (0) absent, (1) present (Raschi and Tabit, 1992).

**Ordinal Character Data Matrix**

<b>Taxa</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>	<b>31</b>	<b>32</b>	
Hybodontiformes	1	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
<i>Heterodontus</i>	1	0	1	?	1	0	0	1	0	1	2	0	0	0	0	0	3	1	0	1	2	0	1	1	1	1	0	0	0	0	0	1	1
Myliobatiformes	0	1	1	1	0	1	1	1	1	2	2	1	0	0	0	0	2	0	1	0	2	0	1	1	1	1	1	1	1	1	0	0	0
Rhinobatiformes	1	1	1	0	1	0	0	1	0	1	1	1	0	0	0	0	3	1	1	0	2	0	1	1	1	1	1	1	1	0	0	0	0
Lamniformes	1	0	1	0	0	0	0	1	0	1	2	0	0	1	0	0	2	1	0	1	2	1	1	1	1	1	0	0	0	0	0	0	1
Ptychodontiformes	1	?	1	1	1	1	1	1	1	2	2	1	0	1	1	0	0	0	0	0	1	2	1	1	1	0	0	0	0	0	0	0	1

**APPENDIX III**

**Table of Tooth Measurement Data**

Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			left	left	right	right								
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge								
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
<b>Specimens</b>														
<i>Hylaeobatis ornatus</i>														
BMNH P. 47211	6.5	3					3	3	3	14	14	14	14	0
BMNH P. 47212	5.5	2.8					4	4	4	10.5	10.5	10.5	10.5	0
BMNH P. 47218	5	2.5					4	4	4	9	9	9	9	0
BMNH P. 47213	5	3					4	4	4	5.8	5.8	5.8	5.8	0
BMNH P. 47217	4	1.8	<b>Values Not Obtained</b>				3	3	3	4	4	4	4	0
BMNH P. 47214	4	2					3	3	3	6.8	6.8	6.8	6.8	0
BMNH P. 47219	2.5	1					1.8	1.8	1.8	5	5	5	5	0
BMNH P. 47215	3	1					2	2	2	4.5	4.5	4.5	4.5	0
BMNH P. 47216	2	1					1	1	1	3	3	3	3	1
BMNH P. 47220	2	1					1	1	1	5	5	5	5	1
<b>Specimens</b>														
<i>Parptychodus washitaensis</i>														
Type specimen SMU 615	3.11	3.11	5.29	5.29	5.62	5.29	8.00	5.29	8.25	5.29	5.66	8.25	1	5.0
SMU 76442	5.72	5.72	6.66	6.66	6.56	6.66	8.68	6.79	10.21	6.79	4.68	10.21	1	6.0
SMU 76443- 9 teeth	4.61	4.61	8.54	8.54	8.19	8.54	10.18	6.86	10.06	6.86	6.28	10.06	1	5.0
	3.47	3.47	6.46	6.46	7.01	6.46	8.00	6.41	8.28	6.41	6.61	8.28	1	4.0
	3.85	3.85	6.08	6.08	6.33	6.08	9.95	4.41	9.77	4.41	5.20	9.77	1	5.0
	2.77	2.77	5.90	5.90	5.85	5.90	8.57	4.64	9.39	4.64	5.81	9.39	1	5.0
	3.73	3.73	6.81	6.81	3.33	6.81	7.68	3.21	10.15	3.21	4.89	10.15	1	4.0
	2.95	2.95	8.08	8.08	5.51	8.08	8.99	2.55	10.17	2.55	3.31	10.17	1	4.0
	5.84	5.84	5.87	5.87	5.37	5.87	8.24	4.87	8.97	4.87	4.70	8.97	1	4.0
SMU 76444	3.00	3.00	8.50	8.50	8.31	8.50	11.50	5.11	11.95	5.11	6.04	11.95	1	5.0
	2.35	2.35	4.21	4.21	6.40	4.21	7.91	3.21	10.06	3.21	5.05	10.06	1	3.0
	1.22	1.22	3.21	3.21	3.10	3.21	4.20	3.90	4.47	3.90	3.36	4.47	1	9.0
	2.97	2.97	2.07	2.07	1.51	2.07	2.54	3.54	3.43	3.54	2.58	3.43	1	3.0
<i>Ptychodus mammillaris</i>														

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
<b>Texas specimens</b>														
SMU 62808	8.88	5.37	14.17	9.02	13.84	7.53	10.47	16.89	18.76	12.06	7.31	13.72	7.12	
SMU 63309 21 teeth	6.91	2.80	8.68	4.40	11.15	5.20	4.63	11.73	13.50	10.26	5.01	7.21	5.98	7.0
	10.19	5.31	17.29	9.60	17.37	8.86	8.95	15.59	18.09	17.39	9.00	17.11	12.03	8.0
	10.93	5.25	14.80	7.50	14.77	6.80	7.24	12.51	14.18	10.82	7.54	15.46	7.17	8.0
	9.69	5.82	12.46	8.30	12.36	8.42	6.84	12.14	12.35	11.05	6.99	10.94	8.82	8.0
	3.86	2.16	6.01	3.30	6.40	3.16	3.76	7.38	7.84	5.29	3.20	5.23	3.98	5.0
	3.84	2.17	5.60	3.50	6.34	3.42	3.44	5.68	7.22	5.42	3.61	5.19	3.83	5.0
	10.09	5.76	15.58	7.55	15.84	7.84	6.47	16.98	17.40	11.46	6.72	10.84	9.68	9.0
	7.52	2.82	11.97	4.70	10.37	5.00	6.05	10.37	11.68	13.00	5.47	11.30	7.01	8.0
	5.48	1.77	10.39	4.39	7.70	4.22	5.18	10.87	10.72	6.83	5.59	8.33	4.91	8.0
	6.46	2.76	11.20	4.67	9.71	4.33	5.08	11.62	12.88	6.72	4.83	9.97	5.84	8.0
	7.50	3.93	10.82	5.11	9.70	6.26	5.08	9.11	8.70	9.57	5.48	9.18	6.54	8.0
	5.43	2.25	8.71	3.65	7.59	4.28	4.17	7.09	7.51	9.61	3.76	8.17	4.42	8.0
	9.14	4.28	15.51	7.39	12.87	6.19	6.58	13.62	16.39	10.43	7.07	12.81	7.82	7.0
	11.39	5.40	15.67	7.14	13.47	7.55	7.09	14.90	15.43	11.87	5.98	9.23	8.66	8.0
	6.03	2.91	9.69	4.23	8.64	4.16	4.50	10.40	12.79	5.15	4.41	8.43	5.58	8.0
	6.15	2.33	10.43	4.59	8.86	5.21	4.67	12.75	8.59	11.09	5.88	9.59	6.61	8.0
	2.90	2.84	10.95	3.96	7.27	3.76	4.16	10.97	11.73	5.70	4.52	8.47	5.01	8.0
	6.64	3.07	10.07	4.59	8.68	4.73	4.54	9.86	7.77	9.97	4.86	8.30	4.44	8.0
	3.55	2.73	8.67	5.06	8.19	4.44	3.64	9.84	7.66	6.22	5.48	11.61	7.25	7.0
	5.00	3.07	7.29	4.26	7.34	4.13	4.12	7.19	5.17	8.62	4.13	6.24	3.06	7.0
	2.23	0.03	4.46	1.75	4.24	2.21	1.78	5.64	5.18	5.03	4.05	5.42	3.25	6.0
	1.53	1.07	4.28	1.98	2.00	2.63	3.09	2.90	11.31	5.54	3.91	6.39	3.30	6.0
	1.73	0.32	3.82	1.72	11.89	0.83	2.00	11.27	4.76	4.00	2.16	12.88	2.37	2.0
	1.38	0.21	4.04	2.09	3.36	1.48	1.90	1.90	3.29	4.43	2.76	3.98	2.20	3.0
SMU 75593	8.53	3.18	13.57	9.10	14.84	9.37	12.36	16.88	16.07	14.42	9.65	13.83	9.50	
<b>Kansas specimens</b>														
KUVP 32450 3 teeth	9.42	6.56	13.32	8.78	13.16	8.21	15.10	10.32	5.04	5.04	10.62	13.55	6.60	7.0
	7.63	5.34	12.50	7.89	11.75	8.36	11.81	10.19	5.86	5.86	10.69	11.33	6.08	7.0
	5.45	3.65	7.70	5.24	7.76	5.18	6.67	8.36	4.38	4.38	7.58	7.99	4.96	5.0



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
KUVP 32480 4 teeth	7.64	4.62	12.72	7.52	11.62	7.76	12.96	9.62	6.24	6.24	12.08	16.40	6.52	7.0
	2.28	2.37	7.71	4.06	8.39	4.60	9.57	7.18	3.94	3.94	9.06	13.37	3.98	6.0
	7.08	4.54	11.18	6.06	10.25	4.85	11.23	9.96	8.07	8.07	10.93	8.06	7.93	6.0
	3.95	1.79	7.11	4.60	8.17	5.81	7.98	7.15	4.10	4.10	6.82	9.61	4.23	6.0
KUVP 55243 7 teeth	3.41	2.35	8.03	4.94	5.88	4.60	10.76	6.76	3.52	3.52	5.85	7.71	3.64	7.0
	6.83	3.70	9.72	6.22	11.31	7.82	11.54	9.14	5.15	5.15	8.27	12.72	4.50	6.0
	3.69	2.48	7.73	5.78	9.90	7.55	10.22	9.56	4.50	4.50	9.23	10.29	4.64	7.0
	6.46	3.92	12.50	6.15	10.49	7.43	12.89	11.90	4.69	4.69	10.59	10.81	5.96	6.0
	6.82	4.60	9.09	5.00	9.40	4.84	7.32	9.03	4.91	4.91	8.91	8.22	4.62	6.0
	7.06	3.60	8.90	4.61	9.13	5.44	9.77	7.22	3.18	3.18	6.50	10.92	4.61	6.0
	1.41	2.89	7.77	4.14	9.43	4.48	6.61	10.68	3.30	3.30	7.63	10.48	3.91	5.0
KUVP 85019	3.93	1.86	6.65	4.21	6.99	4.16	10.00	7.02	3.51	3.51	3.97	5.47	3.80	6.0
KUVP 55241	9.45	5.97	15.34	10.68	14.81	10.25	15.48	13.77	8.48	8.48	15.04	16.60	8.55	7.0
KUVP 25282 2 teeth	4.71	2.95	7.66	4.80	8.71	4.99	10.72	6.12	3.87	3.87	7.35	12.13	4.15	6.0
	7.03	5.18	12.56	7.62	11.49	10.16	19.24	11.61	5.78	5.78	7.57	14.72	5.28	6.0
KUVP 55240 5 teeth	11.02	6.45	16.24	8.89	15.17	7.66	16.37	12.84	7.58	7.58	10.90	14.46	7.55	7.0
	4.58	1.52	9.21	5.43	8.38	8.29	11.84	7.85	4.54	4.54	8.13	12.57	4.72	7.0
	3.28	1.94	6.53	4.28	5.84	6.15	6.67	8.67	3.64	3.64	6.48	7.31	4.99	<b>7.0</b>
	8.21	5.48	13.03	8.09	12.14	9.74	15.02	11.55	5.74	5.74	12.77	18.19	7.88	6.0
KUVP 65056 11 teeth	7.64	5.83	12.42	8.71	13.51	10.21	14.40	11.07	6.06	6.06	12.29	14.98	6.82	8.0
	8.44	6.38	14.09	9.72	13.53	9.20	14.20	14.05	8.41	8.41	12.98	16.12	7.23	8.0
	5.43	4.51	8.41	6.43	11.18	7.04	11.27	9.31	5.27	5.27	8.44	12.45	5.63	8.0
	7.37	4.68	10.93	6.90	13.05	5.84	11.93	8.98	5.17	5.17	9.93	12.15	5.43	7.0
	7.04	4.82	12.84	8.32	15.64	8.70	19.42	15.06	7.20	7.20	15.30	9.22	6.62	7.0
	6.63	5.28	15.18	9.20	14.81	10.69	16.24	11.84	8.44	8.44	11.10	16.37	6.62	7.0
	7.54	5.27	10.91	7.80	13.17	10.52	14.64	13.66	9.77	9.77	11.54	15.14	8.04	6.0
	7.09	4.41	11.89	8.02	12.75	8.99	13.45	10.98	6.70	6.70	11.33	13.67	6.47	7.0
	6.58	2.24	11.12	6.61	11.72	5.67	14.44	8.80	4.84	4.84	9.29	16.46	5.02	6.0
	3.87	3.55	8.12	5.34	9.12	6.80	10.49	7.16	9.96	9.96	7.76	11.69	8.06	6.0
	6.42	4.53	11.17	5.12	8.76	6.59	13.60	6.60	4.49	4.49	6.23	12.91	7.74	7.0
5.91	1.79	8.79	4.80	10.14	5.55	13.23	8.73	4.27	4.27	5.30	13.69	4.58	7.0	

Distances in mm	Tooth Height	Crown Height	Apex to left posterior r tooth	Apex to left posterior r crown edge	Apex to right posterior r tooth edge	Apex to right posterior r crown edge	Posterior r Crown Width	Posterior r Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	

*Ptychodus decurrens*

Specimens Texas specimens, isolated teeth

SMU 62768- 11 teeth	2.20	2.20	4.49	4.49	4.28	4.28	5.36	5.36	4.62	5.36	5.36	6.07	6.07	6.0
	3.07	3.07	5.83	5.83	7.39	7.39	8.25	8.25	6.04	7.11	7.11	8.70	8.70	9.0
	3.68	3.68	8.11	8.11	6.98	6.98	8.65	8.65	14.56	6.14	6.14	11.38	11.38	7.0
	4.12	4.12	8.42	8.42	9.28	9.28	11.69	11.69	11.95	11.26	11.26	10.89	10.89	6.0
	4.74	4.74	10.37	10.37	11.70	11.70	15.70	15.70	18.74	13.44	13.44	15.13	15.13	7.0
	7.63	7.63	12.93	12.93	13.57	13.57	12.85	12.85	7.88	16.20	16.20	15.84	15.84	6.0
	3.00	3.00	6.29	6.29	9.10	9.10	11.16	11.16	9.84	8.58	8.58	9.77	9.77	6.0
	3.49	3.49	8.44	8.44	7.37	7.37	9.82	9.82	9.01	6.85	6.85	6.36	6.36	5.0
	5.29	5.29	8.44	8.44	8.67	8.67	10.66	10.66	7.58	10.69	10.69	9.82	9.82	5.0
	3.15	3.15	7.86	7.86	6.78	6.78	10.85	10.85	8.19	7.71	7.71	8.25	8.25	6.0
SMU 62769- 4 teeth	3.48	3.48	8.94	8.94	5.87	5.87	10.07	10.07	4.57	9.88	9.88	6.65	6.65	7.0
	5.71	5.71	9.10	9.10	10.25	10.25	12.27	12.27	7.97	12.30	12.30	8.86	8.86	7.0
	5.71	5.71	9.10	9.10	10.25	10.25	12.27	12.27	12.82	9.53	9.53	8.86	8.86	7.0
	8.10	8.10	11.44	11.44	11.75	11.75	13.25	13.25	7.62	14.15	14.15	11.15	11.15	7.0
SMU 62771- single tooth	6.71	6.71	12.59	12.59	11.29	11.29	15.11	15.11	16.00	13.52	13.52	13.08	13.08	7.0
SMU 76425- 5 teeth	3.04	3.04	9.70	9.70	15.99	15.99	17.63	17.63	20.16	18.47	18.47	15.43	15.43	11.0
	9.85	9.85	19.71	19.71	19.41	19.41	24.64	24.64	28.19	21.65	21.65	22.10	22.10	9.0
	2.88	2.88	6.03	6.03	6.70	6.70	7.39	7.39	7.33	5.80	5.80	7.12	7.12	5.0
	1.96	1.96	6.03	6.03	6.69	6.69	8.57	8.57	6.86	8.48	8.48	9.01	9.01	5.0
	4.44	4.44	9.36	9.36	9.90	9.90	12.25	12.25	12.99	10.31	10.31	8.92	8.92	5.0
	5.35	5.35	9.44	9.44	9.61	9.61	12.35	12.35	12.86	7.22	7.22	7.55	7.55	6.0

*Ptychodus anonymus*

Type Specimen *P. anonymus* KUV 55255

pl. xi, fig 8	6.86	4.69	10.00	7.27	9.29	6.73	8.71	10.21	10.45	8.70	4.64	8.08	5.42	12.0
pl. 11, fig. 17	6.81	4.67	9.73	6.69	11.51	6.98	7.75	11.57	13.79	9.11	4.97	9.28	5.09	11.0
pl. xii, fig. 18	6.05	4.28	10.60	7.84	8.60	6.32	8.26	11.52	8.59	7.64	5.35	7.88	5.51	12.0
pl. xi, fig. 27	5.97	3.46	10.55	6.30	10.11	5.06	6.38	11.43	11.94	10.29	5.86	10.92	5.82	11.0

Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			left	left	right	right	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			posterior	posterior	posterior	posterior	Width	Width	Width	Length	Length	Length	Length	
		edge	edge	edge	edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
pl. xi, fig. 22	5.72	3.41	9.00	6.04	9.61	6.21	8.52	9.46	10.80	11.12	5.87	11.10	5.85	8.0
pl. xi, fig. 7	5.23	3.34	10.34	5.69	11.93	5.63	6.47	12.89	11.62	10.11	5.04	11.10	5.22	12.0
pl. xi, fig. 5	4.89	3.70	8.88	7.55	6.59	5.29	8.64	8.98	7.62	8.69	5.02	8.07	6.16	8.0
pl xi, fig. 6	2.78	2.41	6.94	5.23	8.39	5.44	7.67	7.75	9.21	8.46	4.29	8.76	5.09	5.0
I-L fig by me	6.69	4.85	10.44	6.91	10.43	6.89	8.21	10.63	10.65	9.84	5.17	9.34	5.45	9.0
k	7.21	4.89	10.50	7.19	9.43	7.15	8.73	11.01	12.20	8.00	4.86	6.65	4.75	9.0
L	5.72	4.12	9.35	8.22	8.87	6.22	9.22	10.48	8.80	8.56	5.08	8.97	5.81	8.0

Specimens	Texas Cenomanian <i>P. anonymus</i>													
SMU 62772 lower media	5.65	2.50	6.83	3.89	7.93	4.48	4.55	4.34	8.58	8.64	4.58	7.90	5.34	9.0
SMU 62773 upper media	1.89	0.43	4.26	1.83	4.17	2.40	2.70	5.34	3.38	5.92	2.17	5.46	2.41	3.0
SMU 62774 4 teeth	4.06	0.84	6.81	2.80	6.46	4.19	4.72	8.40	9.19	6.34	4.54	6.46	5.81	8.0
	4.60	1.18	6.57	2.73	6.44	4.45	4.37	7.65	9.12	5.52	3.87	5.24	4.53	7.0
	3.71	1.25	6.68	3.54	5.84	3.14	3.89	6.85	8.69	3.71	4.59	5.90	3.96	8.0
	3.28	0.76	5.64	5.68	4.33	1.75	4.66	5.91	6.35	4.48	2.61	4.31	4.44	cw
SMU 62775 6 teeth	4.58	2.10	8.39	4.26	8.44	4.28	4.63	8.46	8.59	7.87	4.52	7.74	5.16	9.0
	4.33	1.84	6.60	2.67	6.80	3.33	3.05	8.00	4.53	8.63	3.29	4.95	3.80	8.0
	3.80	1.57	6.45	2.41	6.83	3.63	3.64	7.86	8.32	5.14	3.22	5.56	4.10	8.0
	3.91	1.52	7.12	3.15	5.76	3.48	4.36	7.87	6.62	6.29	3.78	5.42	4.31	9.0
	2.86	1.23	5.20	1.89	4.55	2.46	2.97	6.71	6.53	4.18	2.89	3.03	2.86	8.0
	4.02	2.65	7.47	4.06	6.10	4.32	3.44	9.15	7.77	6.92	4.24	6.52	5.92	9.0
SMU 62776 14 teeth	4.03	1.79	7.49	3.37	5.67	3.53	3.76	7.89	8.95	5.49	4.32	6.02	4.64	9.0
	3.91	1.53	7.57	3.39	5.49	3.31	3.67	8.30	9.28	4.10	3.18	5.46	3.48	9.0
	3.36	1.02	6.12	2.25	4.82	3.50	5.04	5.49	4.62	5.63	4.01	7.26	4.08	8.0
	2.54	0.80	5.58	1.85	5.45	3.56	3.48	8.53	6.78	4.88	3.00	5.92	4.56	6.0
	2.48	0.92	5.17	2.31	4.83	3.32	3.77	5.54	6.51	5.05	3.51	4.94	3.52	6.0
	2.48	0.72	4.81	1.33	3.84	2.21	2.72	6.04	6.61	4.55	3.30	4.02	3.25	6.0
	1.87	0.50	4.21	1.63	3.37	1.49	2.15	5.42	5.56	3.32	2.20	3.35	2.64	6.0
	2.03	1.10	4.00	1.78	3.85	2.47	2.79	5.13	6.21	4.42	2.65	2.94	3.27	5.0
	2.07	0.72	4.11	2.76	3.74	2.22	3.51	6.04	5.26	4.76	3.19	3.34	2.81	5.0
	1.53	0.13	3.74	1.64	3.84	2.22	2.54	5.51	4.17	3.81	2.20	4.49	3.13	5.0
	1.44	0.04	2.22	1.01	3.01	1.98	2.42	2.84	4.98	4.35	2.76	2.14	2.84	4.0

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
	1.70	0.57	3.31	1.14	3.08	1.67	1.59	4.90	4.87	2.66	1.99	2.99	2.25	4.0
	1.25	0.15	2.86	1.26	2.72	1.76	2.36	3.62	4.61	4.59	1.99	2.59	2.31	4.0
	1.17	0.22	2.62	1.53	3.07	1.67	1.96	1.72	2.74	5.35	2.17	4.17	2.15	4.0
SMU 76420 28 teeth														
Upper medial	0.82	0.25	2.83	0.84	2.89	1.72	1.75	3.37	5.38	1.22	1.43	1.95	2.32	0.0
Lower medials 6 teeth	7.32	3.50	11.29	5.88	12.49	6.22	4.90	11.91	12.04	8.25	5.37	8.61	6.69	12.0
	6.20	2.74	8.86	4.65	9.49	5.37	4.89	9.88	11.27	5.88	4.03	6.38	7.20	10.0
	4.95	2.35	7.56	4.21	8.09	3.62	5.20	9.21	10.20	6.45	6.14	6.88	5.41	8.0
	6.28	2.11	7.33	7.33	6.74	4.38	6.51	3.58	9.84	9.41	3.11	4.67	6.61	8.0
	4.18	1.90	7.41	2.81	6.66	2.49	3.19	9.10	10.46	4.28	3.15	4.74	4.14	8.0
	3.80	2.16	6.26	3.59	7.20	3.97	4.62	8.12	8.74	5.08	3.06	6.02	4.44	8.0
Right pm	4.25	2.35	5.98	3.77	6.99	4.52	4.04	7.37	7.40	5.98	3.90	5.92	4.58	8.0
anterolateral teeth	4.64	1.96	8.40	3.84	7.56	4.85	4.37	9.04	9.04	8.47	4.41	8.20	6.17	8.0
	3.19	2.03	7.58	3.46	5.09	3.65	3.83	9.07	8.91	3.95	3.12	4.99	4.16	8.0
	4.66	2.07	7.71	3.72	7.10	2.42	3.44	5.98	8.87	3.99	3.41	7.03	4.22	8.0
	3.61	1.04	4.88	2.58	6.22	2.99	3.10	3.56	8.74	6.00	2.92	6.17	3.05	8.0
	4.51	2.41	7.01	4.18	7.05	3.83	3.51	4.97	4.89	6.99	3.95	8.06	4.80	8.0
	4.17	2.61	6.32	3.94	5.87	3.43	3.57	6.08	6.98	5.10	3.46	4.66	3.92	8.0
	2.96	1.57	5.64	2.68	4.37	2.87	2.58	5.96	5.78	5.65	3.00	4.66	4.14	8.0
	6.77	2.98	12.64	6.17	12.17	6.30	6.83	15.03	12.61	15.45	7.13	9.94	8.03	12.0
	5.40	3.31	9.27	4.66	8.83	4.58	3.89	9.20	5.33	8.67	4.24	8.24	4.99	10.0
	5.50	2.58	8.00	4.05	8.82	4.15	3.66	9.16	9.47	6.79	4.00	6.48	4.52	8.0
	2.28	2.19	7.01	4.49	7.67	4.07	4.00	7.52	10.52	6.62	4.84	5.60	5.50	8.0
	2.16	0.92	5.77	3.06	6.39	3.73	3.47	6.90	7.82	6.19	2.93	5.81	3.85	5.0
	3.48	1.18	6.02	2.81	5.49	3.24	3.58	6.35	6.92	5.60	3.33	5.33	4.43	5.0
	0.48	1.54	4.36	2.70	5.28	2.73	2.56	6.49	8.27	3.40	2.86	5.20	3.36	4.0
	3.76	1.18	6.04	3.73	8.06	4.11	4.10	8.72	9.47	6.78	3.43	6.80	4.17	5.0
	4.18	1.53	6.43	2.96	7.90	3.71	4.09	8.14	4.10	7.88	3.93	9.74	4.07	5.0
	5.83	2.71	8.88	4.48	9.55	5.16	5.19	9.47	10.12	3.53	4.39	11.45	5.42	8.0
	2.12	0.60	5.23	2.02	6.59	2.71	3.08	2.20	3.88	6.76	2.52	7.85	3.80	4.0
	3.50	0.37	5.39	1.32	5.08	2.08	2.80	7.02	7.40	5.68	2.59	2.55	2.54	4.0
	1.79	0.62	3.01	1.60	4.28	2.74	2.68	4.90	5.57	2.87	1.99	2.32	2.49	4.0

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth	r crown	r tooth	r crown	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			edge	edge	edge	edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
<b>Specimens</b>														
Texas Turonian <i>P. anonymus</i>														
SMU 63280	4.58	2.68	7.46	5.10	7.79	3.45	5.49	10.62	9.74	4.64	5.71	8.55	5.00	8.0
	4.07	2.45	7.36	5.31	6.79	2.98	4.34	9.85	7.90	3.59	6.05	9.14	5.18	8.0
	4.23	2.59	7.62	3.93	7.86	3.07	3.82	9.56	7.92	3.30	4.50	7.91	3.11	8.0
	3.24	1.94	5.84	3.57	5.26	3.02	3.06	7.43	6.39	2.72	3.97	5.36	3.07	8.0
	1.00	0.48	6.32	6.53	5.18	4.37	2.19	3.87	6.15	7.43	7.85	5.29	3.59	8.0
	3.69	1.51	5.97	3.24	3.84	1.76	3.57	4.40	6.32	7.84	4.00	4.81	2.77	8.0
	2.50	1.50	5.46	3.23	4.71	2.00	2.62	8.22	6.32	2.53	3.73	4.78	3.43	8.0
Right series 5 teeth	4.23	3.67	9.79	7.93	4.73	4.96	6.25	10.40	8.54	5.20	7.45	8.05	5.17	10.0
	4.62	2.61	7.66	4.98	6.55	3.28	4.74	10.22	6.46	3.92	5.29	8.00	4.78	8.0
	2.59	1.28	5.52	3.52	3.64	1.65	3.40	7.28	4.57	4.12	2.88	6.19	3.71	8.0
	3.84	2.04	5.65	4.03	6.30	2.38	4.27	8.13	6.06	4.01	4.15	6.56	4.17	8.0
	3.82	2.05	7.27	4.03	5.53	2.63	4.12	9.43	5.57	3.65	4.16	5.89	3.33	8.0
Left series 7 teeth	3.34	1.67	5.42	3.74	7.35	2.12	4.30	9.53	7.15	4.04	4.38	8.48	3.80	8.0
	3.07	0.89	6.64	3.73	5.21	2.63	4.10	8.25	6.91	3.00	273.31	6.91	5.48	8.0
	3.35	1.62	5.26	4.04	6.19	2.38	5.02	7.94	6.56	4.02	4.35	7.00	3.22	8.0
	1.44	2.01	4.59	3.21	4.78	2.81	3.46	6.09	8.91	3.77	3.33	5.46	3.78	8.0
	2.66	0.67	5.07	2.94	4.21	0.93	2.82	6.24	17.41	3.95	3.08	6.07	2.71	8.0
	3.85	1.92	6.49	3.78	6.15	2.53	4.24	9.26	7.84	3.70	3.85	6.45	3.59	8.0
	4.46	2.58	8.43	5.16	7.94	4.19	4.49	13.39	13.39	22.76	4.91	6.97	6.56	8.0
SMU 76422 23 teeth	3.08	2.37	8.03	8.68	5.90	6.27	2.48	5.00	8.34	12.56	5.30	7.60	10.09	8.0
	5.19	1.78	9.11	5.56	7.56	5.98	5.45	12.10	8.43	11.46	8.57	7.79	5.48	8.0
	5.04	3.43	9.06	5.49	9.56	3.28	5.38	11.42	11.99	3.71	4.89	10.38	5.88	8.0
	5.49	2.68	8.69	5.64	8.76	3.88	5.24	12.76	8.91	4.97	6.17	8.61	5.71	8.0
	5.31	3.36	7.30	4.53	6.66	2.79	4.08	10.20	9.54	4.78	5.62	8.01	4.22	8.0
	3.99	1.98	8.83	5.47	9.01	3.25	5.37	11.54	8.93	3.20	4.52	9.55	4.82	8.0
	5.20	2.88	10.63	6.57	10.65	3.83	5.66	12.99	8.83	3.43	5.81	9.07	5.78	10.0
	6.82	3.75	8.62	5.69	8.70	4.41	4.93	9.30	8.84	4.80	6.94	10.04	5.30	8.0
	5.78	2.95	6.84	5.18	7.96	2.41	4.54	10.70	9.10	3.73	5.47	7.77	5.76	6.0
	4.30	2.33	9.59	3.85	8.82	2.22	3.04	11.61	10.52	18.49	5.72	8.60	3.89	10.0
	5.42	2.03	6.34	3.95	5.12	2.31	4.02	7.92	7.95	4.05	3.96	8.29	3.54	6.0

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
	3.36	1.73	8.37	5.87	9.51	4.08	6.80	11.42	6.13	4.06	3.39	11.69	4.23	8.0
	5.42	3.32	9.56	3.60	9.20	4.10	4.15	14.44	7.79	5.21	6.00	11.40	7.38	10.0
	4.14	0.44	9.30	4.99	8.78	3.90	5.37	12.42	8.85	19.91	4.09	8.28	6.21	10.0
	5.38	3.24	10.29	6.49	10.56	4.80	6.41	14.55	10.17	2.84	5.42	10.12	7.36	8.0
	6.49	3.85	8.68	5.80	8.72	4.55	5.28	11.93	11.48	5.22	7.72	8.21	5.66	8.0
	5.30	3.02	11.34	6.52	8.91	4.59	6.49	12.44	9.47	3.85	5.86	9.95	6.76	10.0
	7.59	4.11	9.78	4.75	9.08	4.47	4.74	11.39	13.48	5.03	7.13	9.50	4.39	10.0
	4.53	3.14	12.63	6.63	12.50	5.89	6.08	16.02	9.85	4.07	5.17	13.09	6.81	12.0
	8.98	4.84	9.08	5.32	9.02	4.39	4.41	10.94	12.16	5.51	7.52	9.35	5.61	10.0
	4.89	3.11	7.67	5.63	10.24	4.74	6.80	10.40	9.90	3.98	5.90	9.56	6.43	8.0
	6.08	3.74	7.83	3.91	6.24	3.13	3.80	3.89	9.16	6.63	6.64	9.09	4.76	8.0
	4.38	2.35	6.90	3.26	6.82	3.86	4.03	9.38	8.77	2.72	4.15	6.54	4.37	6.0
	3.95	2.03	8.48	3.88	7.92	2.55	3.10	10.03	8.29	2.07	3.70	8.13	4.11	8.0
	4.26	2.12	5.74	3.17	5.79	1.83	4.00	9.77	8.47	3.74	4.21	8.85	2.91	6.0
	2.02	1.09	8.89	3.93	8.52	3.99	4.18	10.24	7.50	2.34	3.26	7.59	4.88	6.0

*Ptychodus atcoensis*

Specimens														
Type specimen SMU 75599	9.13	5.86	12.57	8.31	13.21	8.72	7.88	13.14	13.78	10.86	6.61	10.29	6.43	5.0
SMU 75599	6.18	4.34	9.15	6.55	9.89	6.66	6.89	11.26	12.55	9.45	5.73	9.02	5.63	3.0
SMU 63302 (3 teeth)	1.50	1.50	3.51	4.39	3.02	3.02	5.19	5.19	5.79	4.00	4.00	4.59	4.59	3.0
	1.88	1.88	4.14	4.48	3.45	3.45	5.53	5.53	7.91	3.50	3.50	1.72	1.72	4.0
	4.48	4.48	6.09	4.30	7.13	7.13	6.17	6.17	7.02	6.78	6.78	5.62	5.62	5.0
SMU 76433 (2 teeth)	6.88	6.88	10.78	3.42	10.27	10.27	11.77	11.77	10.58	10.86	10.86	10.25	10.25	5.0
	10.73	10.73	15.87	3.59	14.08	14.08	20.44	20.44	19.09	16.36	16.36	14.96	14.96	5.0
SMU 76434 (3 teeth)	6.77	6.77	11.15	3.94	10.03	10.03	11.30	11.30	12.89	10.06	10.06	9.64	9.64	5.0
	5.22	5.22	9.41	4.10	9.21	9.21	10.83	10.83	13.65	5.88	5.88	7.40	7.40	4.0
	4.56	4.56	7.15	4.22	8.00	8.00	4.94	4.94	4.68	8.82	8.82	7.94	7.94	4.0
SMU 76435 (4 teeth)	6.33	6.33	10.82	4.44	9.66	9.66	9.45	9.45	9.94	10.16	10.16	9.72	9.72	5.0
	5.17	5.17	8.91	4.57	9.34	9.34	10.85	10.85	10.87	6.13	6.13	5.87	5.87	4.0
	4.48	4.48	6.87	4.69	6.48	6.48	6.35	6.35	7.23	7.38	7.38	4.79	4.79	4.0

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior r tooth edge	posterior r crown edge	posterior r tooth edge	posterior r crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
SMU 76436 (8 teeth)	1.85	1.85	6.70	4.81	5.36	5.36	4.95	4.95	5.44	6.67	6.67	4.46	4.46	4.0
	1.25	1.25	6.74	3.83	6.53	6.53	9.51	9.51	10.29	2.40	2.40	3.62	3.62	4.0
	4.61	4.61	6.74	3.92	7.21	7.21	7.55	7.55	9.39	5.34	5.34	3.91	3.91	5.0
	6.26	6.26	8.85	4.05	9.54	9.54	9.56	9.56	11.85	8.97	8.97	6.06	6.06	5.0
	7.10	7.10	11.15	4.26	11.56	11.56	10.71	10.71	8.37	12.79	12.79	13.14	13.14	5.0
	8.01	8.01	12.28	4.43	11.20	11.20	8.57	8.57	9.49	13.78	13.78	11.29	11.29	4.0
	4.81	4.81	6.77	4.58	6.68	6.68	8.26	8.26	10.38	5.56	5.56	1.82	1.82	4.0
SMU 76437 (6 teeth)	5.32	5.32	10.12	4.74	8.15	8.15	11.26	11.26	15.19	5.78	5.78	2.69	2.69	5.0
	3.75	3.75	5.03	4.44	4.90	4.90	5.18	5.18	7.27	3.66	3.66	3.46	3.46	5.0
	5.57	5.57	7.20	3.47	6.25	6.25	6.39	6.39	6.98	7.17	7.17	6.99	6.99	5.0
	1.02	1.02	4.88	3.56	7.27	7.27	5.67	5.67	12.77	6.49	6.49	8.47	8.47	3.0
	7.83	7.83	9.86	3.68	10.40	10.40	9.44	9.44	10.31	10.89	10.89	8.38	8.38	5.0
	5.96	5.96	9.38	3.87	8.02	8.02	11.65	11.65	11.67	5.64	5.64	2.23	2.23	5.0
	4.79	4.79	6.33	4.01	6.81	6.81	6.77	6.77	8.68	7.32	7.32	3.71	3.71	4.0
	5.12	5.12	6.52	4.12	6.80	6.80	7.33	7.33	10.12	3.00	3.00	3.47	3.47	5

**Specimens *Ptychodus occidentalis***

**TYPE SPECIMENS**

ANSP 1460	0.64	0.64	2.28	2.28	2.51	2.51	4.32	4.32	3.27	3.01	3.01	3.74	3.74	8.0
ANSP 1461	5.43	3.72	10.65	7.31	10.60	5.33	7.96	15.00	13.65	4.57	7.50	10.95	8.23	8.0
ANSP 1462	0.34	0.34	2.54	2.54	2.44	2.44	4.80	4.80	2.69	1.13	1.13	2.72	2.72	7.0
ANSP 1463	3.06	1.82	5.81	3.00	7.12	3.50	4.56	10.51	7.70	2.58	3.27	6.72	4.96	9.0
ANSP 1464	3.78	3.12	6.98	6.37	5.53	3.66	5.79	8.63	5.66	4.73	5.66	7.03	4.97	9.0
ANSP 1466	0.45	0.45	2.72	2.72	2.52	2.52	4.97	4.97	2.80	1.86	1.86	2.50	2.50	9.0

**Specimens *Kansas P. occidentalis***

FHSM VP 16700 81 teeth														
lower medial, crown wor	12.03	6.74	18.26	12.58	18.34	12.17	17.44	16.38	21.17	19.25	11.38	18.32	9.83	cw~10
medium sized right anter	5.21	2.61	11.13	5.85	9.89	6.25	8.47	12.79	13.64	10.67	6.68	11.55	6.60	cw~10
small medial?	7.03	4.39	10.65	6.10	9.94	6.27	8.44	9.35	10.38	9.38	4.32	9.05	6.39	cw~8
small left antero	4.13	2.57	8.76	6.41	6.35	3.76	8.05	9.45	8.40	8.27	5.02	8.53	4.82	10.0

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Small medial? In matrix	5.50	3.16	8.15	4.87	9.02	6.09	6.51	8.19	8.27	7.16	3.68	6.41	3.74	8.0
lower medial	2.26	0.83	5.91	2.12	5.96	2.00	3.61	8.78	3.84	7.46	1.73	7.34	2.07	10.0
	3.54	1.34	7.15	3.30	5.87	3.49	5.30	7.30	6.49	8.85	3.90	8.43	4.49	10.0
	5.09	2.88	7.60	4.72	7.02	4.87	7.42	8.03	7.35	7.98	4.11	8.14	4.07	10.0
possible posterior, no rai:	2.62	2.62	5.78	5.78	8.33	8.33	11.08	11.08	7.88	8.17	8.17	9.65	9.65	10.0
small pm? 2 teeth	4.63	2.15	6.18	4.08	7.18	3.91	5.33	6.53	8.17	5.67	2.79	5.39	3.22	10.0
	3.29	0.75	6.46	3.61	6.33	3.38	6.19	5.54	6.38	7.64	2.71	7.81	4.33	10.0
antero's 7 teeth	3.54	1.19	6.42	3.64	5.47	3.18	5.57	5.53	5.01	7.56	4.25	7.20	3.23	10.0
	2.46	1.52	4.55	3.19	4.71	2.79	4.97	5.24	6.38	7.05	2.64	5.50	2.12	10.0
	3.12	1.37	6.26	2.87	5.07	3.35	4.90	8.39	6.04	4.65	3.10	6.00	2.67	10.0
	2.60	0.72	5.16	2.35	4.86	2.81	4.48	6.46	6.78	4.65	2.69	6.04	3.46	10.0
	2.72	1.25	6.12	2.96	4.50	2.94	4.64	5.73	6.59	5.99	2.54	6.09	3.12	10.0
	2.09	0.18	5.80	2.00	3.78	2.27	3.03	6.81	6.20	5.05	1.94	4.28	4.93	10.0
	2.32	0.19	4.45	2.19	4.56	2.69	4.47	6.83	6.79	4.36	2.80	4.11	2.07	10.0
	1.77	1.77	4.71	4.71	3.74	3.74	5.91	5.91	5.89	5.55	5.55	5.52	5.52	10.0
right antero crown worn	7.15	2.95	12.75	7.35	11.37	9.05	12.97	11.31	10.95	16.87	9.68	16.04	9.62	10.0
Left PM	7.83	1.88	10.30	5.55	10.61	5.65	5.88	9.45	11.29	9.46	3.70	7.63	7.06	10.0
	6.25	3.43	10.69	6.85	12.46	7.50	11.42	17.57	8.39	12.23	5.43	10.67	7.31	10.0
	3.89	1.30	6.67	4.10	7.61	4.17	6.70	7.89	7.31	8.59	3.44	9.28	4.98	10.0
	4.10	2.08	6.47	3.29	6.24	3.95	5.06	7.15	6.02	4.40	2.64	8.06	2.97	10.0
	2.67	1.02	5.96	2.83	6.68	3.00	4.67	8.55	4.93	5.38	2.08	7.74	2.41	10.0
Posteriors	2.61	2.61	5.42	5.42	5.02	5.02	7.32	7.32	9.89	6.19	6.19	4.21	4.21	8.0
	2.27	2.27	5.78	5.78	5.40	5.40	7.22	7.22	9.03	6.27	6.27	2.29	2.29	8.0
	2.89	2.89	5.21	5.21	5.20	5.20	7.51	7.51	6.94	6.29	6.29	2.07	2.07	8.0
	2.18	2.18	5.10	5.10	5.22	5.22	6.43	6.43	8.98	3.68	3.68	5.23	5.23	8.0
	1.98	1.98	4.90	4.90	4.22	4.22	5.91	5.91	8.11	3.04	3.04	4.71	4.71	8.0
	1.06	1.06	4.81	4.81	4.34	4.34	6.78	6.78	7.90	5.65	5.65	4.80	4.80	8.0
	1.84	1.84	3.76	3.76	2.84	2.84	4.47	4.47	5.46	3.85	3.85	4.74	4.74	6.0
	0.46	0.46	3.52	3.52	3.65	3.65	3.66	3.66	5.46	5.71	5.71	5.31	5.31	6.0
	1.93	1.93	3.05	3.05	4.72	4.72	5.35	5.35	4.22	4.09	4.09	3.15	3.15	6.0
	0.00	0.00	2.96	2.96	6.22	6.22	6.89	6.89	8.55	5.46	5.46	0.00	0.00	5.0
	0.00	0.00	2.95	2.95	2.38	2.38	3.70	3.70	3.85	3.62	3.62	3.35	3.35	5.0



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
gel capsule with 12 teeth	1.92	1.92	2.78	2.78	2.60	2.60	4.00	4.00	3.60	5.05	5.05	3.80	3.80	5.0
	1.05	1.05	4.03	4.03	3.20	3.20	5.35	5.35	5.78	4.07	4.07	3.43	3.43	8.0
	1.80	1.80	3.48	3.48	3.58	3.58	4.29	4.29	6.35	3.76	3.76	3.06	3.06	5.0
	1.22	1.22	4.56	4.56	3.56	3.56	6.06	6.06	8.17	3.71	3.71	2.75	2.75	6.0
	1.35	1.35	3.17	3.17	2.77	2.77	4.06	4.06	3.42	4.24	4.24	4.26	4.26	5.0
	1.33	1.33	2.68	2.68	2.90	2.90	3.62	3.62	3.68	3.81	3.81	2.82	2.82	5.0
	0.90	0.90	2.96	2.96	4.24	4.24	6.59	6.59	2.68	3.12	3.12	3.78	3.78	5.0
	3.12	3.12	2.47	2.47	2.81	2.81	2.89	2.89	2.73	3.78	3.78	3.57	3.57	5.0
	1.02	1.02	2.13	2.13	3.62	3.62	4.01	4.01	4.07	2.54	2.54	3.72	3.72	5.0
	0.82	0.82	2.56	2.56	2.82	2.82	3.84	3.84	4.17	3.36	3.36	5.30	5.30	5.0
Gel capsule with 30 teeth	0.44	0.44	2.60	2.60	2.64	2.64	3.53	3.53	3.34	3.64	3.64	5.09	5.09	5.0
	0.68	0.68	2.12	2.12	2.69	2.69	1.37	1.37	3.33	3.18	3.18	2.62	2.62	5.0
	1.62	1.62	4.10	4.10	4.74	4.74	6.61	6.61	4.78	4.24	4.24	6.96	6.96	6.0
	1.33	1.33	3.27	3.27	2.67	2.67	4.23	4.23	2.52	1.99	1.99	4.81	4.81	5.0
	1.33	1.33	3.18	3.18	3.42	3.42	5.46	5.46	3.22	3.04	3.04	3.52	3.52	5.0
	1.02	1.02	3.36	3.36	2.66	2.66	3.98	3.98	3.45	2.51	2.51	3.88	3.88	5.0
	0.80	0.80	3.24	3.24	2.40	2.40	5.11	5.11	4.84	2.15	2.15	1.64	1.64	5.0
	0.80	0.80	3.33	3.33	9.17	9.17	12.07	12.07	3.52	3.06	3.06	8.55	8.55	5.0
	0.92	0.92	2.43	2.43	2.09	2.09	3.25	3.25	2.38	2.72	2.72	3.52	3.52	5.0
	0.45	0.45	5.40	5.40	7.29	7.29	4.92	4.92	1.84	5.93	5.93	4.73	4.73	6.0
	0.05	0.05	3.95	3.95	4.15	4.15	2.44	2.44	2.71	5.67	5.67	2.64	2.64	5.0
	0.94	0.94	3.43	3.43	2.38	2.38	4.87	4.87	4.20	2.89	2.89	4.13	4.13	5.0
	0.67	0.67	1.69	1.69	2.89	2.89	3.28	3.28	3.41	2.62	2.62	3.35	3.35	5.0
	0.91	0.91	3.52	3.52	2.59	2.59	2.98	2.98	0.00	4.66	4.66	2.21	2.21	5.0
	1.13	1.13	1.88	1.88	2.41	2.41	2.86	2.86	3.66	2.34	2.34	2.17	2.17	5.0
	1.44	1.44	2.37	2.37	3.16	3.16	4.55	4.55	3.58	3.04	3.04	2.16	2.16	5.0
	1.44	1.44	2.74	2.74	2.29	2.29	3.73	3.73	4.17	2.56	2.56	1.89	1.89	5.0
1.14	1.14	2.29	2.29	3.65	3.65	4.46	4.46	2.63	2.48	2.48	2.99	2.99	5.0	
0.99	0.99	2.17	2.17	4.57	4.57	5.47	5.47	4.75	3.44	3.44	4.35	4.35	5.0	
1.24	1.24	2.80	2.80	2.05	2.05	3.73	3.73	4.07	1.31	1.31	1.68	1.68	5.0	
0.69	0.69	2.19	2.19	2.42	2.42	4.39	4.39	2.99	2.15	2.15	0.77	0.77	5.0	
0.70	0.70	1.60	1.60	1.45	1.45	2.54	2.54	2.56	2.23	2.23	2.87	2.87	5.0	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
The tiniest of teeth 7	1.02	1.02	2.12	2.12	2.62	2.62	4.20	4.20	2.73	1.46	1.46	1.97	1.97	5.0
	0.24	0.24	1.49	1.49	2.33	2.33	2.72	2.72	3.59	2.14	2.14	3.67	3.67	5.0
	0.96	0.96	1.66	1.66	2.13	2.13	2.86	2.86	1.79	1.36	1.36	3.01	3.01	5.0
	0.68	0.68	2.15	2.15	1.79	1.79	3.05	3.05	1.71	1.64	1.64	3.43	3.43	5.0
	0.16	0.16	0.43	0.43	1.86	1.86	2.25	2.25	2.33	1.59	1.59	1.47	1.47	5.0
	0.63	0.63	1.46	1.46	1.17	1.17	1.71	1.71	2.34	1.41	1.41	2.28	2.28	5.0
	0.47	0.47	1.27	1.27	1.08	1.08	2.13	2.13	1.19	1.58	1.58	1.87	1.87	5.0
Gel capsule with 5 teeth	0.73	0.73	1.49	1.49	1.32	1.32	2.00	2.00	1.49	1.76	1.76	2.11	2.11	5.0
	0.46	0.46	1.12	1.12	1.19	1.19	1.64	1.64	2.03	1.62	1.62	1.68	1.68	5.0
	4.01	1.18	6.37	2.96	5.66	3.40	5.16	7.17	6.87	6.19	3.15	5.78	3.01	5.0
	2.29	0.82	4.15	1.92	5.05	2.46	3.82	6.68	4.12	4.71	1.39	6.33	1.83	5.0
	2.22	2.22	4.45	4.45	5.21	5.21	7.17	7.17	5.84	3.63	3.63	3.69	3.69	5.0
	3.01	3.01	4.76	4.76	4.60	4.60	5.87	5.87	5.79	3.48	3.48	3.46	3.46	5.0
	0.77	0.77	2.56	2.56	2.54	2.54	4.64	4.64	3.62	2.73	2.73	2.03	2.03	5.0

Specimens	Texas <i>P. occidentalis</i>													
SMU 62764	6.63	6.63	10.83	10.83	12.03	12.03	11.53	11.53	7.80	10.62	10.62	15.05	15.05	6.0
SMU 62765	7.78	7.78	11.47	11.47	12.77	12.77	10.52	10.52	13.84	10.59	10.59	8.60	8.60	5.0
SMU 62766-10 teeth	4.95	4.95	7.42	7.42	8.44	8.44	8.45	8.45	9.16	7.04	7.04	8.00	8.00	10.0
	4.69	4.69	6.43	6.43	7.41	7.41	6.66	6.66	6.70	8.08	8.08	7.55	7.55	6.0
	2.51	2.51	5.04	5.04	4.99	4.99	5.59	5.59	8.35	6.60	6.60	4.58	4.58	6.0
	2.91	2.91	6.20	6.20	4.79	4.79	7.34	7.34	8.99	5.72	5.72	4.38	4.38	8.0
	3.13	3.13	6.46	6.46	4.64	4.64	7.61	7.61	8.34	6.02	6.02	6.03	6.03	6.0
	2.27	2.27	4.72	4.72	5.51	5.51	7.53	7.53	7.23	5.64	5.64	6.05	6.05	7.0
	1.94	1.94	5.08	5.08	4.48	4.48	7.17	7.17	5.65	3.71	3.71	5.94	5.94	6.0
	2.23	2.23	4.03	4.03	6.00	6.00	7.09	7.09	8.57	2.46	2.46	4.18	4.18	6.0
	1.57	1.57	3.90	3.90	4.04	4.04	5.37	5.37	5.84	3.85	3.85	4.12	4.12	6.0
	2.24	2.24	3.78	3.78	3.90	3.90	5.08	5.08	4.94	3.92	3.92	2.68	2.68	7.0
0.04	0.04	2.29	2.29	2.95	2.95	4.13	4.13	4.09	1.89	1.89	3.13	3.13	5.0	

*Ptychodus whipplei*

Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			left	left	right	right	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			posterior	posterior	posterior	posterior	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
<b>Tooth Files</b>														
<b>SMU 63290 <i>Ptychodus whipplei</i> composite dentition</b>														
M1	8.72	5.89	11.23	6.62	11.52	7.14	5.26	10.16	7.30	13.64	4.25	9.33	4.46	***
M2	9.04	6.42	11.70	7.05	11.67	7.64	5.86	10.66	8.94	12.72	4.54	4.90	3.90	***
M3	9.40	6.85	10.73	7.78	11.16	7.50	5.80	9.21	9.14	13.37	5.22	4.91	5.08	***
M4	9.00	6.85	11.96	7.39	11.72	7.50	5.30	10.94	9.35	13.79	4.46	5.24	5.19	***
M5	7.61	5.24	12.76	7.78	11.47	7.95	6.77	11.92	9.77	13.58	5.40	3.45	5.50	***
M6	7.27	4.44	10.03	5.39	10.43	5.35	4.87	10.56	9.43	11.68	3.50	2.90	3.79	***
M7	7.43	6.31	10.72	7.08	10.90	7.11	6.21	11.08	10.28	12.53	4.32	3.11	3.96	***
M8	7.55	5.47	9.05	6.11	9.70	6.60	5.19	9.35	9.34	11.24	4.34	2.68	4.14	***
RPM1	6.20	4.31	9.19	5.14	8.87	5.84	5.20	8.61	11.93	4.35	4.46	4.76	4.84	***
RPM2	8.42	5.40	10.70	6.36	9.47	6.11	4.43	10.59	13.45	7.25	4.20	3.45	4.76	***
RPM3	5.92	4.20	9.54	4.75	8.87	5.22	4.28	10.15	13.77	7.02	3.59	4.25	4.09	***
RPM4	6.70	5.16	10.07	6.07	9.38	5.97	4.75	9.42	8.90	5.96	4.32	12.14	4.07	***
RPM5	7.92	5.45	11.03	6.58	9.07	6.27	5.66	8.52	12.54	6.01	3.77	3.81	5.01	***
RPM6	7.05	5.81	10.78	6.61	10.64	6.65	4.13	8.60	12.30	3.96	3.81	4.24	3.35	***
RPM7	5.84	4.29	8.19	5.06	8.56	5.14	4.19	8.05	12.39	5.23	4.50	3.57	4.12	***
RPM8	5.62	4.30	9.98	4.77	8.63	5.64	4.18	8.60	9.63	3.07	3.70	10.11	4.05	***
RPM9	6.59	4.37	8.98	5.06	8.68	5.05	4.22	8.54	10.89	2.71	3.53	4.48	4.20	***
RPM10	5.40	4.64	7.98	5.44	8.86	6.03	4.69	7.80	10.56	3.36	3.37	2.90	4.42	***
2R1	8.70	5.27	11.65	5.89	10.29	5.88	4.52	10.41	15.31	6.12	4.23	4.36	5.68	***
2R2	7.35	5.33	10.92	6.32	9.06	5.60	3.87	8.17	12.49	7.13	5.27	4.03	4.42	***
2R3	7.68	4.93	10.03	5.63	9.16	5.67	4.67	9.13	12.39	4.59	3.91	3.22	4.98	***
2R4	6.92	4.60	9.13	5.56	8.43	5.13	4.61	8.77	12.47	3.26	3.73	3.20	4.32	***
2R5	8.21	5.23	9.93	6.14	8.89	5.80	4.40	8.96	12.00	2.55	4.66	2.34	4.62	***
2R6	6.12	4.20	9.08	5.10	8.87	5.52	4.39	8.95	12.65	5.81	4.43	4.45	4.29	***
2R7	8.55	5.25	11.38	6.46	9.59	6.71	4.97	10.01	11.66	6.02	4.58	3.25	4.22	***
2R8	8.32	4.30	10.17	5.70	9.28	4.42	3.53	8.31	11.21	3.71	3.72	1.83	3.68	***
2R9	6.80	4.90	9.46	6.02	8.60	5.91	5.40	8.27	7.61	8.70	3.84	7.97	4.28	***
2R10	7.36	5.09	9.10	5.48	8.18	6.20	5.02	7.23	11.33	3.67	4.00	2.96	5.07	***
3R1	7.58	4.19	9.54	5.11	8.95	4.93	3.89	8.78	12.60	6.18	4.47	2.73	4.61	***
3R2	7.12	4.40	10.27	5.42	8.29	5.58	5.21	8.31	10.49	4.97	3.92	7.09	5.47	***
3R3	6.48	3.63	9.97	5.29	8.01	5.11	5.25	8.40	12.43	4.72	4.15	3.09	5.02	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
3R4	4.77	3.92	9.51	5.08	7.98	4.59	4.67	8.67	13.68	4.80	4.02	3.35	4.95	***
3R5	7.02	4.61	9.98	6.57	8.73	6.10	5.81	8.27	11.30	6.19	4.77	4.38	5.94	***
3R6	5.98	4.05	9.07	5.24	8.22	5.09	5.18	7.53	12.05	5.89	2.95	3.13	4.35	***
3R7	4.53	3.14	9.00	5.26	7.55	3.80	4.86	11.08	9.80	3.89	4.39	7.25	4.00	***
3R8	5.73	3.19	8.10	3.91	6.53	4.03	3.79	8.16	11.28	4.84	2.90	2.07	4.27	***
3R9	3.93	3.41	7.16	4.09	7.32	4.13	3.61	7.91	9.97	7.46	3.66	3.25	4.46	***
3R10	5.24	3.49	7.30	4.07	7.20	4.24	4.19	6.58	10.77	4.15	3.06	1.83	4.29	***
4R1	5.07	3.53	7.65	4.80	6.97	3.80	4.22	6.94	10.06	4.15	3.25	3.32	3.07	***
4R2	5.57	3.42	8.60	4.90	7.29	3.73	4.20	8.32	10.13	4.36	3.76	4.01	3.67	***
4R3	6.03	3.41	7.88	4.41	7.47	3.95	3.08	8.89	9.52	5.94	3.26	4.50	4.51	***
4R4	4.05	2.49	6.79	3.30	6.31	3.50	3.22	6.99	10.61	3.67	2.63	2.99	4.03	***
4R5	4.83	2.45	6.82	3.39	6.30	3.26	3.88	7.17	8.53	3.91	3.36	2.44	4.25	***
4R6	5.11	3.60	8.15	4.53	6.86	4.57	3.84	7.18	9.00	3.15	2.81	2.86	3.73	***
4R7	5.82	3.09	8.15	4.33	6.64	3.44	3.25	6.51	8.90	5.04	3.48	3.72	3.34	***
4R8	3.10	1.68	5.27	2.37	4.98	2.37	3.30	6.61	7.12	3.24	3.11	5.69	2.69	***
4R9	4.05	2.75	6.64	3.53	5.89	3.43	3.08	6.21	9.30	3.23	2.70	2.41	2.62	***
4R10	3.83	2.53	5.92	3.50	6.02	3.42	4.30	5.87	7.02	4.21	2.32	5.42	3.15	***
5R1	3.48	2.40	6.73	3.24	5.81	3.52	3.88	10.35	11.61	6.25	2.40	2.13	5.33	***
5R2	4.82	2.67	6.96	3.55	6.39	3.56	4.60	7.21	9.91	4.43	3.03	1.91	3.54	***
5R3	4.84	3.25	8.32	4.48	6.38	4.23	4.66	8.39	0.00	9.55	3.17	10.52	4.51	***
5R4	3.75	2.20	6.23	3.01	5.52	3.19	4.09	7.31	10.95	4.97	2.60	1.71	3.81	***
5R5	5.11	3.19	8.91	4.32	5.93	3.83	3.57	7.57	10.64	4.09	3.52	3.29	3.64	***
5R6	4.50	2.37	7.51	3.56	5.89	3.44	3.47	8.38	9.33	5.34	3.19	2.55	3.94	***
5R7	2.27	3.27	7.56	4.65	7.47	3.85	4.17	5.27	10.66	5.12	3.85	3.68	5.12	***
5R8	3.93	2.59	6.77	4.33	5.87	4.04	4.14	2.58	9.02	8.20	4.51	3.52	6.66	***
5R9	2.25	2.57	4.93	3.24	5.58	2.85	2.94	4.92	8.17	4.83	4.09	2.09	3.49	***
5R10	3.41	2.27	6.57	3.23	5.53	2.58	2.80	5.33	8.73	8.34	2.97	7.95	3.95	***
6R1	4.63	3.06	8.23	4.76	6.90	4.79	5.00	8.37	11.19	4.69	3.81	2.97	4.19	***
6R2	3.92	2.31	6.47	3.54	5.25	3.33	4.85	8.10	9.53	2.51	2.91	3.49	2.06	***
6R3	4.91	2.81	7.61	4.61	6.30	3.11	4.98	8.10	9.03	2.56	2.82	6.28	3.08	***
6R4	2.83	1.93	6.12	3.78	5.68	2.75	4.41	6.38	0.00	7.85	2.68	9.25	3.77	***
6R5	4.53	3.07	6.87	3.88	5.39	3.76	3.76	6.04	9.06	4.25	3.47	3.08	4.58	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
6R6	3.41	2.20	5.87	3.00	5.68	2.83	3.32	5.47	8.12	5.42	2.98	3.74	3.12	***
6R7	3.09	2.26	5.10	2.40	4.70	3.33	3.22	6.78	6.37	3.65	2.02	5.98	2.58	***
6R8	2.27	1.90	4.40	2.36	4.52	2.88	3.34	6.15	7.61	6.41	2.28	3.51	3.47	***
6R9	3.33	1.85	4.79	2.48	5.03	2.85	3.56	5.29	8.21	3.88	2.06	2.32	3.32	***
7R1	3.78	2.12	5.45	2.73	5.23	3.28	4.03	7.12	9.14	2.55	2.85	2.29	2.68	***
7R2	3.35	2.06	5.48	2.89	5.62	2.73	3.48	5.87	9.12	4.73	2.46	2.21	3.23	***
7R3	3.97	2.38	6.34	3.35	5.20	3.45	4.55	6.94	8.01	2.50	2.58	4.30	4.61	***
7R4	2.72	1.59	5.35	2.41	5.33	2.49	3.46	6.74	4.76	4.50	2.17	8.68	3.04	***
7R5	3.89	2.46	5.67	3.52	5.96	3.68	4.29	4.31	8.25	4.38	2.59	5.15	3.41	***
7R6	3.64	2.42	6.39	2.75	5.25	3.58	3.15	6.76	7.78	5.06	2.75	4.40	4.02	***
7R7	2.57	1.31	4.91	2.05	4.76	2.24	2.99	5.69	4.33	4.65	2.24	8.70	3.06	***
7R8	3.24	1.90	5.57	2.62	5.13	2.93	3.39	5.58	7.97	3.62	2.35	2.31	2.82	***
7R9	2.97	2.03	4.63	2.33	4.76	3.18	3.37	4.99	8.85	4.64	2.60	1.36	3.99	***
7R10	2.73	1.90	4.83	2.48	5.14	2.99	3.53	5.95	5.15	3.39	1.76	7.64	3.37	***
8R1	3.48	1.49	4.74	2.33	5.36	3.35	3.93	5.89	9.85	4.04	2.64	1.53	4.47	***
8R2	2.34	1.29	4.10	1.97	4.72	2.56	3.69	5.89	4.50	3.13	1.89	8.04	3.57	***
8R3	2.18	1.56	4.04	2.01	4.92	3.55	4.09	4.72	5.70	4.27	1.35	4.17	3.60	***
8R4	2.24	1.14	3.99	1.68	4.36	2.62	3.18	4.61	7.48	4.89	2.09	2.19	3.05	***
8R5	1.37	0.49	3.38	1.38	4.01	1.83	2.10	5.93	6.88	5.48	1.99	3.98	3.67	***
8R6	2.27	0.99	4.75	2.34	4.14	1.76	3.03	4.57	6.75	3.77	2.10	4.43	3.51	***
8R7	1.89	5.03	4.05	1.95	4.19	2.61	3.34	4.20	3.42	4.16	2.01	7.54	3.64	***
8R8	6.86	5.41	3.41	1.28	3.74	2.09	2.51	4.49	4.11	2.70	1.91	6.94	3.50	***
8R9	5.39	4.16	3.37	1.94	4.97	1.83	2.81	4.66	3.96	4.83	2.02	6.99	3.47	***
8R10	4.55	4.28	3.18	2.01	3.39	2.01	0.00	3.80	7.61	5.38	0.00	5.92	0.00	***
8R11	5.81	4.25	2.54	1.81	3.42	1.81	0.00	3.85	6.21	3.52	0.00	6.03	0.00	***
8R12	5.75	4.98	2.14	1.62	3.03	1.62	0.00	3.25	3.33	2.78	0.00	5.75	0.00	***
LPM1	5.13	3.68	9.58	5.85	9.21	5.81	5.26	8.97	10.36	4.35	6.29	12.17	6.45	***
LPM2	6.97	5.99	10.02	6.78	10.13	6.88	4.76	9.34	9.12	4.20	4.55	11.73	5.04	***
LPM3	5.57	1.59	8.73	5.86	8.87	5.21	4.45	6.02	7.58	6.55	5.82	11.88	7.24	***
LPM4	5.45	3.98	9.42	5.67	10.23	5.78	5.05	10.14	9.58	4.43	5.27	11.64	4.82	***
LPM5	6.03	5.03	9.67	5.64	10.61	6.13	4.30	8.72	8.77	4.83	3.98	11.53	4.45	***
LPM6	6.20	4.79	9.89	5.74	10.01	5.47	4.20	6.89	8.77	6.39	4.74	12.02	4.21	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
LPM7	6.11	5.03	8.88	6.20	8.56	6.14	5.01	8.70	8.00	5.05	4.28	10.04	4.78	***
LPM8	6.86	5.41	9.40	6.05	9.93	6.27	4.53	7.63	9.55	3.31	7.98	10.87	6.10	***
LPM9	5.39	4.16	7.42	5.22	8.61	4.63	3.79	6.87	9.13	4.15	5.44	11.07	4.67	***
LPM10	4.55	4.28	8.77	5.18	9.64	5.81	4.04	5.80	8.19	6.54	4.25	9.82	3.70	***
2L1	5.81	4.25	7.70	5.11	10.27	5.02	4.51	9.77	10.16	3.88	4.97	11.96	4.07	***
2L2	5.75	4.98	9.13	5.72	9.52	5.56	3.61	9.13	8.39	4.04	4.36	11.25	3.86	***
2L3	6.71	4.90	9.00	5.77	10.30	5.82	5.19	11.35	9.96	3.83	5.59	12.18	4.91	***
2L4	6.35	4.32	10.05	6.21	10.51	6.54	4.46	8.90	8.26	4.99	4.87	10.85	5.08	***
2L5	6.09	3.53	7.78	4.70	9.74	4.33	5.20	10.22	8.55	4.09	5.03	12.20	3.37	***
2L6	6.67	4.59	9.62	5.16	9.96	6.03	5.14	9.52	8.36	5.07	4.28	10.79	4.28	***
2L7	6.35	4.61	8.47	5.18	9.37	5.51	4.51	8.87	8.93	4.45	4.81	11.99	4.73	***
2L8	6.34	5.07	9.15	6.10	8.82	5.88	4.09	8.14	3.75	3.52	4.84	10.68	5.09	***
2L9	6.51	5.16	9.95	6.48	9.67	5.90	4.21	7.83	8.65	3.49	3.95	10.05	4.10	***
2L10	5.35	4.50	7.97	5.53	9.13	5.12	4.61	7.40	8.52	3.12	4.24	9.98	3.90	***
3L1	6.73	4.56	10.47	6.72	10.72	6.36	5.90	10.00	9.64	4.73	4.75	11.76	5.08	***
3L2	5.72	3.98	8.22	5.03	9.29	5.14	4.58	7.67	9.02	4.72	4.77	10.83	4.58	***
3L3	6.87	4.33	10.29	6.40	11.04	7.11	4.71	8.07	8.93	4.67	5.45	11.48	4.81	***
3L4	5.32	3.72	8.37	4.37	9.61	5.09	4.44	9.21	9.72	2.84	4.44	10.42	4.63	***
3L5	5.38	3.54	8.21	4.72	9.19	4.87	4.29	8.34	5.75	6.65	4.35	9.79	4.26	***
3L6	5.55	3.87	7.23	4.11	8.69	4.85	3.68	5.75	9.15	3.49	3.87	8.78	4.25	***
3L7	5.65	3.96	8.75	5.10	8.41	4.88	4.71	7.68	9.20	3.46	4.76	9.49	4.12	***
3L8	5.45	4.09	7.67	5.20	8.05	5.69	4.08	7.00	8.79	3.09	4.50	9.23	3.78	***
3L9	5.08	3.67	7.86	4.83	7.87	4.99	3.45	6.74	8.82	4.06	4.58	9.26	4.60	***
3L10	4.35	3.26	6.89	4.13	7.65	4.58	3.76	5.27	6.48	4.09	3.96	8.24	3.83	***
4L1	4.33	2.60	7.48	3.58	7.12	3.65	4.06	7.04	8.98	2.01	3.86	8.40	3.33	***
4L2	4.89	2.80	7.13	4.02	7.70	4.55	3.52	6.95	8.61	2.94	4.20	8.10	3.49	***
4L3	4.59	3.54	6.33	3.73	6.74	4.51	3.63	6.97	7.22	2.72	3.32	7.63	3.33	***
4L4	4.29	2.84	6.23	3.64	7.56	3.62	3.16	8.31	0.00	8.82	3.65	8.79	3.15	***
4L5	3.80	2.82	5.71	3.34	7.14	4.05	3.71	7.33	0.00	9.31	4.13	7.70	3.07	***
4L6	4.37	2.87	7.05	4.27	7.62	3.55	4.29	8.61	0.00	10.25	3.91	8.42	3.56	***
4L7	4.72	3.43	5.72	4.27	6.52	3.88	4.21	4.38	0.00	8.01	4.26	4.42	2.90	***
4L8	4.50	2.92	6.56	3.73	6.81	3.56	3.80	6.16	5.42	9.50	4.41	5.28	3.45	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
4L9	4.46	2.84	6.58	3.61	6.60	3.93	3.43	5.70	5.17	9.10	3.69	5.30	3.36	***
4L10	3.93	2.33	6.08	3.13	6.13	4.02	3.30	5.33	0.00	9.05	4.06	7.47	5.30	***
5L1	5.81	3.79	6.89	4.24	8.60	4.83	4.06	8.09	7.05	9.39	4.07	5.24	3.40	***
5L2	4.67	3.12	6.92	4.18	8.27	4.78	3.66	6.40	0.00	10.69	4.92	9.76	4.05	***
5L3	3.78	2.87	7.17	4.26	7.31	3.80	4.06	5.37	0.00	10.52	4.33	9.18	4.02	***
5L4	4.40	2.80	6.55	3.59	8.11	4.68	3.82	7.11	0.00	9.84	4.43	8.95	4.11	***
5L5	4.53	3.54	6.03	4.11	7.26	4.55	3.91	5.23	0.00	9.90	3.99	8.55	3.41	***
5L6	4.29	3.05	6.65	3.86	7.43	4.27	3.65	7.00	0.00	9.71	4.02	8.41	3.12	***
5L7	4.61	3.77	6.91	4.41	7.76	4.66	3.65	7.85	0.00	8.92	3.56	7.57	3.15	***
5L8	5.24	3.52	7.44	4.42	8.22	4.56	4.47	7.18	0.00	10.21	4.12	8.92	3.46	***
5L9	5.51	3.13	6.58	3.73	7.25	4.99	4.07	5.96	5.26	9.67	4.13	5.25	3.09	***
5L10	4.82	3.37	6.31	4.00	7.56	4.77	4.53	6.09	4.80	9.18	3.76	5.40	3.19	***
6L1	4.18	2.76	5.81	3.72	6.49	3.22	3.44	6.55	9.33	3.80	3.76	4.28	2.76	***
6L2	4.36	2.67	5.83	3.52	5.71	3.57	3.70	5.50	6.10	8.70	4.01	3.39	3.43	***
6L3	3.88	3.05	5.40	3.84	6.93	4.48	4.92	6.97	5.97	7.80	3.13	7.22	3.64	***
6L4	3.61	2.25	5.41	3.03	6.77	3.80	3.16	6.19	5.19	9.00	3.41	4.94	3.22	***
6L5	3.62	2.10	4.70	3.10	5.86	3.76	4.73	6.88	5.55	8.97	4.08	1.57	2.69	***
6L6	3.58	2.47	5.16	3.26	6.02	3.14	3.53	6.35	7.27	2.63	3.09	6.65	2.87	***
6L7	4.34	2.38	5.11	2.79	5.69	3.94	4.46	4.42	5.82	9.52	4.06	3.26	3.53	***
6L8	3.64	2.32	5.23	3.30	6.11	3.88	4.47	6.73	6.02	8.91	3.58	2.30	3.20	***
6L9	3.54	2.17	6.04	4.17	5.05	2.69	4.77	4.47	5.27	8.72	2.33	3.15	2.62	***
6L10	3.31	2.21	5.42	3.16	5.58	3.30	3.64	5.56	5.41	8.24	3.01	2.56	2.62	***
7L1	3.44	2.15	5.11	2.90	5.42	2.88	3.37	6.40	0.00	8.19	3.17	6.34	2.50	***
7L2	2.53	1.71	4.25	2.93	4.76	3.38	5.20	5.44	0.00	8.75	3.49	6.08	3.54	***
7L3	3.81	2.20	5.90	3.18	5.98	3.16	3.78	5.52	0.00	9.73	3.48	6.67	3.01	***
7L4	2.78	1.56	4.92	2.55	5.68	2.54	2.89	5.67	0.00	9.00	3.61	7.36	2.92	***
7L5	3.58	2.40	4.87	3.35	5.13	2.76	3.41	4.90	7.60	2.65	4.41	6.67	2.97	***
7L6	2.83	1.79	5.52	3.00	6.36	2.43	2.96	6.99	4.79	8.70	3.40	4.61	2.61	***
7L7	3.34	1.18	4.28	3.22	4.31	2.96	5.15	5.40	5.53	6.27	3.47	3.14	3.20	***
7L8	3.05	0.96	4.95	2.98	5.98	3.54	5.53	7.27	0.00	8.51	3.49	6.06	3.19	***
7L9	2.27	1.41	5.19	2.89	6.02	2.75	4.85	6.45	0.00	8.95	3.50	6.92	3.45	***
7L10	2.18	1.29	4.63	2.92	4.45	2.41	4.65	4.58	4.16	8.43	3.50	4.67	3.57	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
8L1	2.26	1.59	4.54	2.67	4.35	3.02	2.92	4.31	5.80	5.85	3.48	4.72	2.95	***
8L2	3.89	2.46	4.37	2.54	4.82	1.45	2.95	5.47	6.73	5.63	2.52	3.63	1.59	***
8L3	3.64	2.42	4.03	1.94	4.26	2.34	3.48	4.23	6.07	5.05	2.81	3.90	2.35	***
8L4	2.57	1.31	3.55	2.61	4.52	2.22	3.10	5.16	5.33	5.24	2.45	2.81	2.23	***
8L5	3.24	1.90	4.37	2.31	4.44	2.92	3.27	2.30	6.39	4.40	2.62	4.33	2.22	***
8L6	2.97	2.03	4.11	2.55	4.11	1.73	3.13	4.29	6.03	3.79	2.81	3.45	1.45	***
8L7	2.73	1.90	3.46	2.34	3.21	1.56	2.42	4.27	6.37	3.33	2.50	3.35	2.30	***
8L8	3.48	1.49	3.47	2.10	3.08	2.28	2.20	4.10	4.31	3.78	1.67	3.52	1.44	***
8L9	2.34	1.29	3.66	2.23	2.62	0.96	2.29	3.27	5.06	4.27	1.57	2.67	1.48	***
8L10	2.18	1.56	3.28	2.36	2.88	2.05	2.86	4.38	5.79	6.88	2.49	4.87	2.00	***

\*\*\* weak ridges

SUMMARY SMU 63290 *Ptychodus whipplei* composite dentition

Medial														
N=8														
Minimum	7.27	4.44	9.05	5.39	9.70	5.35	4.87	9.21	7.30	11.24	3.50	2.68	3.79	
Maximum	9.40	6.85	12.76	7.78	11.72	7.96	6.77	11.92	10.28	13.79	5.40	9.33	5.50	
Arithmetic Mean	8.25	5.93	11.02	6.90	11.07	7.10	5.66	10.49	9.19	12.82	4.50	4.56	4.50	
Standard Deviation	0.81	0.79	1.16	0.83	0.70	0.82	0.62	0.90	0.87	0.96	0.59	2.17	0.67	
Right PM														
N=10														
Minimum	5.40	4.20	7.99	4.75	8.56	5.05	4.14	7.80	8.90	2.71	3.37	2.90	3.35	
Maximum	8.42	5.81	11.03	6.61	10.64	6.65	5.66	10.59	13.77	7.25	4.51	12.14	5.01	
Arithmetic Mean	6.57	4.79	9.65	5.59	9.10	5.79	4.57	8.89	11.64	4.89	3.93	5.37	4.29	
Standard Deviation	0.94	0.57	1.06	0.75	0.62	0.53	0.51	0.89	1.60	1.64	0.41	3.12	0.49	
R2														
N=10														
Minimum	6.12	4.20	9.09	5.10	8.18	4.42	3.53	7.23	7.61	2.55	3.72	1.83	3.68	
Maximum	8.70	5.33	11.65	6.46	10.29	6.71	5.40	10.41	15.31	8.70	5.27	7.97	5.68	
Arithmetic Mean	7.60	4.91	10.08	5.83	9.04	5.68	4.54	8.82	11.91	5.16	4.24	3.76	4.56	



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Standard Deviation	0.80	0.39	0.95	0.42	0.61	0.61	0.55	0.92	1.90	1.93	0.50	1.70	0.56	
R3														
N=10														
Minimum	3.93	3.14	7.16	3.91	6.53	3.80	3.61	6.58	9.80	3.89	2.90	1.83	4.00	
Maximum	7.58	4.61	10.27	6.57	8.95	6.10	5.81	11.08	13.68	7.46	4.77	7.25	5.94	
Arithmetic Mean	5.84	3.80	8.99	5.00	7.88	4.76	4.65	8.37	11.44	5.31	3.83	3.82	4.74	
Standard Deviation	1.16	0.48	1.11	0.80	0.74	0.74	0.74	1.15	1.25	1.10	0.67	1.90	0.61	
R4														
N=10														
Minimum	3.10	1.68	5.27	2.37	4.98	2.37	3.08	5.87	7.02	3.15	2.32	2.41	2.62	
Maximum	6.03	3.60	8.60	4.90	7.47	4.57	4.30	8.89	10.61	5.94	3.76	5.69	4.51	
Arithmetic Mean	4.75	2.90	7.19	3.91	6.47	3.55	3.64	7.07	9.02	4.09	3.07	3.74	3.50	
Standard Deviation	0.91	0.59	1.08	0.81	0.74	0.56	0.50	0.92	1.20	0.88	0.44	1.17	0.64	
R5														
N=10														
Minimum	2.25	2.20	4.93	3.01	5.52	2.58	2.80	2.58	0.00	4.09	2.41	1.71	3.49	
Maximum	5.11	3.27	8.91	4.65	7.47	4.23	4.66	10.35	11.61	9.55	4.51	10.52	6.67	
Arithmetic Mean	3.84	2.68	7.05	3.76	6.04	3.51	3.83	6.73	8.90	6.11	3.33	3.94	4.40	
Standard Deviation	0.97	0.39	1.11	0.62	0.59	0.52	0.64	2.22	3.31	1.90	0.66	2.94	1.02	
R6														
N=10														
Minimum	2.27	1.85	4.93	3.01	5.52	2.58	2.80	2.58	0.00	4.09	2.41	1.71	3.49	
Maximum	4.91	3.07	8.91	4.65	7.47	4.23	4.66	10.35	11.61	9.55	4.51	10.52	6.67	
Arithmetic Mean	3.66	2.38	7.05	3.76	6.04	3.51	3.83	6.73	8.90	6.11	3.33	3.94	4.40	
Standard Deviation	0.85	0.46	1.11	0.62	0.59	0.52	0.64	2.22	3.31	1.90	0.66	2.94	1.02	
R7														
N=10														

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Minimum	2.57	1.31	4.63	2.05	4.76	2.24	3.00	4.31	4.33	2.50	1.76	1.36	2.68	
Maximum	3.97	2.46	6.39	3.52	5.96	3.68	4.55	7.12	9.15	5.06	2.85	8.70	4.61	
Arithmetic Mean	3.29	2.02	5.46	2.71	5.24	3.06	3.63	6.00	7.34	4.00	2.44	4.70	3.42	
Standard Deviation	0.49	0.35	0.59	0.45	0.36	0.47	0.50	0.91	1.86	0.93	0.32	2.78	0.61	
R8														
N=12														
Minimum	1.37	0.49	2.15	1.28	3.03	1.62	0.00	3.25	3.33	2.70	0.00	1.53	0.00	
Maximum	6.86	5.41	4.75	2.34	5.36	3.55	4.09	5.93	9.85	5.48	2.64	8.04	4.47	
Arithmetic Mean	3.68	2.92	3.64	1.86	4.19	2.30	2.39	4.65	5.82	4.08	1.50	5.29	2.71	
Standard Deviation	1.81	1.81	0.80	0.33	0.72	0.64	1.55	0.87	2.01	0.94	0.95	2.07	1.66	
LPM														
N=12														
Minimum	4.55	1.59	2.15	1.62	3.03	1.62	0.00	3.25	3.33	2.78	0.00	5.75	0.00	
Maximum	6.97	5.99	10.02	6.78	10.61	6.88	5.26	10.14	10.36	6.55	7.98	12.17	7.24	
Arithmetic Mean	5.83	4.39	8.04	5.14	8.52	5.13	3.78	7.18	8.22	4.67	4.38	10.38	4.29	
Standard Deviation	0.72	1.15	2.75	1.65	2.56	1.69	1.82	2.16	1.88	1.26	2.32	2.22	2.24	
L2														
N=10														
Minimum	5.35	3.53	7.70	4.70	8.83	4.33	3.61	7.40	3.75	3.12	3.95	9.98	3.37	
Maximum	6.71	5.16	10.05	6.48	10.51	6.54	5.20	11.35	10.16	5.07	5.59	12.20	5.09	
Arithmetic Mean	6.19	4.59	8.88	5.60	9.73	5.57	4.55	9.11	8.35	4.05	4.70	11.19	4.34	
Standard Deviation	0.42	0.46	0.87	0.56	0.54	0.62	0.52	1.18	1.75	0.64	0.48	0.85	0.58	
L3														
N=10														
Minimum	4.35	3.26	6.89	4.11	7.65	4.58	3.46	5.27	5.75	2.84	3.87	8.24	3.78	
Maximum	6.87	4.56	10.47	6.72	11.04	7.11	5.90	10.00	9.72	6.65	5.45	11.76	5.08	
Arithmetic Mean	5.61	3.90	8.40	5.06	9.05	5.36	4.36	7.57	8.55	4.18	4.54	9.93	4.39	
Standard Deviation	0.70	0.36	1.18	0.88	1.16	0.80	0.70	1.46	1.33	1.10	0.45	1.16	0.42	

Distances in mm	Tooth Height	Crown Height	Apex to left posterior tooth edge	Apex to left posterior crown edge	Apex to right posterior tooth edge	Apex to right posterior crown edge	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
L4														
N=10														
Minimum	3.80	2.33	5.71	3.13	6.13	3.55	3.16	4.38	0.00	2.01	3.32	4.42	2.90	
Maximum	4.89	3.54	7.48	4.27	7.70	4.55	4.29	8.61	8.98	10.25	4.41	8.79	5.30	
Arithmetic Mean	4.39	2.90	6.49	3.73	6.99	3.93	3.71	6.68	3.54	7.17	3.95	7.15	3.49	
Standard Deviation	0.31	0.34	0.59	0.37	0.52	0.36	0.38	1.31	3.91	3.24	0.33	1.55	0.67	
L5														
N=10														
Minimum	3.78	2.80	6.03	3.59	7.25	3.80	3.65	5.23	0.00	8.92	3.56	5.24	3.09	
Maximum	5.81	3.79	7.44	4.42	8.60	4.99	4.53	8.09	7.05	10.69	4.92	9.76	4.11	
Arithmetic Mean	4.76	3.30	6.74	4.08	7.78	4.59	3.99	6.63	1.71	9.80	4.13	7.72	3.50	
Standard Deviation	0.57	0.34	0.41	0.28	0.49	0.34	0.32	0.98	2.81	0.56	0.37	1.77	0.41	
L6														
N=10														
Minimum	3.31	2.10	4.70	2.79	5.05	2.69	3.16	4.42	5.19	2.63	2.33	1.57	2.62	
Maximum	4.36	3.05	6.04	4.17	6.93	4.48	4.92	6.97	9.33	9.52	4.08	7.22	3.64	
Arithmetic Mean	3.81	2.44	5.41	3.39	6.02	3.58	4.08	5.96	6.19	7.63	3.45	3.93	3.06	
Standard Deviation	0.35	0.29	0.40	0.42	0.58	0.51	0.65	0.94	1.25	2.39	0.57	1.85	0.39	
L7														
N=10														
Minimum	2.18	0.96	4.25	2.55	4.31	2.41	2.90	4.58	0.00	2.65	3.17	3.14	2.50	
Maximum	3.81	2.40	5.90	3.35	6.36	3.55	5.53	7.27	7.60	9.73	4.41	7.36	354.17	
Arithmetic Mean	2.98	1.66	4.96	2.99	5.41	2.88	4.18	5.86	2.21	7.92	3.55	5.85	38.16	
Standard Deviation	0.53	0.45	0.51	0.22	0.72	0.39	1.00	0.88	2.98	2.05	0.32	1.31	111.04	
L8														
N=10														
Minimum	2.18	1.29	2.82	346.67	2.71	346.67	0.00	2.85	0.00	3.74	0.00	3.37	0.00	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Maximum	3.89	2.46	4.80	354.55	5.90	354.55	0.00	8.34	5.32	9.00	0.00	6.50	0.00	
Arithmetic Mean	2.93	1.80	3.78	350.47	4.02	350.47	0.00	4.80	0.92	6.41	0.00	5.09	0.00	
Standard Deviation	0.58	0.40	0.59	2.56	0.90	2.56	0.00	1.48	1.97	1.86	0.00	0.96	0.00	

0, 200-300 values=missing data

Tooth Files SMU 76416 <i>Ptychodus whipplei</i> composite dentition														
M1	15.24	12.30	20.75	15.05	21.73	15.03	11.71	20.54	19.37	10.08	8.93	19.60	9.21	***
M2	15.11	12.17	19.55	14.00	20.13	13.28	11.62	21.53	18.28	7.37	9.48	18.29	9.69	***
M3	16.81	13.99	21.95	15.88	20.69	15.81	11.43	20.42	19.16	6.58	9.88	17.64	9.31	***
M4	15.28	11.89	18.72	13.89	19.03	13.68	11.35	17.66	16.58	7.42	7.89	15.21	8.94	***
M5	15.02	12.36	18.42	14.40	20.08	14.57	11.77	16.63	17.31	10.58	8.23	17.52	9.49	***
M6	13.80	11.55	18.37	13.71	19.76	12.85	10.08	16.37	18.01	8.60	8.31	16.72	8.82	***
M7	15.22	12.27	19.46	13.96	19.68	14.71	11.34	18.88	16.37	5.62	7.78	15.75	8.54	***
M8	14.63	12.58	19.77	15.00	18.35	13.65	11.81	15.79	16.96	7.23	8.29	12.91	9.56	***
M9	12.52	10.30	17.98	12.94	17.73	12.50	11.64	20.56	15.84	6.55	7.93	15.68	8.31	***
M10	14.87	11.91	18.30	13.33	18.56	13.82	11.44	17.74	15.00	5.95	6.80	12.66	8.92	***
RPM1	14.73	13.34	22.84	19.31	19.50	14.91	16.25	21.14	17.50	12.95	12.43	19.12	12.54	***
RPM2	14.78	12.08	21.12	18.11	17.43	13.90	14.76	20.79	7.34	11.47	11.27	21.26	10.39	***
RPM3	12.69	10.19	21.17	13.03	17.07	12.06	9.59	21.80	16.73	11.29	7.92	15.36	8.49	***
RPM4	12.49	10.95	20.14	16.05	16.20	12.63	12.11	17.33	14.78	7.57	8.32	16.91	10.22	***
RPM5	14.09	11.18	20.12	13.65	16.98	12.33	10.95	19.07	13.80	12.06	7.23	14.65	7.29	***
RPM6	11.71	9.88	17.02	12.22	14.06	10.48	8.30	15.36	11.79	11.32	7.64	13.15	6.89	***
RPM7	10.79	8.89	15.43	10.95	13.01	9.56	8.99	17.06	12.21	7.30	7.70	13.75	8.51	***
RPM8	10.64	8.34	17.24	12.02	13.56	10.42	9.47	15.58	13.06	7.76	8.31	13.70	7.07	***
RPM9	10.11	8.10	15.06	10.21	12.96	8.51	7.56	15.95	11.49	6.90	6.82	15.58	5.97	***
RPM10	10.03	8.44	16.15	11.19	12.54	9.46	8.70	15.19	13.86	6.68	7.08	12.90	7.89	***
2R1	11.02	10.21	19.19	12.42	15.79	11.21	9.86	18.59	11.76	10.32	8.30	16.53	7.65	***
2R2	10.90	9.04	16.41	12.03	14.11	10.16	9.41	17.27	10.88	10.83	6.80	16.71	8.52	***
2R3	12.96	10.56	18.10	13.18	14.34	11.10	9.28	17.23	10.39	10.86	8.06	16.70	8.41	***
2R4	12.84	10.84	17.17	13.37	14.76	11.62	9.99	15.99	13.78	9.82	7.48	13.33	8.52	***
2R5	10.47	7.72	16.43	11.70	13.19	8.63	9.33	16.07	11.11	9.91	8.14	15.34	8.81	***
2R6	9.83	8.70	14.21	12.24	14.30	9.46	10.32	13.04	14.74	9.50	8.15	14.11	6.69	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
2R7	9.00	8.64	15.60	12.71	13.48	9.40	10.24	14.57	11.16	11.22	7.17	15.62	9.05	***
2R8	12.10	10.13	17.39	15.38	13.93	11.36	11.39	16.28	11.10	10.19	10.25	13.27	8.93	***
2R9	11.15	8.31	15.14	9.56	13.24	8.99	7.69	14.61	11.84	5.28	6.17	14.13	7.47	***
2R10	9.13	7.83	14.52	8.81	10.25	8.25	6.58	14.53	9.91	6.01	5.57	12.85	6.08	***
3R1	10.44	8.41	15.49	11.59	12.65	9.43	9.77	13.23	11.42	10.17	6.65	16.79	8.69	***
3R2	9.23	7.85	15.72	9.11	11.93	8.67	6.39	14.46	10.51	10.03	6.92	12.72	6.78	***
3R3	9.33	7.84	14.71	9.83	11.86	8.47	6.43	12.58	8.03	9.65	7.47	16.15	7.94	***
3R4	10.44	8.15	16.37	10.78	12.97	8.99	7.19	14.61	9.50	7.35	7.71	14.75	6.83	***
3R5	10.47	8.46	14.64	10.92	13.34	8.88	8.58	14.46	10.70	8.24	6.83	12.91	7.04	***
3R6	10.96	8.92	14.63	10.93	12.89	9.55	8.19	11.79	11.44	6.09	6.96	12.33	7.83	***
3R7	9.47	8.15	14.37	9.19	13.17	9.18	6.62	14.08	10.07	7.09	4.88	12.01	5.88	***
3R8	7.87	7.07	15.68	9.40	10.79	7.91	7.56	15.22	10.86	7.08	5.69	12.80	5.87	***
3R9	8.64	6.58	12.23	8.17	11.30	6.81	6.45	12.24	8.75	7.06	3.84	14.44	4.82	***
3R10	8.15	6.70	12.97	8.58	9.65	7.50	6.01	11.62	8.69	7.40	4.93	8.34	5.82	***
4R1	11.86	9.52	16.65	11.39	13.84	9.94	8.08	14.96	10.90	9.30	8.33	14.27	7.81	***
4R2	10.58	8.83	15.58	10.67	13.78	9.60	7.61	16.86	11.82	7.11	5.58	14.27	6.02	***
4R3	10.69	8.99	15.67	11.53	12.56	9.46	8.26	14.88	10.81	9.56	6.29	13.75	7.98	***
4R4	9.94	7.64	17.23	9.60	13.77	9.06	7.64	16.29	11.89	8.89	6.91	17.17	7.26	***
4R5	10.31	8.03	15.72	9.49	11.93	8.74	7.38	15.81	11.21	6.16	6.81	14.07	6.95	***
4R6	10.27	7.71	14.99	9.13	11.67	8.49	6.34	14.27	10.55	10.55	5.57	10.45	6.32	***
4R7	7.92	6.94	16.33	10.28	9.00	7.96	6.78	12.54	9.92	8.43	6.41	10.91	7.40	***
4R8	9.71	7.22	14.96	8.68	12.37	7.76	6.10	14.36	9.56	7.91	4.89	11.33	4.91	***
4R9	8.58	6.59	12.66	8.08	10.34	7.25	6.66	12.00	9.65	5.04	4.49	14.76	6.17	***
4R10	9.54	8.14	13.43	9.55	11.48	8.63	6.10	11.81	10.86	4.18	4.72	12.66	6.11	***
5R1	9.62	8.48	15.50	11.05	13.62	9.91	7.68	14.00	10.61	8.62	5.89	12.59	6.08	***
5R2	8.69	7.39	14.46	10.78	12.07	7.63	8.25	13.45	9.45	9.71	6.10	10.57	5.85	***
5R3	9.03	6.85	14.38	7.86	12.10	7.61	5.95	14.59	10.52	7.43	5.26	11.95	6.09	***
5R4	9.44	8.11	14.95	10.20	10.53	8.64	7.50	12.79	11.44	4.93	4.78	10.21	5.36	***
5R5	8.66	6.55	11.93	8.64	10.93	6.86	6.84	11.89	10.88	5.75	5.23	11.40	5.37	***
5R6	8.46	6.50	13.31	8.98	10.20	7.20	6.75	11.92	8.77	7.91	5.96	11.87	5.71	***
5R7	7.07	5.31	11.54	6.67	11.00	5.93	6.14	13.01	8.69	8.29	4.51	15.78	5.42	***
5R8	9.14	7.37	13.34	10.67	11.03	7.72	8.20	11.83	8.86	6.59	5.76	12.57	5.02	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
5R9	7.12	5.68	12.91	8.22	9.61	6.18	5.90	10.53	9.61	8.05	5.88	13.25	5.86	***
5R10	8.30	7.54	14.31	11.01	10.54	9.13	7.09	11.63	8.72	8.57	6.58	10.98	6.21	***
6R1	8.76	7.39	12.63	9.49	10.40	8.06	7.45	10.81	9.58	6.47	5.40	12.82	7.02	***
6R2	8.48	6.17	11.95	8.03	10.42	6.55	6.17	13.02	9.43	8.32	4.71	13.07	5.43	***
6R3	8.36	6.45	13.21	9.54	10.59	7.65	7.16	12.27	7.94	7.90	5.54	13.64	6.76	***
6R4	8.13	6.51	12.26	8.85	10.26	7.60	7.76	11.50	10.47	8.47	4.94	11.62	7.36	***
6R5	9.11	6.53	12.35	8.43	11.59	7.19	6.98	11.05	9.08	7.82	5.43	13.11	5.14	***
6R6	7.93	6.52	12.88	9.46	10.21	7.11	6.93	11.10	9.53	7.26	5.43	13.98	5.91	***
6R7	8.99	7.10	13.19	8.76	10.08	8.02	6.24	12.91	8.75	7.83	5.83	9.53	5.80	***
6R8	7.31	6.57	12.93	8.72	8.66	7.03	5.92	9.92	9.34	7.79	5.41	10.19	5.21	***
6R9	6.53	4.66	11.06	6.32	8.61	4.84	5.44	10.50	7.01	8.39	3.68	12.72	4.25	***
6R10	7.37	5.65	12.03	6.82	9.57	6.44	5.89	11.00	9.41	5.50	3.94	12.60	4.56	***
7R1	7.36	5.62	11.63	7.42	8.84	5.88	6.22	11.69	6.49	7.09	4.28	12.19	5.45	***
7R2	5.84	3.72	11.48	8.73	8.08	4.90	7.01	9.53	8.96	8.62	4.17	9.32	4.40	***
7R3	7.93	6.18	11.62	7.91	9.26	6.36	5.60	9.91	8.64	7.51	4.18	8.32	4.61	***
7R4	6.13	4.75	9.54	7.09	7.46	5.32	5.84	9.69	5.97	6.45	3.34	11.65	4.72	***
7R5	6.82	5.64	10.56	6.12	9.56	6.21	3.98	10.53	7.78	6.33	3.34	10.15	4.05	***
7R6	7.00	5.77	11.51	7.15	8.92	6.33	4.84	10.30	6.88	6.11	3.53	9.65	4.21	***
7R7	5.99	4.61	10.17	6.08	7.91	5.20	5.06	9.42	8.33	7.20	3.99	8.95	4.85	***
7R8	6.27	5.07	9.80	6.52	7.96	5.66	5.21	8.78	6.84	3.46	3.03	10.09	4.85	***
7R9	5.96	4.59	8.38	5.30	8.03	5.46	5.29	8.50	7.75	6.75	3.81	9.14	4.77	***
7R10	3.23	2.38	5.84	3.86	6.53	3.47	5.18	8.74	7.24	5.44	3.75	8.42	3.78	***
8R1	4.74	3.69	7.98	4.76	8.04	4.32	4.50	9.25	6.95	7.24	4.06	10.41	4.21	***
8R2	4.94	4.10	8.26	5.12	7.90	4.86	4.88	8.70	6.64	5.71	2.99	8.96	4.61	***
8R3	4.07	3.10	8.26	5.01	5.90	4.33	4.57	7.98	5.92	5.28	3.26	10.54	4.29	***
8R4	5.75	4.54	9.20	6.24	7.95	5.25	5.73	8.90	5.67	6.66	3.59	10.75	4.06	***
8R5	5.23	3.61	7.92	4.98	7.04	4.17	3.87	8.04	4.58	5.41	3.44	8.84	3.85	***
8R6	3.63	2.51	7.24	3.31	5.61	3.47	4.00	7.92	6.00	4.52	1.99	7.97	2.88	***
8R7	3.80	3.04	6.84	4.11	6.78	4.72	3.96	7.02	5.28	5.40	2.21	7.84	3.32	***
8R8	2.95	1.78	5.12	2.96	4.76	2.92	3.95	5.79	5.72	6.08	2.96	5.79	3.65	***
8R9	2.58	2.30	7.60	4.56	6.75	4.25	4.43	7.95	5.84	5.79	3.06	8.89	3.86	***
8R10	1.51	1.22	6.94	3.99	6.19	3.91	4.04	7.34	5.49	5.44	2.73	7.87	3.51	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
LPM1	16.81	13.99	17.42	12.30	19.70	13.35	10.26	21.93	17.16	10.96	8.30	11.40	10.16	***
LPM2	15.28	11.89	17.13	12.67	18.71	11.68	11.38	17.02	17.57	5.91	8.21	17.11	8.26	***
LPM3	15.02	12.36	15.70	9.70	17.68	11.35	8.56	18.16	15.86	6.95	7.45	17.61	7.18	***
LPM4	13.80	11.55	15.57	10.07	17.78	10.54	8.84	15.23	16.27	9.36	8.88	18.88	9.18	***
LPM5	15.22	12.27	16.04	10.31	17.46	11.33	7.23	17.45	12.71	9.91	7.37	11.27	7.07	***
LPM6	14.63	12.58	15.83	11.01	17.91	11.36	9.18	19.69	16.73	5.29	7.83	10.81	7.82	***
LPM7	12.52	10.30	13.78	9.26	16.65	8.81	7.46	17.96	13.05	6.47	8.01	10.91	9.81	***
LPM8	14.87	11.91	13.34	8.34	14.65	9.27	7.07	17.37	13.48	5.42	6.81	11.16	7.22	***
LPM9	14.73	13.34	12.72	8.33	15.10	9.68	8.50	15.32	14.23	5.11	7.29	13.21	7.18	***
LPM10	14.78	12.08	14.37	9.43	15.45	10.02	7.43	13.79	14.90	5.86	6.55	12.48	5.92	***
2L1	12.69	10.19	18.21	12.18	20.30	12.86	9.38	22.20	18.43	6.71	8.97	15.81	9.04	***
2L2	12.49	10.95	15.85	11.24	22.33	13.96	10.83	18.68	17.71	5.80	6.55	19.10	7.11	***
2L3	14.09	11.18	16.41	10.67	20.30	12.04	9.18	16.11	18.64	5.97	8.24	18.16	9.76	***
2L4	11.71	9.88	15.24	9.88	18.02	10.62	9.87	19.33	16.32	6.42	6.74	16.25	7.70	***
2L5	10.79	8.89	15.56	11.09	18.41	12.32	8.80	18.81	18.15	6.77	8.54	9.04	8.69	***
2L6	10.64	8.34	13.29	9.61	18.01	10.61	8.13	12.09	17.32	7.57	7.44	18.60	8.01	***
2L7	10.11	8.10	15.58	9.88	17.44	10.96	9.39	17.11	18.15	4.01	7.89	14.37	7.69	***
2L8	10.03	8.44	15.30	8.67	18.23	10.85	9.57	22.55	19.14	4.36	7.87	9.88	8.22	***
2L9	11.02	10.21	16.06	9.95	17.55	11.04	9.26	15.37	14.45	5.43	6.62	17.00	7.15	***
2L10	10.90	9.04	15.72	10.35	18.95	11.70	9.38	18.03	17.59	5.89	7.65	15.35	8.15	***
3L1	12.96	10.56	15.54	11.47	20.26	13.26	9.38	20.15	15.79	8.03	7.38	13.05	8.09	***
3L2	12.84	10.84	14.52	10.59	19.23	11.74	9.30	17.07	19.98	6.42	8.42	8.63	8.45	***
3L3	10.47	7.72	16.54	10.20	17.81	11.78	8.08	19.49	19.29	4.24	6.87	10.19	8.01	***
3L4	9.83	8.70	14.31	10.60	17.20	10.50	8.52	15.41	14.38	7.82	7.44	14.91	7.67	***
3L5	9.00	8.64	14.91	9.64	18.72	11.65	8.35	20.85	13.88	6.89	6.63	11.35	6.50	***
3L6	12.10	10.13	15.37	11.16	16.80	11.62	8.77	15.65	17.57	5.88	7.49	12.95	8.03	***
4L1	11.15	8.31	14.72	9.59	15.36	9.83	8.19	14.53	13.11	6.61	7.98	18.61	6.85	***
4L2	9.13	7.83	13.80	8.07	16.40	9.15	8.31	18.52	12.49	9.48	6.57	9.12	6.79	***
4L3	10.44	8.41	14.20	9.69	16.53	10.15	8.34	18.49	17.49	4.10	6.28	9.61	7.34	***
4L4	9.23	7.85	14.10	8.73	15.59	11.60	8.87	18.48	17.62	5.03	6.87	10.09	7.24	***
4L5	9.33	7.84	14.01	9.88	15.64	10.11	7.55	15.12	11.31	5.92	6.07	12.95	6.83	***
4L6	10.44	8.15	13.44	8.66	14.33	8.41	7.18	18.34	13.49	5.57	5.54	9.81	5.62	***

Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			left	left	right	right	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			posterior	posterior	posterior	posterior	Width	Width	Width	Length	Length	Length	Length	
		edge	edge	edge	edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
4L7	10.47	8.46	12.80	10.33	15.22	9.89	8.18	16.22	13.66	7.34	5.99	8.90	6.77	***
4L8	10.96	8.92	13.07	9.38	15.28	11.13	7.72	15.21	14.27	6.15	6.38	10.63	7.15	***
4L9	9.47	8.15	11.94	8.58	15.65	9.46	7.20	13.47	13.30	5.10	6.16	13.92	6.74	***
5L1	7.87	7.07	13.95	8.43	16.35	9.48	7.74	16.83	16.33	7.18	6.26	10.48	6.22	***
5L2	8.64	6.58	13.56	10.01	15.37	11.14	9.70	14.86	14.22	7.50	5.94	12.34	6.65	***
5L3	8.15	6.70	15.16	10.57	15.60	10.87	9.31	17.20	14.67	4.68	6.30	11.82	7.00	***
5L4	11.86	9.52	14.08	8.64	15.73	9.43	7.83	16.51	14.35	5.52	6.20	10.67	6.59	***
5L5	10.58	8.83	13.16	8.79	15.57	9.16	6.71	17.19	12.47	4.86	5.54	10.60	7.03	***
5L6	10.69	8.99	10.95	7.16	13.63	8.18	7.08	15.83	13.32	3.86	3.79	7.54	5.51	***
5L7	9.94	7.64	11.75	7.85	14.82	9.48	7.12	15.39	12.50	5.30	5.08	9.24	6.63	***
5L8	10.31	8.03	12.61	7.41	13.76	8.67	7.96	15.61	15.39	4.30	5.75	12.76	6.58	***
5L9	10.27	7.71	12.01	7.45	14.71	8.52	6.90	15.43	12.57	5.71	4.79	11.07	6.54	***
5L10	7.92	6.94	12.56	8.14	12.91	8.50	6.61	13.15	10.54	4.61	5.78	10.74	4.78	***
6L1	9.71	7.22	10.76	7.73	19.78	9.52	7.71	19.87	12.75	5.92	7.20	14.06	8.39	***
6L2	8.58	6.59	13.05	8.14	15.52	10.42	7.54	16.09	13.46	4.53	5.65	9.23	5.47	***
6L3	9.54	8.14	11.76	7.69	14.81	9.24	7.27	14.69	15.89	4.41	5.93	13.23	6.18	***
6L4	9.62	8.48	12.32	8.92	15.21	9.35	6.57	13.71	12.89	4.27	6.37	11.30	6.51	***
6L5	8.69	7.39	11.16	7.03	15.57	9.76	7.98	17.17	14.13	3.64	4.96	12.64	5.42	***
6L6	9.03	6.85	12.08	6.81	14.88	8.91	7.43	16.78	13.74	4.70	5.70	8.90	6.01	***
6L7	9.44	8.11	12.48	7.93	14.74	8.83	6.43	14.27	12.25	4.81	5.20	9.47	5.93	***
6L8	8.66	6.55	13.25	8.97	14.74	9.02	6.55	12.25	13.01	6.08	5.19	11.61	5.18	***
6L9	8.46	6.50	9.88	6.94	13.10	8.30	6.78	13.85	12.79	6.17	5.24	10.07	5.87	***
6L10	7.07	5.31	12.02	8.13	15.79	8.86	6.58	15.90	13.96	4.85	5.92	9.43	6.25	***
7L1	9.14	7.37	9.96	6.01	14.98	9.34	7.43	16.01	13.09	4.57	6.02	9.03	5.47	***
7L2	7.12	5.68	10.54	7.46	13.23	8.08	6.90	14.13	11.97	6.07	5.49	7.05	4.92	***
7L3	8.30	7.54	10.33	5.72	12.80	7.02	6.90	16.00	10.38	5.92	4.32	6.35	4.88	***
7L4	8.76	7.39	9.97	6.55	12.77	7.84	5.77	10.93	11.82	5.27	4.35	11.11	5.66	***
7L5	8.48	6.17	8.86	6.20	11.62	6.73	6.46	11.89	10.98	4.67	5.22	9.22	4.87	***
7L6	8.36	6.45	7.83	5.41	12.06	7.42	6.39	14.26	10.52	7.80	4.51	8.63	4.85	***
7L7	8.13	6.51	9.94	6.63	11.90	7.33	4.91	12.91	12.36	6.08	5.03	10.43	5.34	***
7L8	9.11	6.53	8.32	5.73	13.07	6.69	5.80	13.68	11.20	2.79	4.58	7.89	4.55	***
7L9	7.93	6.52	8.22	5.43	11.46	6.28	4.90	12.23	10.95	4.26	3.96	6.58	4.95	***



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges	
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Crown	Tooth	Crown	Tooth		Crown
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
7L10	8.99	7.10	8.16	4.92	10.96	5.95	6.17	11.72	9.79	3.48	3.70	7.69	3.72	***	
8L1	7.31	6.57	8.53	3.54	10.92	4.59	5.20	15.14	8.17	4.29	3.92	9.60	3.61	***	
8L2	6.53	4.66	7.71	5.56	10.56	5.39	4.40	12.59	12.45	3.97	4.73	3.56	4.04	***	
8L3	7.37	5.65	7.67	5.68	10.72	6.40	4.29	11.65	10.99	2.53	5.04	5.37	4.40	***	
8L4	7.36	5.62	7.01	4.98	10.31	6.31	4.23	10.85	10.06	3.78	4.97	5.87	4.87	***	
8L5	5.84	3.72	6.94	4.22	10.81	5.84	4.77	12.02	9.18	1.69	4.31	6.64	4.80	***	
8L6	7.93	6.18	5.31	4.08	10.16	4.69	3.36	10.99	10.91	1.64	3.00	6.50	2.91	***	
8L7	6.13	4.75	7.58	4.97	9.67	4.49	4.55	10.80	12.45	1.71	3.25	7.32	3.67	***	
8L8	6.82	5.64	6.53	3.83	8.37	3.36	4.93	11.04	13.32	1.76	3.14	6.69	7.66	***	
8L9	7.00	5.77	7.25	3.84	7.46	3.87	4.07	11.04	13.19	1.85	5.66	6.79	8.25	***	
8L10	5.99	4.61	4.98	2.56	6.70	2.21	4.39	10.82	13.11	1.81	4.34	6.41	7.70	***	

**SUMMARY SMU 76416 *Ptychodus whipplei* composite dentition**

Medial														
N=10														
Minimum	12.52	10.3	17.98	12.94	17.73	12.50	10.08	15.79	15.00	5.62	6.81	12.66	8.31	~5
Maximum	16.81	13.99	21.95	15.88	21.73	15.81	11.81	21.53	19.37	10.58	9.88	19.60	9.69	
Arithmetic Mean	14.85	12.132	19.33	14.21	19.57	13.99	11.42	18.61	17.29	7.60	8.35	16.20	9.08	
Standard Deviation	1.105	0.916	1.26	0.88	1.19	1.03	0.50	2.05	1.42	1.67	0.89	2.23	0.45	
RPM														
N=10														
Minimum	10.03	8.1	15.06	10.21	12.54	8.51	7.56	15.19	7.34	6.68	6.82	12.90	5.97	~5
Maximum	14.78	13.34	22.84	19.31	19.50	14.91	16.25	21.80	17.50	12.95	12.43	21.26	12.54	
Arithmetic Mean	12.206	10.139	18.63	13.67	15.33	11.42	10.67	17.93	13.26	9.53	8.47	15.64	8.53	
Standard Deviation	1.847	1.753	2.76	3.13	2.40	2.07	2.88	2.57	2.88	2.48	1.87	2.74	1.99	
R2														
N=10														
Minimum	9	7.72	14.21	8.81	10.25	8.25	6.58	13.04	9.91	5.28	5.57	12.85	6.08	~5
Maximum	12.96	10.84	19.19	15.38	15.79	11.62	11.39	18.59	14.74	11.22	10.25	16.71	9.06	
Arithmetic Mean	10.94	9.198	16.42	12.14	13.74	10.02	9.41	15.82	11.67	9.39	7.61	14.86	8.01	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Standard Deviation	1.398	1.149	1.59	1.87	1.45	1.24	1.37	1.65	1.50	2.05	1.31	1.51	1.01	
R3														
N=10														
Minimum	7.87	6.58	12.23	8.17	9.65	6.81	6.01	11.62	8.03	6.09	3.84	8.34	4.82	~4
Maximum	10.96	8.92	16.37	11.59	13.34	9.56	9.77	15.22	11.44	10.17	7.71	16.79	8.69	
Arithmetic Mean	9.5	7.813	14.68	9.85	12.05	8.54	7.32	13.43	10.00	8.02	6.19	13.32	6.75	
Standard Deviation	1.063	0.785	1.28	1.15	1.19	0.88	1.20	1.30	1.20	1.44	1.28	2.40	1.18	
R4														
N=10														
Minimum	7.92	6.59	12.23	8.17	9.65	6.81	6.01	11.62	8.03	6.09	3.84	8.34	4.82	~4
Maximum	11.86	9.52	16.37	11.59	13.34	9.56	9.77	15.22	11.44	10.17	7.71	16.79	8.69	
Arithmetic Mean	9.94	7.961	14.68	9.85	12.05	8.54	7.32	13.43	10.00	8.02	6.19	13.32	6.75	
Standard Deviation	1.108	0.938	1.28	1.15	1.19	0.88	1.20	1.30	1.20	1.44	1.28	2.40	1.18	
R5														
N=10														
Minimum	7.07	5.31	11.54	6.67	9.61	5.93	5.91	10.53	8.69	4.93	4.51	10.21	5.02	~4
Maximum	9.62	8.48	15.50	11.05	13.62	9.91	8.25	14.59	11.44	9.71	6.58	15.78	6.21	
Arithmetic Mean	8.553	6.978	13.66	9.41	11.16	7.68	7.03	12.56	9.75	7.58	5.60	12.12	5.70	
Standard Deviation	0.873	1.004	1.29	1.54	1.15	1.26	0.87	1.23	1.03	1.45	0.63	1.60	0.39	
R6														
N=10														
Minimum	6.53	4.66	11.06	6.32	8.61	4.84	5.44	9.92	7.01	5.50	3.68	9.53	4.25	~3
Maximum	9.11	7.39	13.21	9.54	11.59	8.06	7.76	13.02	10.47	8.47	5.83	13.98	7.36	
Arithmetic Mean	8.097	6.355	12.45	8.44	10.04	7.05	6.60	11.41	9.06	7.58	5.03	12.33	5.74	
Standard Deviation	0.824	0.758	0.67	1.11	0.90	0.95	0.76	1.02	0.96	0.94	0.72	1.45	1.04	
R7														
N=10														

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Minimum	3.23	2.38	5.84	3.86	6.53	3.47	3.98	8.50	5.97	3.46	3.03	8.32	3.78	~2
Maximum	7.93	6.18	11.63	8.73	9.56	6.36	7.01	11.69	8.96	8.62	4.28	12.19	5.45	
Arithmetic Mean	6.253	4.833	10.05	6.62	8.25	5.48	5.42	9.71	7.49	6.50	3.74	9.79	4.57	
Standard Deviation	1.265	1.125	1.83	1.38	0.91	0.86	0.82	0.96	0.97	1.37	0.42	1.29	0.48	
R8														
N=10														
Minimum	1.51	1.22	5.12	2.96	4.76	2.92	3.87	5.79	4.58	4.52	1.99	5.79	2.88	~2
Maximum	5.75	4.54	9.20	6.24	8.04	5.25	5.73	9.25	6.95	7.25	4.06	10.75	4.61	
Arithmetic Mean	3.92	2.989	7.54	4.50	6.69	4.22	4.39	7.89	5.81	5.75	3.03	8.79	3.82	
Standard Deviation	1.31	1.045	1.10	0.95	1.10	0.67	0.58	1.00	0.66	0.76	0.62	1.53	0.51	
LPM														
N=10														
Minimum	12.52	10.3	12.72	8.33	14.65	8.81	7.07	13.79	12.71	5.11	6.55	10.81	5.92	~5
Maximum	16.81	13.99	17.42	12.67	19.70	13.35	11.38	21.93	17.57	10.96	8.88	18.88	10.16	
Arithmetic Mean	14.766	12.227	15.19	10.14	17.11	10.74	8.59	17.39	15.20	7.12	7.67	13.48	7.98	
Standard Deviation	1.091	0.994	1.58	1.49	1.63	1.35	1.41	2.33	1.77	2.14	0.71	3.14	1.36	
L2														
N=10														
Minimum	10.03	8.1	13.29	8.67	17.44	10.61	8.13	12.09	14.45	4.01	6.55	9.04	7.11	~5
Maximum	14.09	11.18	18.21	12.18	22.33	13.96	10.83	22.55	19.14	7.58	8.97	19.10	9.76	
Arithmetic Mean	11.447	9.522	15.72	10.35	18.95	11.70	9.38	18.03	17.59	5.89	7.65	15.36	8.15	
Standard Deviation	1.293	1.108	1.21	0.99	1.56	1.11	0.70	3.12	1.35	1.09	0.82	3.45	0.83	
L3														
N=6														
Minimum	9	7.72	14.31	9.64	16.80	10.50	8.08	15.41	13.88	4.24	6.64	8.63	6.51	~4
Maximum	12.96	10.84	16.54	11.47	20.26	13.26	9.38	20.85	19.98	8.03	8.42	14.91	8.45	
Arithmetic Mean	11.2	9.432	15.20	10.61	18.34	11.76	8.73	18.10	16.82	6.55	7.37	11.84	7.79	
Standard Deviation	1.664	1.252	0.81	0.65	1.31	0.88	0.52	2.37	2.54	1.40	0.62	2.25	0.68	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
L4														
N=9														
Minimum	9.13	7.83	11.94	8.07	14.33	8.41	7.19	13.47	11.31	4.10	5.54	8.90	5.62	~4
Maximum	11.15	8.92	14.72	10.33	16.53	11.60	8.88	18.52	17.62	9.48	7.98	18.61	7.34	
Arithmetic Mean	10.069	8.213	13.56	9.21	15.56	9.97	7.95	16.49	14.08	6.14	6.43	11.51	6.81	
Standard Deviation	0.782	0.36	0.85	0.74	0.66	0.97	0.57	2.00	2.14	1.57	0.69	3.16	0.50	
L5														
N=10														
Minimum	7.87	6.58	10.95	7.16	12.91	8.18	6.61	13.15	10.54	3.86	3.79	7.54	4.78	~4
Maximum	11.86	9.52	15.16	10.57	16.35	11.14	9.70	17.20	16.33	7.50	6.30	12.76	7.04	
Arithmetic Mean	9.623	7.801	12.98	8.45	14.85	9.34	7.70	15.80	13.64	5.35	5.54	10.73	6.35	
Standard Deviation	1.381	1.027	1.25	1.12	1.10	0.99	1.06	1.23	1.69	1.19	0.79	1.51	0.70	
L6														
N=10														
Minimum	7.07	5.31	9.88	6.81	13.10	8.30	6.43	12.25	12.25	3.64	4.96	8.90	5.18	~3
Maximum	9.71	8.48	13.25	8.97	19.78	10.42	7.98	19.87	15.89	6.17	7.20	14.06	8.39	
Arithmetic Mean	8.88	7.114	11.88	7.83	15.41	9.22	7.09	15.46	13.49	4.94	5.74	10.99	6.12	
Standard Deviation	0.791	0.96	1.04	0.76	1.71	0.59	0.57	2.18	1.04	0.85	0.67	1.85	0.90	
L7														
N=10														
Minimum	7.12	5.68	7.83	4.92	10.96	5.95	4.90	10.93	9.79	2.79	3.71	6.35	3.72	~2
Maximum	9.14	7.54	10.54	7.46	14.98	9.34	7.43	16.01	13.09	7.80	6.02	11.11	5.66	
Arithmetic Mean	8.432	6.726	9.21	6.01	12.48	7.27	6.16	13.38	11.31	5.09	4.72	8.40	4.92	
Standard Deviation	0.621	0.602	1.03	0.74	1.15	0.98	0.84	1.76	1.00	1.45	0.71	1.59	0.54	
L8														
N=10														
Minimum	5.84	3.72	4.98	2.56	6.70	2.21	3.36	10.80	8.17	1.64	3.00	3.56	2.91	~2

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Maximum	7.93	6.57	8.53	5.68	10.92	6.40	5.20	15.14	13.32	4.29	5.66	9.60	8.25	
Arithmetic Mean	6.828	5.317	6.95	4.33	9.57	4.72	4.42	11.69	11.38	2.50	4.24	6.48	5.19	
Standard Deviation	0.692	0.858	1.10	0.97	1.52	1.33	0.51	1.35	1.81	1.08	0.90	1.52	1.94	

\*\*many teeth greatly abraded--values obtained from those teeth with distinct ridges

*Ptychodus rugosus*

Tooth Files	AMNH 19553 <i>P. rugosus</i> Lower dentition													
M1	12.01	7.54	17.43	11.22	18.01	11.88	12.15	20.07	18.16	16.30	9.90	16.01	11.38	4
M2	11.74	7.83	17.91	12.23	17.66	11.78	12.48	20.61	18.23	15.49	10.37	15.22	8.97	4
M3	11.47	8.30	18.30	12.90	17.68	12.07	13.45	20.37	16.88	17.60	11.72	16.72	11.39	4
M4	11.29	7.77	17.93	12.98	18.62	12.65	13.52	21.15	19.00	16.14	10.24	14.94	10.91	4
RPM1	13.58	9.22	18.87	12.60	14.23	8.88	10.50	20.98	17.19	11.79	8.58	14.29	9.28	4
RPM2	10.91	6.29	19.27	13.12	13.94	9.68	12.11	20.22	18.97	12.90	8.86	13.46	8.63	4
RPM3	10.25	8.02	18.45	12.21	16.01	9.81	10.80	20.48	19.82	12.22	8.50	14.33	9.48	4
RPM4	10.59	8.55	17.69	12.54	13.85	9.55	12.71	19.84	18.52	13.46	8.37	15.65	7.89	4
RPM5	11.54	8.83	19.75	12.63	15.87	11.28	12.52	21.69	20.25	13.89	9.72	12.34	7.80	4
2R1	9.56	5.33	17.70	7.91	12.96	8.68	7.40	17.21	19.67	9.90	7.11	11.82	8.27	4
2R2	10.25	6.36	17.37	9.12	13.27	6.85	8.63	17.20	21.45	9.12	8.11	11.75	6.58	4
2R3	10.45	6.48	18.18	8.97	13.70	7.79	9.75	17.51	20.83	10.18	7.76	12.99	7.63	4
2R4	9.85	6.83	19.79	9.77	12.28	8.56	10.03	22.22	20.76	9.02	7.08	12.65	10.25	4
2R5	10.61	7.09	19.01	10.52	13.20	8.35	9.73	18.79	20.37	12.66	6.97	13.67	8.96	4
3R1	8.17	4.88	13.80	7.28	10.26	6.33	6.72	14.92	16.30	10.58	6.11	10.73	7.97	4
3R2	9.24	5.63	14.99	7.40	12.46	8.15	9.12	16.17	16.70	9.00	5.43	12.30	7.50	4
3R3	8.28	5.43	15.24	7.53	12.16	6.88	7.85	17.38	14.56	7.13	5.35	12.58	7.31	4
3R4	7.32	4.85	14.49	7.25	10.55	6.13	8.44	16.74	15.85	8.91	5.85	10.46	6.51	4
3R5	8.53	5.35	15.97	7.53	11.78	6.55	8.01	15.85	15.63	8.07	6.70	13.65	7.61	4
3R6	7.76	5.48	14.71	8.23	10.55	7.11	7.88	14.87	15.54	9.58	6.96	12.10	7.43	4
4R1	6.77	5.07	12.15	7.84	9.71	6.81	6.82	12.31	12.66	9.25	6.48	10.77	8.49	4
4R2	6.86	4.97	13.31	6.95	9.39	7.63	7.27	15.79	14.02	6.06	5.25	9.95	8.55	4
4R3	5.79	4.46	12.66	6.71	9.83	6.05	6.98	12.87	13.15	8.12	5.31	11.14	7.18	4
4R4	3.29	10.84	12.70	7.17	9.64	6.83	7.02	13.66	13.28	7.81	5.68	10.62	8.07	4

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
4R5	10.47	7.72	13.02	7.23	10.01	6.00	7.83	15.09	14.43	8.52	5.93	11.72	7.29	4
4R6	9.83	8.70	12.29	6.45	9.88	5.70	7.52	15.32	13.95	8.35	6.29	11.30	6.77	4
4R7	9.00	8.64	13.75	8.00	10.15	6.31	8.13	14.87	14.90	8.70	5.58	12.14	7.81	4
5R1	12.10	10.13	11.18	6.07	9.47	5.95	7.35	13.36	12.56	8.72	5.07	11.07	7.21	3
5R2	11.15	8.31	11.75	6.54	9.20	6.13	7.07	13.23	12.51	8.57	5.10	10.21	7.07	3
5R3	9.13	7.83	11.77	4.82	9.59	6.13	6.87	14.51	12.47	8.65	5.04	10.89	7.35	3
5R4	10.44	8.41	12.57	6.84	9.62	5.59	8.11	12.34	12.68	8.94	5.07	12.12	7.21	3
5R5	9.23	7.85	8.64	6.07	9.47	5.95	7.35	13.36	12.56	8.72	5.07	11.07	7.21	3
6R1	9.33	7.84	11.10	6.13	8.73	5.06	6.76	12.40	12.73	7.72	4.91	9.79	6.81	3
6R2	10.44	8.15	9.49	4.63	7.57	4.12	6.12	11.89	11.57	6.13	3.69	8.51	4.74	3
6R3	10.47	8.46	10.47	6.34	9.30	4.46	6.46	11.60	11.21	8.17	5.88	11.96	6.48	3
6R4	10.96	8.92	12.94	7.23	9.02	5.66	7.67	13.57	13.51	8.17	4.81	9.34	7.31	3
6R5	9.47	8.15	11.50	6.32	9.02	6.01	6.77	12.55	14.65	8.41	5.25	9.37	8.70	3
7R1	7.87	7.07	9.27	4.90	6.99	4.01	5.67	10.88	11.30	6.77	3.98	7.81	3.71	2
7R2	8.64	6.58	8.39	3.51	7.77	4.48	5.65	11.16	12.48	5.09	3.10	7.03	4.27	2
7R3	8.15	6.70	10.18	5.00	8.02	4.64	5.82	11.86	11.93	6.04	4.46	8.85	5.66	2
7R4	11.86	9.52	10.86	6.20	8.04	5.07	5.68	11.70	11.87	7.66	4.31	8.80	5.83	2
7R5	10.58	8.83	10.43	5.09	8.28	5.44	6.60	12.52	12.82	7.94	4.05	7.59	6.06	2
8R1	10.69	8.99	6.20	3.31	5.62	3.09	4.91	9.21	7.42	6.18	2.97	5.14	2.72	0
8R2	9.94	7.64	4.82	2.13	4.85	2.51	3.97	8.33	7.90	4.15	1.31	3.54	2.39	0
8R3	10.31	8.03	5.87	2.57	5.52	3.40	3.06	9.07	5.28	6.87	4.78	6.36	2.78	0
8R4	10.27	7.71	7.14	4.54	6.12	3.37	6.13	9.49	6.56	7.94	3.18	6.28	3.25	0
8R5	7.92	6.94	6.77	3.28	6.25	3.01	5.64	10.70	8.14	5.81	2.17	4.19	1.91	0
8R6	9.71	7.22	6.42	4.03	5.37	3.15	5.77	8.45	9.22	6.15	3.40	5.32	3.27	0
LPM1	8.58	6.59	11.87	7.18	18.32	9.55	9.21	19.06	12.13	12.80	10.38	16.68	8.23	4
LPM2	9.54	8.14	11.94	7.17	16.26	9.87	8.77	15.42	21.72	10.81	8.10	9.91	7.60	4
LPM3	9.62	8.48	15.39	11.32	16.95	10.13	9.86	16.83	16.93	15.73	9.24	13.29	7.91	4
LPM4	8.69	7.39	12.42	7.12	19.53	9.70	9.20	19.63	17.24	12.09	12.96	11.18	7.20	4
LPM5	9.03	6.85	13.11	7.84	20.99	10.57	10.56	22.90	15.84	12.14	18.45	11.61	7.52	4
2L1	9.44	8.11	11.72	6.40	18.07	8.83	7.84	16.35	18.64	12.05	7.48	10.75	6.87	4
2L2	8.66	6.55	11.33	7.52	17.65	9.82	6.28	16.54	7.44	10.49	10.33	18.23	8.18	4
2L3	8.46	6.50	17.42	8.08	17.99	9.84	5.93	11.13	6.73	15.64	10.83	17.45	8.12	4

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
2L4	7.07	5.31	11.54	7.51	17.86	9.80	6.64	21.96	8.15	5.34	9.83	19.01	8.24	4
3L1	9.14	7.37	10.96	6.19	13.20	7.77	11.30	14.01	15.50	11.54	14.02	8.45	6.97	4
3L2	7.12	5.68	11.24	6.87	14.47	8.95	8.39	14.82	16.60	10.12	7.69	10.57	6.93	4
3L3	8.30	7.54	15.28	8.02	9.38	9.34	16.40	18.92	16.12	11.71	10.54	5.74	9.14	4
3L4	8.76	7.39	11.49	7.13	14.00	8.40	12.02	19.00	11.32	12.71	9.34	7.79	5.27	4
3L5	8.48	6.17	9.92	6.78	14.24	8.54	7.85	14.38	15.86	11.23	9.78	9.92	6.37	4
3L6	8.36	6.45	11.10	5.98	15.14	7.35	8.01	18.08	16.09	13.47	7.18	8.43	6.15	4
4L1	8.13	6.51	10.00	6.23	11.93	7.18	6.92	13.87	13.48	9.59	5.04	8.38	6.42	4
4L2	9.11	6.53	10.33	6.37	11.68	6.99	7.58	14.23	14.75	9.16	6.63	8.23	5.40	4
4L3	7.93	6.52	11.87	5.74	14.19	7.11	6.84	14.91	15.92	10.34	4.54	8.85	5.53	4
4L4	8.99	7.10	10.38	5.83	13.91	7.43	7.60	15.00	15.03	11.46	5.45	9.64	6.43	4
4L5	7.31	6.57	11.32	6.81	10.94	6.92	8.13	12.50	17.64	10.84	8.68	10.39	6.13	4
5L1	6.53	4.66	10.24	5.76	13.02	6.48	6.13	13.10	11.53	9.86	6.47	10.12	4.97	4
5L2	7.37	5.65	9.50	5.00	11.57	4.92	6.10	14.24	14.96	6.12	4.72	8.37	5.49	4
5L3	7.36	5.62	9.69	5.80	12.25	6.50	6.88	13.70	13.49	9.96	5.35	8.15	5.48	4
5L4	5.84	3.72	10.86	6.23	11.96	5.72	6.23	14.99	13.92	9.46	5.99	7.99	4.84	4
5L5	7.93	6.18	10.59	7.77	13.59	7.60	6.86	13.35	14.76	10.16	8.04	10.25	6.71	4
6L1	6.13	4.75	9.84	6.12	10.46	5.57	4.96	12.10	12.35	9.23	6.00	7.55	5.04	4
6L2	6.82	5.64	9.45	19.84	10.65	14.89	5.53	12.93	28.63	13.21	7.47	7.03	3.82	4
6L3	7.00	5.77	9.77	4.89	11.33	6.13	6.14	11.96	13.31	9.07	12.12	6.89	5.01	4
6L4	5.99	4.61	9.77	4.12	12.06	5.83	6.10	13.77	14.21	9.95	5.52	7.19	5.04	4
6L5	6.27	5.07	9.55	6.02	11.20	7.54	6.82	13.02	13.80	9.97	7.48	8.24	5.41	4
7L1	5.96	4.59	7.70	4.40	8.94	6.11	5.67	9.64	11.30	7.78	5.13	7.84	5.33	3
7L2	3.23	2.38	8.52	5.02	9.78	5.07	5.53	12.50	10.44	10.25	4.46	6.69	4.52	3
7L3	4.74	3.69	9.04	5.11	10.72	4.77	6.62	11.64	12.36	8.29	5.48	6.89	4.92	3
7L4	4.94	4.10	8.67	5.16	9.75	5.45	6.73	11.88	10.83	7.96	5.05	7.09	4.44	3
7L5	4.07	3.10	9.18	4.24	9.92	5.78	6.45	11.28	12.30	10.14	5.77	7.80	4.20	3
8L1	5.75	4.54	5.58	2.76	7.38	2.78	4.15	8.18	9.01	5.58	2.30	5.39	2.15	0
8L2	5.23	3.61	7.23	2.07	9.40	3.71	4.65	12.00	9.89	9.15	4.05	5.15	3.85	0
8L3	3.63	2.51	8.24	3.71	8.85	5.23	5.74	9.79	12.11	8.86	4.52	6.29	3.77	0
8L4	3.80	3.04	6.37	1.69	8.48	4.85	5.31	10.14	9.44	9.26	3.78	6.40	3.13	0
8L5	2.95	1.78	6.89	3.82	8.45	4.23	5.97	11.13	12.42	7.01	3.31	6.25	3.60	0

Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			left posterior r tooth edge	left posterior r crown edge	right posterior r tooth edge	right posterior r crown edge								
			A-B	A-F	A-C	A-G								
8L6	2.58	1.50	7.33	5.83	8.26	4.33	5.43	10.33	11.77	9.33	3.59	7.25	4.04	0

**SUMMARY AMNH 19553 *P. rugosus* Lower dentition**

Medial

N=4

Minimum	11.29	7.54	17.43	11.22	17.66	11.78	12.15	20.07	16.88	15.49	9.90	14.94	8.97	4
Maximum	12.01	8.3	18.30	12.98	18.62	12.65	13.52	21.15	19.00	17.60	11.72	16.72	11.39	
Arithmetic Mean	11.628	7.86	17.89	12.33	17.99	12.09	12.90	20.55	18.07	16.38	10.56	15.72	10.66	
Standard Deviation	0.315	0.319	0.36	0.82	0.44	0.39	0.69	0.46	0.88	0.88	0.80	0.81	1.15	

RPM

N=5

Minimum	10.25	6.29	17.69	12.21	13.85	8.88	10.50	19.84	17.19	11.79	8.37	12.34	7.80	4
Maximum	13.58	9.22	19.75	13.12	16.01	11.28	12.71	21.69	20.25	13.89	9.73	15.65	9.48	
Arithmetic Mean	11.374	8.182	18.80	12.62	14.78	9.84	11.73	20.64	18.95	12.85	8.81	14.02	8.62	
Standard Deviation	1.322	1.144	0.79	0.33	1.07	0.88	1.01	0.72	1.20	0.86	0.55	1.22	0.77	

R2

N=5

Minimum	9.56	5.33	17.37	7.91	12.28	6.85	7.40	17.20	19.67	9.02	6.97	11.75	6.58	4
Maximum	10.61	7.09	19.79	10.52	13.70	8.68	10.03	22.22	21.45	12.66	8.11	13.67	10.25	
Arithmetic Mean	10.144	6.418	18.41	9.26	13.08	8.05	9.11	18.59	20.62	10.18	7.40	12.58	8.34	
Standard Deviation	0.433	0.673	0.99	0.97	0.52	0.75	1.09	2.14	0.66	1.47	0.50	0.81	1.38	

R3

N=6

Minimum	7.32	4.85	13.80	7.25	10.26	6.13	6.72	14.87	14.56	7.14	5.35	10.46	6.51	4
Maximum	9.24	5.63	15.97	8.23	12.46	8.15	9.12	17.38	16.70	10.58	6.96	13.65	7.97	
Arithmetic Mean	8.217	5.27	14.87	7.54	11.29	6.86	8.01	15.99	15.76	8.88	6.07	11.97	7.39	
Standard Deviation	0.658	0.327	0.73	0.36	0.95	0.73	0.79	0.99	0.73	1.19	0.66	1.20	0.49	

R4



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
N=7														
Minimum	3.29	4.46	12.15	6.45	9.39	5.70	6.82	12.31	12.66	6.06	5.25	9.95	6.77	4
Maximum	10.47	10.84	13.75	8.00	10.15	7.63	8.13	15.79	14.90	9.25	6.48	12.14	8.55	
Arithmetic Mean	7.43	7.2	12.84	7.19	9.80	6.48	7.37	14.27	13.77	8.12	5.79	11.09	7.74	
Standard Deviation	2.518	2.41	0.57	0.57	0.25	0.66	0.48	1.33	0.78	1.01	0.47	0.73	0.68	
R5														
N=5														
Minimum	9.13	7.83	8.64	4.82	9.20	5.59	6.87	12.34	12.47	8.57	5.04	10.21	7.07	3
Maximum	12.1	10.13	12.57	6.85	9.62	6.13	8.11	14.51	12.68	8.94	5.10	12.12	7.35	
Arithmetic Mean	10.41	8.506	11.18	6.07	9.47	5.95	7.35	13.36	12.56	8.72	5.07	11.07	7.21	
Standard Deviation	1.268	0.945	1.51	0.78	0.17	0.22	0.47	0.77	0.08	0.14	0.02	0.68	0.10	
R6														
N=5														
Minimum	9.33	7.84	9.50	4.63	7.57	4.12	6.12	11.60	11.21	6.13	3.69	8.51	4.74	3
Maximum	10.96	8.92	12.94	7.23	9.30	6.01	7.67	13.57	14.65	8.41	5.88	11.96	8.70	
Arithmetic Mean	10.134	8.304	11.10	6.13	8.73	5.06	6.76	12.40	12.73	7.72	4.91	9.79	6.81	
Standard Deviation	0.703	0.408	1.28	0.94	0.68	0.79	0.57	0.76	1.41	0.92	0.80	1.30	1.43	
R7														
N=5														
Minimum	7.87	6.58	8.39	3.51	6.99	4.01	5.65	10.88	11.30	5.09	3.10	7.03	3.71	2
Maximum	11.86	9.52	10.86	6.20	8.28	5.44	6.60	12.52	12.82	7.94	4.46	8.85	6.06	
Arithmetic Mean	9.42	7.74	9.83	4.94	7.82	4.73	5.89	11.62	12.08	6.70	3.98	8.01	5.10	
Standard Deviation	1.726	1.345	0.99	0.96	0.50	0.55	0.41	0.64	0.59	1.17	0.53	0.79	1.05	
R8														
N=6														
Minimum	7.92	6.94	4.82	2.13	4.85	2.51	3.06	8.33	5.28	4.15	1.31	3.54	1.91	0
Maximum	10.69	8.99	7.14	4.54	6.25	3.40	6.13	10.70	9.22	7.94	4.78	6.36	3.27	
Arithmetic Mean	9.807	7.755	6.20	3.31	5.62	3.09	4.91	9.21	7.42	6.18	2.97	5.14	2.72	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Standard Deviation	0.983	0.716	0.81	0.89	0.51	0.32	1.19	0.86	1.36	1.25	1.17	1.12	0.52	
LPM														
N=5														
Minimum	8.58	6.59	11.87	7.12	16.26	9.55	8.77	15.42	12.13	10.81	8.10	9.91	7.20	4
Maximum	9.62	8.48	15.39	11.32	20.99	10.57	10.56	22.90	21.72	15.73	18.45	16.68	8.23	
Arithmetic Mean	9.092	7.49	12.95	8.13	18.41	9.96	9.52	18.77	16.77	12.71	11.83	12.53	7.69	
Standard Deviation	0.476	0.811	1.45	1.81	1.92	0.40	0.70	2.87	3.43	1.83	4.12	2.61	0.39	
L2														
N=4														
Minimum	7.07	5.31	11.33	6.40	17.65	8.83	5.93	11.13	6.73	5.34	7.48	10.75	6.87	4
Maximum	9.44	8.11	17.42	8.08	18.07	9.84	7.84	21.96	18.64	15.64	10.83	19.01	8.24	
Arithmetic Mean	8.408	6.617	13.00	7.38	17.89	9.57	6.67	16.50	10.24	10.88	9.62	16.36	7.85	
Standard Deviation	0.987	1.148	2.95	0.70	0.18	0.50	0.83	4.42	5.63	4.28	1.48	3.80	0.66	
L3														
N=6														
Minimum	7.12	5.68	9.92	5.98	9.38	7.35	7.85	14.01	11.32	10.12	7.18	5.74	5.27	4
Maximum	9.14	7.54	15.28	8.02	15.14	9.34	16.40	19.00	16.60	13.47	14.02	10.57	9.15	
Arithmetic Mean	8.36	6.767	11.67	6.83	13.41	8.39	10.66	16.54	15.25	11.80	9.76	8.48	6.81	
Standard Deviation	0.682	0.773	1.85	0.73	2.07	0.74	3.33	2.37	1.96	1.17	2.44	1.70	1.30	
L4														
N=5														
Minimum	7.31	6.51	10.00	5.74	10.94	6.92	6.84	12.50	13.48	9.16	4.54	8.23	5.40	4
Maximum	9.11	7.1	11.87	6.81	14.19	7.43	8.13	15.00	17.64	11.46	8.68	10.39	6.43	
Arithmetic Mean	8.294	6.646	10.78	6.20	12.53	7.13	7.41	14.11	15.36	10.28	6.07	9.10	5.98	
Standard Deviation	0.755	0.255	0.78	0.43	1.44	0.20	0.54	1.01	1.54	0.93	1.65	0.91	0.49	
L5														
N=5														

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Minimum	5.84	3.72	9.50	5.00	11.57	4.92	6.10	13.10	11.53	6.12	4.72	7.99	4.84	4
Maximum	7.93	6.18	10.86	7.77	13.59	7.60	6.88	14.99	14.96	10.16	8.04	10.25	6.71	
Arithmetic Mean	7.006	5.166	10.18	6.11	12.48	6.25	6.44	13.88	13.73	9.11	6.11	8.98	5.50	
Standard Deviation	0.821	0.977	0.58	1.03	0.82	1.00	0.39	0.75	1.37	1.69	1.27	1.11	0.74	
L6														
N=5														
Minimum	5.99	4.61	9.45	4.12	10.46	5.57	4.96	11.96	12.35	9.07	5.52	6.89	3.82	4
Maximum	7	5.77	9.84	19.84	12.06	14.89	6.82	13.77	28.63	13.21	12.12	8.24	5.41	
Arithmetic Mean	6.442	5.168	9.68	8.20	11.14	7.99	5.91	12.76	16.46	10.29	7.72	7.38	4.86	
Standard Deviation	0.443	0.52	0.17	6.56	0.63	3.93	0.70	0.74	6.84	1.69	2.61	0.54	0.61	
L7														
N=5														
Minimum	3.23	2.38	7.70	4.24	8.94	4.77	5.53	9.64	10.44	7.78	4.46	6.69	4.20	3
Maximum	5.96	4.59	9.18	5.16	10.72	6.11	6.73	12.50	12.36	10.25	5.77	7.84	5.33	
Arithmetic Mean	4.588	3.572	8.62	4.79	9.82	5.43	6.20	11.39	11.44	8.88	5.18	7.26	4.68	
Standard Deviation	1.018	0.862	0.58	0.43	0.63	0.54	0.56	1.08	0.86	1.21	0.49	0.53	0.45	
L8														
N=6														
Minimum	2.58	1.5	5.58	1.69	7.38	2.78	4.15	8.18	9.01	5.58	2.30	5.15	2.15	0
Maximum	5.75	4.54	8.25	5.84	9.40	5.23	5.97	12.00	12.42	9.33	4.52	7.25	4.04	
Arithmetic Mean	3.99	2.83	6.94	3.31	8.47	4.19	5.21	10.26	10.77	8.20	3.59	6.12	3.42	
Standard Deviation	1.255	1.145	0.91	1.50	0.67	0.87	0.69	1.29	1.50	1.55	0.76	0.76	0.70	

Tooth Files AMNH 19553 <i>P. rugosus</i> Upper dentition														
Median	12.39	8.99	5.44	1.92	5.23	2.08	3.30	8.44	7.08	5.00	1.50	5.24	2.05	0
RPM1	12.75	9.81	16.42	10.52	16.13	9.45	9.86	18.86	15.81	13.04	8.09	13.68	9.82	4
RPM2	12.61	9.66	16.72	11.32	16.00	10.36	10.94	18.90	17.51	14.13	8.91	14.57	7.84	4
RPM3	13.55	10.11	16.25	10.35	16.23	9.37	10.46	18.33	17.26	16.24	9.54	16.05	10.86	4

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
RPM4	10.81	7.96	18.31	11.95	18.27	10.57	11.59	20.93	21.42	13.39	9.02	12.59	7.68	4
2R1	10.97	8.50	21.12	11.04	14.55	8.56	10.30	20.48	17.30	14.03	7.56	10.57	8.35	4
2R2	11.00	8.02	19.21	12.28	17.20	11.94	10.21	18.30	19.00	13.15	7.67	15.82	9.01	4
2R3	10.59	8.55	19.12	16.67	21.02	19.86	10.19	11.96	14.02	12.16	3.69	20.36	9.93	4
2R4	11.54	8.83	19.37	10.35	15.70	9.74	9.81	20.25	20.91	13.67	8.43	12.27	8.40	4
2R5	9.56	5.33	19.51	10.77	15.97	8.68	10.98	20.76	20.30	13.40	9.38	16.11	9.40	4
2R6	10.25	6.36	18.86	11.34	16.10	9.48	9.87	20.21	20.76	13.37	9.17	14.54	8.31	4
3R1	10.45	6.48	15.16	8.33	11.42	7.13	8.18	15.20	17.90	7.94	5.72	11.11	7.54	4
3R2	9.85	6.83	14.32	7.70	11.18	6.98	7.67	15.24	15.16	10.32	6.27	12.29	9.13	4
3R3	10.61	7.09	15.76	9.26	12.41	7.76	8.86	17.08	16.60	11.35	7.25	12.27	9.73	4
3R4	8.17	4.88	17.03	7.44	12.30	7.50	7.89	18.14	18.74	8.94	6.28	11.96	8.74	4
3R5	9.24	5.63	15.22	8.89	10.89	7.48	8.76	16.18	16.36	10.45	7.01	12.51	7.70	4
3R6	8.28	5.43	18.19	9.08	13.42	8.24	9.52	19.78	17.63	8.65	7.24	13.19	10.20	4
3R7	7.32	4.85	17.89	8.85	11.84	7.04	8.63	18.18	17.85	12.29	8.62	14.28	9.04	4
4R1	8.53	5.35	11.07	5.60	8.85	4.99	6.74	11.55	15.07	7.92	4.22	6.76	5.59	4
4R2	7.76	5.48	9.62	4.91	9.34	6.21	7.03	13.08	13.32	9.49	5.11	9.07	6.29	4
4R3	6.77	5.07	14.87	7.86	10.69	6.38	7.53	14.94	15.94	9.84	6.20	10.55	7.26	4
4R4	6.86	4.97	14.44	7.67	9.43	5.06	7.18	14.93	16.88	9.08	5.74	9.69	5.26	4
4R5	5.79	4.46	14.22	7.22	10.13	5.96	7.22	14.39	14.67	9.28	6.04	10.09	7.25	4
4R6	3.29	10.84	15.61	8.03	11.62	6.52	7.87	14.82	15.48	11.12	6.65	11.93	8.28	4
4R7	10.47	7.72	15.20	8.53	11.58	7.96	7.84	15.59	16.74	9.87	6.38	10.49	8.24	4
5R1	9.83	8.70	10.45	5.55	8.81	4.95	6.39	12.40	13.26	6.84	4.39	9.30	5.29	3
5R2	9.00	8.64	8.17	4.68	6.85	4.61	5.98	8.35	8.12	8.49	11.22	13.25	7.28	3
5R3	12.10	10.13	10.14	5.26	9.01	5.52	5.94	12.08	12.91	9.02	6.03	8.42	6.80	3
5R4	11.15	8.31	9.08	4.96	7.88	5.73	6.64	13.35	12.39	5.89	4.98	7.42	6.10	3
5R5	9.13	7.83	9.46	5.11	8.14	5.20	6.24	11.54	11.67	7.56	6.65	9.60	6.37	3
5R6	10.44	8.41	10.72	6.08	7.97	5.41	5.51	11.90	13.46	7.47	6.20	9.25	6.61	3
5R7	9.23	7.85	9.67	5.27	8.11	5.24	6.12	11.60	11.97	7.55	6.58	9.54	6.41	3
6R1	9.33	7.84	8.61	4.76	4.96	2.22	4.41	10.21	7.44	9.32	4.41	7.30	5.49	3
6R2	10.44	8.15	5.56	4.58	8.23	4.58	5.26	10.13	11.19	8.67	5.49	6.48	5.95	3
6R3	10.47	8.46	9.99	4.65	4.98	4.65	5.39	11.36	7.91	8.75	4.74	4.74	4.95	3
6R4	10.96	8.92	8.05	6.02	6.06	6.02	4.50	10.16	10.51	7.03	4.50	4.51	4.32	3

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
6R5	9.47	8.15	8.81	3.59	7.68	3.61	4.88	10.94	12.47	7.16	4.09	9.37	6.51	3
6R6	7.87	7.07	10.49	6.71	9.22	5.40	6.80	10.80	13.87	8.14	5.65	7.30	4.01	3
7R1	8.64	6.58	8.34	3.99	6.08	3.13	5.00	10.77	9.88	4.92	3.24	7.35	3.77	2
7R2	8.15	6.70	8.45	3.65	7.09	3.55	5.79	10.47	11.23	6.69	3.39	6.80	2.97	2
7R3	11.86	9.52	8.10	3.66	6.89	3.65	5.01	9.96	9.85	5.45	4.78	7.09	3.95	2
7R4	10.58	8.83	7.50	3.34	7.45	4.48	5.79	10.73	11.89	5.44	3.04	5.51	4.33	2
7R5	10.69	8.99	9.55	4.01	5.73	2.55	6.32	11.78	11.66	4.80	2.53	7.32	4.81	2
8R1	9.94	7.64	6.91	3.43	4.67	3.43	5.79	9.07	10.02	4.62	2.96	5.42	3.91	0
8R2	10.31	8.03	7.34	2.55	3.00	5.06	6.89	8.86	9.57	3.60	3.67	4.49	5.18	0
8R3	10.27	7.71	7.02	3.36	4.76	3.01	5.09	8.62	9.22	5.73	2.83	6.36	3.16	0
8R4	7.92	6.94	6.35	3.70	4.40	2.78	5.55	9.16	10.00	5.10	2.18	4.96	3.59	0
8R5	9.71	7.22	7.16	3.88	5.60	3.03	5.52	9.56	11.16	4.95	3.30	5.05	3.56	0
8R6	8.58	6.59	6.67	3.66	5.58	3.25	5.90	9.16	10.14	3.72	2.82	6.23	4.04	0
LPM1	9.54	8.14	16.04	10.43	14.65	8.42	9.94	16.98	15.88	11.94	8.69	12.60	7.79	4
LPM2	9.62	8.48	15.59	9.62	15.69	9.84	9.34	16.75	15.58	12.73	8.25	13.86	8.93	4
LPM3	8.69	7.39	19.36	10.15	19.78	10.90	9.03	21.04	18.20	13.91	8.91	16.00	8.45	4
LPM4	9.03	6.85	18.77	10.73	18.57	11.52	11.02	21.86	20.77	13.99	8.62	12.73	8.59	4
LPM5	9.44	8.11	18.97	11.64	19.20	12.11	9.53	20.18	12.75	7.44	8.91	25.72	13.29	4
2L1	8.66	6.55	12.46	8.52	20.90	10.98	7.70	17.47	10.26	18.90	8.52	9.26	7.67	4
2L2	8.46	6.50	12.35	8.26	18.50	10.19	8.83	19.52	18.77	12.38	8.87	7.46	7.51	4
2L3	7.07	5.31	12.87	8.69	19.88	11.26	10.31	20.68	18.85	13.41	9.35	10.54	9.40	4
2L4	9.14	7.37	12.54	9.51	24.59	11.96	11.18	22.77	20.14	14.72	10.98	11.86	11.84	4
2L5	7.12	5.68	12.08	7.60	20.62	10.51	9.60	18.61	20.84	13.83	8.15	11.07	7.57	4
3L1	8.30	7.54	9.72	5.31	12.95	6.51	6.31	13.32	14.58	10.77	6.28	8.08	5.16	4
3L2	8.76	7.39	11.24	6.51	13.57	7.23	8.04	13.70	16.90	9.87	6.20	11.20	5.59	4
3L3	8.48	6.17	11.70	7.37	16.05	8.52	8.30	16.45	16.76	10.89	7.42	7.88	6.47	4
3L4	8.36	6.45	11.02	5.50	14.52	6.25	6.96	17.12	13.77	12.91	5.92	10.29	6.06	4
3L5	8.13	6.51	11.74	8.71	16.15	9.27	5.85	16.48	18.10	4.42	10.80	9.45	7.82	4
3L6	9.11	6.53	11.91	8.08	17.00	10.24	9.91	17.19	17.61	12.56	7.78	10.63	8.11	4
4L1	7.93	6.52	9.86	6.86	12.91	7.35	7.98	13.37	13.07	11.01	6.21	7.41	5.98	3
4L2	8.99	7.10	10.13	6.06	12.26	5.56	4.60	12.69	12.93	11.65	6.95	8.35	5.54	3
4L3	7.31	6.57	6.58	6.81	11.87	7.25	4.85	8.77	12.32	7.47	6.98	7.92	6.55	3

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
4L4	6.53	4.66	8.81	5.01	12.05	7.23	7.25	12.78	12.75	10.46	5.82	8.55	6.34	3
4L5	7.37	5.65	10.47	6.83	11.82	7.31	7.08	11.72	13.43	11.24	6.83	8.29	5.11	3
5L1	7.36	5.62	8.61	5.39	11.10	6.00	6.54	12.81	11.69	7.14	4.70	5.33	4.99	3
5L2	5.84	3.72	8.06	3.71	9.55	4.29	5.67	12.26	10.96	7.75	4.40	7.09	4.44	3
5L3	7.93	6.18	8.39	4.35	11.94	6.02	5.26	12.50	12.21	8.62	5.71	6.82	4.38	3
5L4	6.13	4.75	8.98	5.32	10.36	5.68	5.56	9.98	12.28	8.40	5.31	7.75	5.49	3
5L5	6.82	5.64	7.97	3.81	9.98	5.20	6.04	11.81	11.00	9.12	5.26	7.77	4.17	3
5L6	7.00	5.77	7.77	5.03	11.27	5.42	5.82	13.42	12.44	9.12	5.43	6.18	4.94	3
6L1	5.99	4.61	9.53	6.09	12.46	7.21	7.20	14.46	12.03	10.09	6.38	8.60	6.11	2
6L2	6.27	5.07	8.56	4.16	9.90	4.99	4.79	10.11	11.14	8.43	4.42	7.68	5.26	2
6L3	5.96	4.59	8.82	5.12	11.12	6.80	7.04	10.54	12.15	10.05	6.43	9.06	4.76	2
6L4	3.23	2.38	8.12	4.43	10.54	5.47	5.13	11.24	13.13	6.71	3.81	7.63	6.07	2
6L5	4.74	3.69	10.32	7.33	13.08	5.64	6.02	13.18	11.69	11.46	8.19	10.05	6.09	2
7L1	4.94	4.10	8.73	5.64	9.25	6.07	5.58	10.23	11.90	7.15	3.65	4.96	4.54	2
7L2	4.07	3.10	8.03	3.43	9.04	4.07	4.99	10.38	9.96	7.86	4.19	6.07	4.11	2
7L3	5.75	4.54	8.07	4.14	10.06	4.90	5.49	10.59	12.64	8.35	3.89	5.68	4.26	2
7L4	5.23	3.61	8.84	4.64	10.91	6.09	5.21	11.59	11.47	8.90	4.74	7.08	5.14	2
7L5	3.63	2.51	7.36	4.92	9.50	5.36	5.01	11.83	9.90	8.23	4.08	6.37	5.44	2
7L6	3.80	3.04	8.58	6.80	10.68	6.79	8.31	11.50	13.34	9.72	5.75	8.24	3.77	2
8L1	2.95	1.78	5.54	3.90	5.40	3.32	5.20	7.72	7.89	5.37	3.34	4.21	3.65	0
8L2	4.70	0.88	6.98	4.88	8.77	4.98	6.12	10.08	9.55	7.27	5.13	7.61	4.18	0
8L3	4.65	2.08	7.48	4.22	8.44	3.97	5.40	10.86	10.80	6.25	5.00	6.19	3.82	0
8L4	2.74	1.22	7.47	6.03	9.10	4.75	6.33	10.94	10.23	9.92	4.58	7.38	4.40	0
8L5	4.55	1.71	6.38	6.27	7.78	4.25	6.58	9.64	10.86	7.85	3.76	6.41	3.24	0
8L6	4.11	3.83	6.96	5.45	8.39	5.19	6.63	10.03	12.26	8.26	3.59	6.77	3.76	0

SUMMARY AMNH 19953 *P. rugosus* Upper dentition

Medial														
N=1														
Minimum	12.39	8.99	5.44	1.92	5.23	2.09	3.30	8.44	7.08	5.00	1.50	5.24	2.05	0
Maximum	12.39	8.99	5.44	1.92	5.23	2.09	3.30	8.44	7.08	5.00	1.50	5.24	2.05	
Arithmetic Mean	12.39	8.99	5.44	1.92	5.23	2.09	3.30	8.44	7.08	5.00	1.50	5.24	2.05	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior r tooth edge <i>A-B</i>	posterior r crown edge <i>A-F</i>	posterior r tooth edge <i>A-C</i>	posterior r crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
Standard Deviation														
RPM														
N=4														
Minimum	10.81	7.96	16.25	10.35	16.00	9.37	9.86	18.33	15.81	13.04	8.09	12.59	7.68	4
Maximum	13.55	10.11	18.31	11.95	18.27	10.57	11.59	20.93	21.42	16.24	9.54	16.05	10.86	
Arithmetic Mean	12.43	9.385	16.93	11.04	16.66	9.94	10.71	19.25	18.00	14.20	8.89	14.22	9.05	
Standard Deviation	1.157	0.968	0.95	0.74	1.08	0.62	0.73	1.15	2.40	1.43	0.60	1.46	1.55	
R2														
N=6														
Minimum	9.56	5.33	18.86	10.35	14.55	8.56	9.81	11.96	14.02	12.16	3.69	10.57	8.31	4
Maximum	11.54	8.83	21.12	16.67	21.02	19.86	10.98	20.76	20.91	14.03	9.38	20.36	9.93	
Arithmetic Mean	10.652	7.598	19.53	12.08	16.76	11.38	10.23	18.66	18.71	13.30	7.65	14.95	8.90	
Standard Deviation	0.688	1.421	0.81	2.34	2.26	4.33	0.42	3.40	2.67	0.64	2.08	3.40	0.67	
R3														
N=7														
Minimum	7.32	4.85	14.32	7.44	10.89	6.98	7.67	15.20	15.16	7.94	5.72	11.11	7.54	4
Maximum	10.61	7.09	18.19	9.26	13.42	8.24	9.52	19.78	18.74	12.29	8.62	14.28	10.20	
Arithmetic Mean	9.131	5.884	16.23	8.51	11.92	7.45	8.50	17.11	17.18	9.99	6.92	12.51	8.87	
Standard Deviation	1.251	0.918	1.49	0.70	0.87	0.45	0.64	1.70	1.20	1.56	0.95	1.00	0.98	
R4														
N=7														
Minimum	3.29	4.46	9.62	4.91	8.85	4.99	6.74	11.55	13.32	7.92	4.23	6.76	5.26	4
Maximum	10.47	10.84	15.61	8.54	11.62	7.96	7.88	15.59	16.88	11.12	6.65	11.93	8.29	
Arithmetic Mean	7.067	6.27	13.58	7.12	10.23	6.16	7.35	14.19	15.44	9.51	5.76	9.80	6.88	
Standard Deviation	2.245	2.268	2.29	1.35	1.10	1.00	0.42	1.40	1.24	0.97	0.84	1.61	1.21	
R5														
N=7														

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Minimum	9	7.83	8.17	4.68	6.85	4.61	5.51	8.35	8.12	5.89	4.39	7.42	5.29	4
Maximum	12.1	10.13	10.72	6.08	9.01	5.73	6.64	13.35	13.46	9.02	11.22	13.25	7.28	
Arithmetic Mean	10.126	8.553	9.67	5.27	8.11	5.24	6.12	11.60	11.97	7.55	6.58	9.54	6.41	
Standard Deviation	1.169	0.776	0.87	0.45	0.70	0.37	0.36	1.56	1.82	1.03	2.21	1.81	0.62	
R6														
N=6														
Minimum	7.87	7.07	5.56	3.59	4.96	2.22	4.41	10.13	7.44	7.03	4.09	4.51	4.01	3
Maximum	10.96	8.92	10.49	6.71	9.22	6.02	6.80	11.36	13.87	9.32	5.65	9.37	6.51	
Arithmetic Mean	9.757	8.098	8.59	5.05	6.86	4.41	5.21	10.60	10.56	8.18	4.81	6.62	5.20	
Standard Deviation	1.118	0.622	1.74	1.12	1.79	1.35	0.87	0.51	2.52	0.92	0.62	1.82	0.96	
R7														
N=5														
Minimum	8.15	6.58	7.50	3.34	5.73	2.55	5.00	9.96	9.85	4.80	2.53	5.51	2.97	2
Maximum	11.86	9.52	9.55	4.01	7.45	4.48	6.32	11.78	11.89	6.69	4.78	7.35	4.81	
Arithmetic Mean	9.984	8.124	8.39	3.73	6.65	3.47	5.58	10.74	10.90	5.46	3.40	6.82	3.97	
Standard Deviation	1.545	1.379	0.74	0.28	0.72	0.71	0.57	0.66	0.98	0.75	0.84	0.76	0.69	
R8														
N=6														
Minimum	7.92	6.59	6.35	2.55	3.00	2.78	5.09	8.62	9.22	3.60	2.18	4.50	3.16	0
Maximum	10.31	8.03	7.35	3.89	5.60	5.06	6.89	9.56	11.16	5.73	3.67	6.36	5.18	
Arithmetic Mean	9.455	7.355	6.91	3.43	4.67	3.43	5.79	9.07	10.02	4.62	2.96	5.42	3.91	
Standard Deviation	0.982	0.536	0.36	0.47	0.96	0.83	0.61	0.32	0.66	0.83	0.50	0.74	0.70	
LPM														
N=5														
Minimum	8.69	6.85	15.59	9.62	14.65	8.42	9.03	16.75	12.75	7.44	8.25	12.60	7.79	4
Maximum	9.62	8.48	19.36	11.64	19.78	12.11	11.02	21.86	20.77	13.99	8.91	25.72	13.29	
Arithmetic Mean	9.264	7.794	17.75	10.51	17.58	10.56	9.77	19.36	16.64	12.00	8.68	16.18	9.41	
Standard Deviation	0.393	0.66	1.78	0.75	2.27	1.46	0.77	2.36	3.01	2.69	0.27	5.50	2.21	



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
L2														
N=5														
Minimum	7.07	5.31	12.08	7.60	18.50	10.19	7.70	17.47	10.26	12.38	8.15	7.46	7.51	4
Maximum	9.14	7.37	12.87	9.51	24.59	11.96	11.18	22.77	20.84	18.90	10.98	11.86	11.84	
Arithmetic Mean	8.09	6.282	12.46	8.52	20.90	10.98	9.52	19.81	17.77	14.65	9.17	10.04	8.80	
Standard Deviation	0.941	0.808	0.29	0.70	2.27	0.69	1.34	2.03	4.29	2.52	1.10	1.73	1.88	
L3														
N=6														
Minimum	8.13	6.17	9.72	5.31	12.95	6.25	5.85	13.32	13.77	4.42	5.92	7.88	5.16	4
Maximum	9.11	7.54	11.91	8.71	17.00	10.24	9.91	17.19	18.10	12.91	10.80	11.20	8.11	
Arithmetic Mean	8.523	6.765	11.22	6.91	15.04	8.00	7.56	15.71	16.29	10.24	7.40	9.59	6.54	
Standard Deviation	0.356	0.559	0.81	1.38	1.61	1.60	1.49	1.74	1.73	3.07	1.82	1.37	1.20	
L4														
N=5														
Minimum	6.53	4.66	6.58	5.01	11.82	5.56	4.60	8.77	12.32	7.47	5.82	7.41	5.11	4
Maximum	8.99	7.1	10.47	6.86	12.91	7.35	7.98	13.37	13.43	11.65	6.98	8.55	6.55	
Arithmetic Mean	7.626	6.1	9.17	6.31	12.18	6.94	6.35	11.87	12.90	10.36	6.56	8.10	5.90	
Standard Deviation	0.911	0.958	1.57	0.80	0.44	0.78	1.53	1.83	0.41	1.67	0.52	0.45	0.59	
L5														
N=6														
Minimum	5.84	3.72	7.77	3.71	9.55	4.29	5.26	9.98	10.96	7.14	4.40	5.33	4.17	3
Maximum	7.93	6.18	8.99	5.40	11.94	6.02	6.54	13.42	12.44	9.12	5.71	7.77	5.49	
Arithmetic Mean	6.847	5.28	8.30	4.60	10.70	5.43	5.81	12.13	11.76	8.36	5.13	6.82	4.74	
Standard Deviation	0.773	0.896	0.45	0.75	0.89	0.65	0.44	1.18	0.66	0.78	0.49	0.95	0.49	
L6														
N=5														
Minimum	3.23	2.38	8.12	4.16	9.90	4.99	4.79	10.11	11.14	6.71	3.81	7.63	4.76	3

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges	
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Crown	Tooth	Crown	Tooth		Crown
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
Maximum	6.27	5.07	10.32	7.33	13.08	7.21	7.20	14.46	13.13	11.46	8.19	10.05	6.12		
Arithmetic Mean	5.238	4.068	9.07	5.43	11.42	6.02	6.04	11.91	12.03	9.35	5.85	8.61	5.66		
Standard Deviation	1.268	1.068	0.87	1.30	1.33	0.94	1.09	1.85	0.73	1.82	1.76	1.01	0.62		
L7															
N=6															
Minimum	3.63	2.51	7.36	3.43	9.04	4.07	4.99	10.23	9.90	7.15	3.65	4.96	3.77	2	
Maximum	5.75	4.54	8.85	6.80	10.91	6.79	8.31	11.83	13.34	9.72	5.75	8.24	5.44		
Arithmetic Mean	4.57	3.483	8.27	4.93	9.91	5.55	5.76	11.02	11.54	8.37	4.38	6.40	4.54		
Standard Deviation	0.859	0.749	0.56	1.18	0.77	0.98	1.27	0.70	1.40	0.88	0.76	1.15	0.64		
L8															
N=6															
Minimum	2.74	0.88	5.54	3.90	5.40	3.32	5.20	7.72	7.90	5.37	3.34	4.21	3.24	0	
Maximum	4.7	3.83	7.48	6.27	9.10	5.19	6.63	10.94	12.26	9.92	5.13	7.61	4.41		
Arithmetic Mean	3.95	1.917	6.80	5.12	7.98	4.41	6.05	9.88	10.27	7.49	4.23	6.43	3.84		
Standard Deviation	0.883	1.03	0.74	0.96	1.34	0.70	0.61	1.17	1.47	1.59	0.77	1.22	0.41		

Tooth Files	FHSM VP-2073 <i>P. rugosus</i> Lower dentition													
M1	16.29	12.26	21.71	16.22	22.17	16.36	17.63	21.12	26.50	18.51	14.62	22.59	16.18	5
M2	17.72	13.16	23.71	16.60	24.19	18.29	17.83	22.99	23.59	25.04	14.59	24.11	15.36	5
M3	17.37	13.21	22.71	17.35	22.61	16.78	18.58	22.63	25.96	23.64	14.87	23.82	15.89	5
M4	18.60	13.90	24.02	16.74	23.10	17.60	17.45	21.28	24.24	25.63	16.55	25.98	17.07	5
M5	18.60	13.56	23.46	17.07	23.53	17.34	17.43	22.95	25.79	24.80	16.18	24.01	16.03	5
M6	17.64	13.22	22.83	16.09	22.64	17.69	17.76	22.44	25.83	24.31	13.45	22.91	14.63	5
M7	17.66	13.07	22.81	15.82	24.39	17.21	17.46	23.50	27.29	24.60	14.80	24.26	15.80	5
M8	18.13	13.23	24.28	16.51	23.67	17.79	17.42	23.13	25.37	26.09	15.37	24.75	15.98	5
M9	18.19	12.88	24.49	16.27	22.61	15.87	17.03	23.79	25.97	25.38	13.98	25.19	15.41	5
M10	17.34	12.83	23.86	15.68	23.00	16.25	16.59	24.75	25.59	25.78	14.26	24.69	15.02	5
M11	15.86	11.50	19.56	16.04	19.63	15.53	17.30	19.08	28.15	23.50	14.94	23.80	14.20	5
RPM1	14.86	10.42	21.03	13.99	22.29	14.87	16.05	21.61	23.84	21.83	13.65	23.93	14.42	5
RPM2	15.06	12.69	21.73	16.13	20.63	15.83	15.79	21.60	23.15	23.64	13.07	23.95	15.61	5

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
RPM3	15.54	11.93	21.79	14.85	21.50	15.02	14.66	21.72	23.79	23.04	13.87	23.50	15.92	5
RPM4	14.75	10.60	21.95	14.25	19.29	12.64	14.42	20.57	22.79	20.57	12.12	22.32	12.42	5
2R1	13.25	9.68	20.17	13.67	19.28	12.99	13.55	23.48	26.51	16.57	11.77	20.38	12.43	5
2R2	12.99	9.77	22.14	13.80	18.02	12.23	13.03	23.68	26.46	18.13	12.02	19.62	11.96	5
2R3	13.35	9.93	20.52	13.23	18.49	12.91	14.44	21.34	24.19	17.90	12.16	19.14	11.61	5
2R4	13.35	8.83	21.39	14.14	17.82	12.09	13.54	21.91	24.81	19.85	11.95	18.92	17.57	5
2R5	12.10	9.02	20.51	12.89	18.57	11.39	12.51	23.55	23.19	19.63	12.14	19.79	11.76	5
2R6	13.34	9.39	21.47	13.66	18.10	11.20	12.88	22.37	25.52	17.99	10.67	18.62	11.97	5
2R7	13.39	10.14	20.29	13.74	18.89	13.16	14.24	20.47	24.50	17.70	10.63	19.69	10.90	5
2R8	13.40	8.75	23.09	13.14	18.85	10.68	13.44	24.54	22.68	17.97	10.60	20.99	11.37	5
2R9	12.43	9.32	20.76	13.05	18.49	11.51	13.68	23.49	25.43	17.91	10.03	19.21	12.07	5
2R10	12.92	9.29	21.01	13.39	18.17	12.49	12.45	22.75	24.22	18.28	10.25	19.15	11.83	5
2R11	12.59	8.83	21.06	14.07	16.78	11.04	14.62	22.37	22.24	17.74	11.19	19.13	12.00	5
2R12	12.42	9.35	21.41	13.11	17.26	11.63	13.54	24.18	24.92	17.60	10.13	19.60	11.02	5
2R13	9.50	7.70	19.54	12.17	15.62	12.48	13.27	20.91	25.12	15.39	10.80	22.12	13.03	5
3R1	10.64	7.09	17.04	10.03	16.13	10.45	11.85	19.68	20.35	16.65	9.31	16.36	10.91	5
3R2	9.65	7.07	16.81	10.57	13.69	10.07	12.24	19.78	20.67	14.19	9.13	14.97	9.72	5
3R3	10.69	6.94	16.56	9.03	15.02	9.78	11.54	18.10	20.40	15.16	8.08	16.73	10.78	5
3R4	10.32	7.38	16.47	10.61	14.43	9.12	11.41	18.75	21.03	15.46	7.70	14.65	9.55	5
3R5	10.55	7.14	17.26	10.72	15.76	9.70	12.29	21.88	21.82	13.71	8.78	17.14	10.13	5
3R6	10.84	7.83	17.25	10.86	14.98	10.11	11.50	17.92	21.02	15.97	7.97	14.46	9.43	5
3R7	9.98	7.26	16.39	9.51	14.12	9.92	12.14	20.02	19.86	14.78	7.08	15.12	9.55	5
3R8	10.01	7.22	16.54	10.22	13.63	9.17	11.57	18.23	20.82	14.36	5.92	16.13	9.77	5
3R9	10.89	7.30	16.96	11.39	16.38	10.54	11.49	17.58	21.61	15.22	9.54	16.97	8.98	5
3R10	11.11	6.99	17.92	10.71	15.47	9.85	11.75	17.48	21.20	16.11	7.09	16.73	10.63	5
3R11	10.92	8.28	18.49	11.46	15.66	10.42	11.82	19.41	21.61	14.92	8.67	18.24	10.83	5
3R12	9.68	6.65	17.14	9.01	14.36	9.08	10.27	19.99	19.95	13.20	7.35	16.63	10.15	5
3R13	10.61	7.83	16.63	10.29	14.63	10.20	12.76	20.82	22.63	13.51	7.08	14.28	8.92	5
3R14	10.49	6.99	17.49	10.72	15.19	9.08	12.04	19.58	20.68	13.62	8.70	17.51	9.48	5
3R15	10.21	6.80	15.91	10.89	14.83	7.94	11.47	17.13	22.23	16.09	7.36	17.12	8.95	5
4R1	10.15	6.26	16.72	10.20	13.21	9.73	12.38	17.84	22.47	14.86	7.53	11.56	8.58	5
4R2	9.09	6.49	13.86	9.98	12.86	8.10	11.61	16.68	18.61	13.18	6.72	14.07	8.66	5

Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			left	left	right	right	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			posterior	posterior	posterior	posterior	Width	Width	Width	Length	Length	Length	Length	
		edge	edge	edge	edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
4R3	9.17	6.80	13.21	8.84	12.70	9.57	11.69	15.30	18.63	13.00	7.85	13.29	8.28	5
4R4	9.22	6.54	13.51	9.79	13.53	9.35	11.79	15.86	18.94	13.42	6.55	14.63	8.37	5
4R5	8.64	6.24	14.14	9.73	12.99	9.20	11.65	16.92	18.97	13.67	6.40	13.92	8.89	5
4R6	7.81	6.52	13.12	10.30	11.91	8.16	11.52	16.50	19.46	15.49	7.28	15.73	8.08	5
4R7	8.60	6.31	14.03	9.40	12.20	8.08	11.17	16.03	17.87	13.43	6.08	14.64	7.70	5
4R8	8.95	6.47	13.26	9.76	13.64	9.18	11.83	16.97	18.49	15.00	7.03	15.76	8.19	5
4R9	8.55	6.23	14.11	9.29	12.61	8.19	11.47	16.41	19.26	13.41	6.15	14.50	8.18	5
4R10	8.71	6.60	14.78	10.66	12.75	9.00	12.75	16.52	17.85	15.12	7.33	17.38	10.46	5
4R11	8.36	6.17	13.40	8.83	13.16	8.51	10.83	17.30	19.00	13.76	7.94	16.22	8.70	5
4R12	8.43	6.85	12.40	9.77	13.34	9.41	11.94	15.56	19.47	14.70	7.66	13.65	8.57	5
5R1	8.62	6.56	12.97	9.35	12.94	8.95	11.55	15.90	18.43	13.13	7.63	13.55	8.94	4
5R2	9.99	6.97	15.60	11.20	13.24	9.31	11.59	15.84	19.30	14.22	7.96	15.38	9.26	4
5R3	7.36	5.53	11.75	8.47	11.72	7.82	10.61	14.50	17.51	13.30	6.45	12.66	7.89	4
5R4	7.32	4.97	11.30	8.32	11.70	8.57	10.99	14.47	15.82	12.54	6.65	11.60	8.16	4
5R5	7.89	5.64	13.36	9.77	11.54	6.75	9.58	15.51	15.93	11.32	6.38	14.82	7.68	4
5R6	7.80	5.68	11.85	9.00	11.62	8.26	11.69	13.36	18.46	12.71	6.33	12.22	8.01	4
5R7	6.91	5.38	10.46	8.01	10.82	8.12	11.10	13.33	15.56	11.34	6.52	13.69	8.27	4
5R8	7.32	5.27	11.30	8.21	11.41	7.10	10.68	15.05	16.28	11.29	5.30	12.49	7.28	4
5R9	6.95	5.15	11.24	7.58	10.29	6.70	9.49	14.26	15.01	12.28	5.84	12.07	7.04	4
5R10	8.25	5.65	13.72	8.68	11.93	8.34	11.17	15.79	16.58	10.89	6.34	13.37	7.26	4
5R11	8.52	5.08	12.34	9.51	12.59	8.55	10.85	13.40	17.06	11.21	5.67	11.71	6.54	4
5R12	7.73	5.59	12.23	8.37	11.38	7.75	10.14	15.53	15.39	10.37	5.42	13.06	7.05	4
5R13	7.41	5.89	10.96	8.61	11.55	8.60	10.66	14.61	14.63	10.96	6.36	12.73	8.20	4
5R14	7.13	5.92	10.70	9.04	12.03	8.72	11.85	14.28	16.61	12.32	6.17	13.88	7.98	4
6R1	6.46	3.88	11.32	6.93	9.65	5.88	8.14	13.04	14.34	9.32	5.01	10.02	6.31	4
6R2	5.72	3.87	9.71	6.40	10.09	6.40	8.85	13.10	13.73	11.13	5.66	12.12	7.98	4
6R3	6.82	4.51	9.02	6.51	10.40	6.76	8.70	11.03	15.74	11.86	7.16	11.43	7.16	4
6R4	6.09	3.96	9.33	7.77	9.82	6.40	9.89	11.22	15.58	9.91	5.95	10.67	6.03	4
6R5	5.26	4.11	9.49	7.20	10.13	6.57	9.84	12.11	14.75	9.02	4.99	11.78	5.94	4
6R6	5.80	4.23	9.18	7.19	9.74	6.01	9.44	12.57	13.94	9.19	5.63	10.78	6.26	4
6R7	5.99	4.20	9.45	5.67	10.78	7.39	9.33	11.90	14.56	11.96	4.18	11.16	6.25	4
6R8	6.44	4.09	8.91	6.44	10.56	6.17	9.12	12.05	14.64	10.41	5.97	11.83	5.48	4

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
6R9	5.69	2.46	10.78	7.42	11.05	6.15	9.89	13.63	14.38	11.74	4.34	11.82	7.18	4
6R10	6.27	4.25	9.34	6.29	11.84	7.59	9.09	12.63	13.44	10.02	5.75	12.07	7.05	4
6R11	6.29	4.47	10.73	7.42	9.55	6.75	9.55	13.72	14.33	8.93	5.55	11.72	7.26	4
6R12	6.32	4.62	9.70	7.97	10.71	6.41	9.98	12.38	14.56	10.81	5.22	11.95	6.12	4
6R13	6.16	4.74	10.69	8.38	11.09	7.60	10.83	12.61	15.24	10.81	5.57	12.63	7.07	4
6R14	5.16	3.12	9.00	6.92	9.34	4.93	8.35	11.71	14.20	8.21	4.76	10.57	5.56	4
6R15	4.82	3.35	8.12	6.68	8.03	4.94	9.23	10.72	13.83	10.80	4.00	9.80	5.33	4
6R16	4.66	3.20	8.79	7.10	9.06	5.35	9.14	11.26	13.50	10.22	5.18	10.64	5.61	4
6R17	4.84	3.31	8.98	6.19	10.32	6.90	9.49	12.54	13.68	9.15	4.52	10.98	6.60	4
6R18	4.76	2.69	9.25	5.59	8.86	6.63	9.79	11.69	11.86	9.25	4.54	9.53	6.84	4
6R19	5.32	3.31	8.78	6.06	8.94	5.51	9.02	12.16	13.22	8.85	4.49	10.05	5.88	4
6R20	3.74	2.72	7.61	6.28	8.65	5.70	9.47	10.08	10.03	10.29	4.74	11.73	5.81	4
7R1	4.91	3.36	8.04	6.47	9.17	5.45	8.71	10.84	12.20	9.16	5.13	10.30	5.90	3
7R2	4.99	2.19	8.19	6.48	9.36	5.59	8.50	11.55	11.22	10.59	4.62	10.60	6.06	3
7R3	3.94	2.32	7.51	6.06	9.03	5.45	7.27	11.25	12.50	9.91	5.39	9.58	6.68	2
7R4	5.04	2.86	9.67	6.88	7.45	4.57	9.62	9.79	12.88	11.84	4.94	8.77	5.76	3
7R5	4.68	3.39	9.45	6.28	9.01	5.81	8.52	12.88	14.00	9.72	4.67	8.77	4.63	3
7R6	3.73	2.68	8.71	6.17	7.54	4.60	8.33	11.51	12.31	7.99	4.30	8.17	4.16	3
7R7	3.17	1.82	6.42	4.29	7.17	4.58	7.56	9.14	11.21	8.72	3.62	8.60	4.37	2
7R8	3.00	1.72	7.59	4.75	6.43	3.66	6.24	9.75	8.74	8.78	7.80	8.96	9.15	2
7R9	3.33	1.68	6.82	4.71	6.72	3.73	6.81	8.35	13.30	8.47	3.76	4.95	4.37	2
7R10	2.56	1.82	8.69	5.10	7.04	4.51	8.15	11.78	10.07	7.71	3.74	10.41	4.73	3
7R11	3.08	2.03	7.30	4.85	7.54	4.08	7.05	9.47	10.22	7.99	2.63	8.23	4.02	4
7R12	2.68	1.59	7.04	3.29	7.17	4.42	5.99	10.25	8.98	7.72	4.00	8.09	5.18	4
8R1	3.31	2.12	7.87	4.69	8.38	5.79	8.29	10.26	11.42	8.29	3.29	10.47	5.54	0
8R2	3.22	2.13	7.61	5.05	6.64	4.18	7.80	10.75	10.30	7.94	3.51	9.33	4.44	0
8R3	2.94	1.47	6.34	4.64	6.22	3.36	6.71	8.84	8.66	8.99	3.81	9.89	4.38	0
8R4	2.55	1.93	6.28	5.18	10.57	4.97	8.65	12.13	10.85	8.40	3.32	14.10	5.36	0
8R5	3.09	1.79	7.30	4.53	6.83	4.06	7.42	10.10	10.85	6.49	2.85	7.94	4.79	0
8R6	3.43	2.21	6.68	5.45	6.85	4.43	8.03	9.79	10.37	6.14	4.00	8.96	4.14	0
9R1	1.78	0.61	5.34	3.86	6.39	3.32	6.13	7.81	8.93	7.92	3.20	7.34	3.22	0
9R2	1.64	0.56	4.63	3.29	6.23	4.00	6.23	7.85	7.95	7.58	3.03	8.25	4.38	0

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges	
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Crown	Tooth	Crown	Tooth		Crown
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
9R3	2.46	0.55	4.99	3.58	6.31	3.66	6.18	7.83	8.44	7.75	3.12	7.80	3.80	0	
LPM1	15.55	11.65	20.70	14.40	23.43	15.47	15.67	22.17	22.57	23.96	14.07	24.53	13.44	5	
LPM2	16.24	9.65	20.62	13.65	23.43	15.46	14.47	21.10	25.42	23.74	14.12	23.47	15.29	6	
LPM3	15.84	11.96	20.51	14.78	23.07	15.43	14.53	22.02	24.87	23.83	14.57	24.87	14.34	5	
2L1	12.79	10.05	17.83	12.74	23.00	12.76	13.61	23.13	25.76	18.17	12.12	17.49	12.75	6	
2L2	12.99	9.14	17.03	11.24	21.00	13.55	14.03	23.12	22.55	19.59	10.33	17.42	10.29	6	
2L3	12.01	8.18	15.66	10.55	19.06	12.17	13.28	22.11	24.71	17.99	10.65	15.60	9.80	5	
2L4	12.28	7.68	16.03	10.46	19.36	11.25	13.02	21.16	22.42	18.62	10.10	16.63	9.53	5	
2L5	14.84	10.77	18.57	13.71	21.01	14.70	14.64	20.96	25.03	19.48	11.53	16.92	11.76	6	
2L6	12.99	10.12	18.00	12.53	21.33	13.93	14.10	20.21	27.51	19.19	11.39	15.91	11.52	6	
2L7	13.88	10.10	18.22	12.24	22.23	14.31	13.49	23.43	27.38	19.74	11.15	18.36	11.93	6	
2L8	14.19	9.88	18.21	12.16	22.91	14.50	15.22	23.46	26.76	19.86	11.04	17.01	12.48	6	
2L9	13.58	6.85	17.87	10.03	21.58	13.69	15.88	22.99	27.81	19.28	11.89	17.04	11.28	6	
2L10	13.73	10.18	18.32	12.80	21.51	13.77	13.95	22.20	25.52	19.10	11.25	16.77	11.90	6	
2L11	13.50	8.35	17.30	10.25	20.35	12.66	14.51	22.97	25.37	19.85	10.63	15.21	11.05	6	
2L12	13.15	9.96	18.44	12.22	22.43	13.73	14.82	24.05	26.32	20.21	11.78	16.15	11.08	6	
2L13	13.98	9.69	18.26	12.53	20.16	12.85	14.17	22.80	26.21	19.04	10.62	17.75	11.58	6	
3L1	10.84	7.66	14.58	10.75	16.76	9.24	11.55	19.84	20.85	15.19	8.40	14.08	9.58	5	
3L2	11.18	7.39	15.38	10.61	17.49	9.28	11.79	19.98	22.89	16.62	8.96	15.35	8.54	5	
3L3	11.57	8.07	15.39	11.07	17.02	10.52	12.17	18.67	21.33	18.11	10.30	14.79	9.15	5	
3L4	9.46	6.66	13.80	9.44	16.27	10.12	10.50	17.68	21.80	16.91	9.54	14.98	9.33	4	
3L5	11.47	7.72	16.08	10.40	16.15	11.06	11.97	18.63	22.93	16.09	8.55	13.69	8.77	5	
3L6	10.93	7.49	15.34	10.43	15.61	10.10	12.15	18.45	21.05	17.76	9.16	14.59	9.08	5	
3L7	11.40	7.62	14.75	10.18	16.03	10.35	12.26	17.39	21.15	17.05	9.58	12.29	9.14	5	
3L8	10.90	7.95	14.79	9.89	16.50	10.51	12.21	18.17	21.46	17.13	9.58	13.87	8.71	5	
3L9	10.56	7.63	14.95	10.54	15.97	10.68	12.63	17.43	21.95	16.87	10.04	12.39	8.83	5	
3L10	11.18	7.97	15.13	10.53	17.12	10.29	11.75	18.94	21.63	16.06	10.29	13.66	9.10	5	
3L11	10.54	7.96	15.04	11.54	17.44	10.33	12.92	19.00	21.44	15.23	9.59	12.84	9.31	5	
3L12	12.10	8.17	15.92	11.93	15.71	10.56	13.06	18.04	20.96	16.83	8.35	12.68	8.03	5	
3L13	8.11	5.70	13.64	8.97	14.65	9.28	11.09	16.12	20.11	16.01	8.19	14.23	7.72	5	
3L14	11.59	7.84	15.57	10.95	16.35	11.17	12.65	18.78	23.67	15.74	9.41	14.92	9.57	5	
3L15	11.37	8.20	15.59	11.34	15.17	10.20	13.11	17.62	22.90	15.15	8.48	15.61	8.76	5	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
3L16	10.02	7.26	14.49	9.90	16.52	10.30	11.72	19.49	22.88	15.62	9.39	13.52	8.02	5
3L17	9.74	7.37	15.70	10.92	17.98	9.60	11.65	21.83	20.38	17.19	8.62	10.19	8.13	5
3L18	9.44	7.09	13.91	9.50	16.59	10.21	12.03	18.43	20.71	16.89	9.29	13.36	8.14	5
3L19	9.79	7.32	15.33	10.82	16.32	9.98	11.86	17.60	24.32	12.97	8.74	15.32	8.89	5
3L20	10.59	7.30	15.05	9.79	16.76	10.07	11.54	18.28	21.88	16.57	8.04	13.72	8.30	5
3L21	11.29	7.83	16.12	10.88	18.25	10.56	11.09	18.91	21.65	17.54	9.90	16.34	9.90	5
3L22	10.94	8.76	13.77	11.51	17.13	11.54	12.66	17.24	22.28	17.01	10.27	15.95	10.46	5
3L23	12.34	9.14	16.80	12.32	18.65	12.63	12.64	20.79	22.10	16.89	10.09	16.75	12.47	5
3L24	11.23	8.62	16.23	11.11	17.87	11.88	12.84	18.06	22.01	18.79	9.77	18.05	9.64	5
3L25	12.61	8.44	16.43	11.75	17.58	12.60	12.73	18.83	26.56	14.86	10.91	18.70	10.20	5
4L1	9.67	6.46	14.30	9.36	14.31	9.32	11.37	17.22	19.48	15.24	9.43	11.91	7.63	5
4L2	9.44	6.28	13.32	9.07	12.95	8.76	11.08	14.94	19.19	15.66	7.17	13.43	7.53	4
4L3	4.49	5.78	11.67	9.04	13.85	8.83	10.32	14.91	19.88	15.93	8.79	11.03	6.85	4
4L4	9.96	6.47	13.15	9.02	13.58	9.14	10.73	16.18	17.64	16.06	7.63	13.36	8.69	4
4L5	8.85	5.92	13.66	8.67	12.65	8.85	11.33	16.06	19.29	14.47	8.45	12.96	7.53	4
4L6	8.12	6.25	12.80	9.05	13.88	8.94	11.70	15.19	18.74	15.62	7.93	11.34	7.53	4
4L7	9.56	5.96	13.07	8.32	12.96	8.58	11.27	15.23	17.02	15.62	7.62	12.79	8.05	4
4L8	9.48	6.18	13.88	8.56	14.21	9.17	11.72	17.70	19.83	15.91	6.78	12.08	7.39	4
4L9	9.59	6.44	13.45	8.64	14.89	9.51	11.17	16.39	17.16	16.03	7.98	12.51	6.73	4
4L10	9.89	6.02	13.68	8.99	13.27	8.28	10.97	16.20	18.19	15.10	7.75	11.98	7.34	4
4L11	9.55	6.60	14.00	9.70	13.65	8.50	11.11	18.36	18.10	15.98	8.16	13.09	7.61	4
4L12	10.76	6.88	13.92	9.66	14.50	8.91	12.03	15.78	19.08	15.20	7.89	13.47	7.69	4
4L13	9.49	6.89	13.55	9.25	13.71	9.12	10.82	16.34	18.81	12.45	7.48	13.24	7.00	4
4L14	9.69	7.00	13.82	10.15	14.16	9.01	11.01	17.11	17.38	14.78	9.29	12.77	8.61	4
4L15	10.10	6.13	12.92	9.08	15.18	7.43	10.14	16.82	18.15	12.07	6.76	12.28	8.32	4
4L16	6.72	4.47	12.76	8.60	12.06	7.93	9.79	15.50	16.20	14.89	7.10	11.08	6.33	4
4L17	5.83	4.48	11.98	7.83	11.28	7.28	10.15	13.73	18.71	13.48	5.76	12.26	6.33	4
4L18	6.74	4.47	11.31	7.03	11.40	7.50	10.33	14.61	20.05	9.73	5.34	11.32	5.87	4
4L19	8.26	5.78	13.24	9.79	10.92	7.68	10.83	14.53	19.61	9.44	6.04	11.74	6.21	4
4L20	7.80	5.42	11.78	8.52	10.95	6.64	10.03	14.81	14.18	15.51	7.07	10.91	6.82	4
4L21	4.62	5.05	10.58	7.62	12.04	8.09	9.41	12.14	15.32	14.21	7.93	11.36	6.34	4
4L22	9.21	6.12	13.39	9.47	13.64	8.64	10.15	15.34	17.67	15.62	7.97	13.51	6.64	4

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
4L23	8.19	6.20	14.26	9.45	14.17	8.11	10.29	17.72	19.24	15.81	7.55	11.51	7.76	4
4L24	8.66	6.46	14.29	9.60	14.10	8.93	10.97	15.88	20.75	15.07	7.83	13.74	7.96	4
4L25	8.75	5.89	14.61	8.98	13.90	8.09	10.49	18.16	20.55	15.23	8.75	14.08	7.78	4
5L1	6.80	5.28	12.60	8.13	12.86	8.25	9.80	14.38	16.76	14.82	5.85	11.38	6.25	4
5L2	8.46	5.68	12.20	8.81	11.80	7.59	10.53	13.37	15.96	12.55	7.87	12.18	7.49	4
5L3	7.79	6.28	12.90	9.58	12.36	8.89	10.62	13.11	16.23	14.52	7.78	10.70	6.61	4
5L4	8.66	2.41	13.90	7.90	10.65	7.10	9.38	14.43	16.94	15.56	6.34	10.65	7.79	4
5L5	7.79	5.20	12.03	7.58	11.27	7.59	9.57	12.64	15.75	13.91	7.20	10.45	6.34	4
5L6	7.45	5.07	11.76	7.38	11.97	8.14	9.35	12.84	16.23	12.39	6.49	10.76	6.46	4
5L7	6.70	4.84	11.29	8.27	11.37	6.70	9.86	13.27	17.44	12.68	6.53	9.61	6.23	4
5L8	7.68	4.93	12.60	7.76	11.29	7.33	9.68	15.87	14.88	14.76	6.81	9.68	6.64	4
5L9	6.07	5.18	12.84	8.15	11.67	7.57	10.58	14.94	16.68	14.96	6.93	11.30	6.18	4
5L10	6.71	3.91	11.80	7.55	10.36	6.35	9.26	12.70	14.42	13.75	6.50	10.17	5.75	3
5L11	5.45	4.11	10.91	7.44	9.60	7.17	10.17	11.34	16.73	13.36	6.05	10.76	5.70	3
5L12	7.37	4.92	12.06	8.17	11.35	7.19	9.78	12.01	14.84	14.08	6.33	9.40	6.26	3
5L13	6.62	5.42	11.85	8.35	11.23	7.13	9.65	13.47	16.43	13.73	7.04	8.32	6.35	3
5L14	7.21	5.18	10.49	7.45	11.04	8.32	10.95	13.09	14.85	10.83	17.69	10.15	11.97	3
5L15	6.95	4.44	11.38	8.50	9.21	5.70	9.59	12.48	14.13	12.67	6.75	9.90	5.99	3
5L16	7.44	4.57	11.96	8.07	10.81	6.06	9.39	12.86	13.67	13.67	6.57	9.85	5.84	3
5L17	3.28	4.25	10.31	7.34	10.71	7.15	9.55	10.86	15.16	12.10	4.88	10.48	5.48	3
5L18	4.41	3.83	10.52	7.02	10.57	7.20	8.79	10.65	15.61	12.95	5.81	9.34	5.57	3
5L19	5.49	3.20	9.94	6.16	9.24	5.38	8.59	12.18	12.39	12.04	5.28	9.79	5.04	3
5L20	6.34	4.66	10.73	7.31	10.89	6.20	8.43	13.18	13.80	12.42	6.11	9.77	5.92	3
5L21	8.61	5.70	13.01	8.41	12.34	7.70	9.31	13.05	15.74	12.54	6.65	10.96	6.57	3
5L22	9.14	5.50	12.95	8.43	11.57	7.57	9.96	13.59	14.90	13.90	7.19	10.46	5.72	3
5L23	8.56	5.63	12.50	8.41	13.61	7.87	10.79	16.71	14.90	12.90	5.40	8.69	6.95	3
5L24	7.29	4.68	10.96	7.81	10.58	6.61	9.85	11.62	14.35	12.19	6.26	8.96	5.70	3
5L25	8.17	4.27	12.30	7.71	10.38	6.63	9.83	12.08	15.14	13.20	6.94	9.03	6.39	3
5L26	6.85	4.56	11.92	7.86	11.77	7.17	8.62	15.02	14.88	12.76	9.33	11.01	7.38	3
5L27	6.38	4.04	10.30	8.04	10.06	4.77	8.36	11.27	15.03	12.70	6.79	10.75	6.65	3
5L28	4.28	3.86	11.11	7.14	10.70	6.27	9.22	13.38	13.84	11.47	5.71	7.33	5.50	3
5L29	6.41	3.89	10.70	6.72	9.72	5.64	7.85	10.32	15.42	13.28	6.75	9.11	6.39	3



Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			left	left	right	right	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			posterior	posterior	posterior	posterior	Width	Width	Width	Length	Length	Length	Length	
		edge	edge	edge	edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
6L1	4.79	3.53	9.38	6.08	9.29	6.67	8.66	10.67	15.39	9.05	5.25	6.69	5.70	3
6L2	4.34	3.49	9.93	5.61	8.66	7.15	5.70	10.00	15.97	4.50	9.35	9.65	9.20	3
6L3	4.55	2.99	9.89	6.00	8.87	5.75	7.82	10.88	13.45	10.30	5.66	7.02	5.53	3
6L4	2.93	1.88	8.00	5.51	7.60	4.52	8.06	9.53	13.25	7.82	5.30	8.17	4.61	3
6L5	2.85	2.80	9.28	6.55	9.22	5.59	8.03	9.70	11.20	12.16	7.45	9.31	5.67	3
6L6	3.42	3.19	9.05	6.08	8.65	6.74	8.95	10.37	12.25	11.49	4.99	8.47	6.13	3
6L7	5.49	3.37	9.66	6.58	8.86	5.09	8.35	12.54	11.94	11.28	5.63	7.75	5.65	3
6L8	5.40	3.11	9.25	6.25	7.94	5.27	8.91	10.93	11.03	11.77	7.05	9.41	5.18	3
6L9	5.20	3.20	8.74	6.82	7.89	4.72	8.91	10.70	11.85	11.81	6.96	8.32	5.45	3
6L10	4.97	2.70	8.59	6.49	7.84	5.12	8.72	9.99	12.85	9.89	6.38	9.26	5.22	3
6L11	1.97	2.30	7.98	5.37	7.23	4.86	8.21	8.89	12.71	9.41	5.06	8.60	4.56	3
6L12	2.65	2.05	7.79	5.14	7.68	4.59	7.40	9.09	9.87	10.57	5.30	8.73	4.87	3
6L13	1.73	1.95	7.48	4.87	6.78	5.04	7.54	9.69	11.56	10.23	4.23	6.88	4.83	3
6L14	5.10	3.06	8.87	6.41	10.03	5.27	7.43	13.05	13.03	9.01	4.82	6.67	4.74	3
6L15	3.51	1.04	9.01	5.03	8.12	3.78	6.66	12.18	10.74	9.58	5.02	6.59	4.35	3
6L16	3.10	2.68	8.22	5.75	7.83	5.48	8.18	9.18	12.49	9.70	4.18	6.29	4.88	3
6L17	2.82	2.41	8.27	6.09	7.85	4.95	8.26	8.61	13.88	8.84	4.71	8.27	4.89	3
6L18	3.32	2.76	7.31	5.96	7.09	4.79	8.32	9.38	10.49	9.76	6.38	8.19	5.27	3
6L19	4.62	3.18	8.91	6.68	7.97	5.36	8.30	8.86	8.77	12.03	6.91	10.78	5.43	3
6L20	3.86	2.27	8.92	6.69	4.67	2.81	7.32	8.21	12.29	10.13	6.41	11.94	4.88	3
6L21	5.22	2.48	8.73	6.00	8.00	5.18	7.99	10.12	12.25	9.97	5.85	8.35	5.35	3
6L22	1.23	2.24	8.32	5.56	7.57	12.07	8.14	11.91	10.30	8.80	4.97	8.05	4.76	3
6L23	4.56	2.84	9.09	6.72	9.02	5.03	7.56	10.56	9.74	9.23	6.30	9.37	5.60	3
7L1	3.59	2.38	9.43	6.19	6.96	5.37	8.62	10.80	11.46	10.40	6.02	8.36	5.35	3
7L2	3.87	1.78	8.96	5.39	6.16	4.14	7.12	10.59	11.27	10.12	5.14	8.56	5.56	3
7L3	3.24	1.23	8.54	4.65	8.24	5.24	7.50	10.91	11.26	10.25	4.53	8.27	3.97	3
7L4	4.82	2.44	8.27	5.62	8.12	4.00	6.66	10.71	10.74	9.37	5.54	7.82	4.07	3
7L5	2.86	1.19	7.41	3.72	6.89	4.90	7.28	8.11	11.03	9.70	3.74	8.75	3.94	3
7L6	3.81	2.10	8.20	4.94	7.09	4.08	7.00	10.29	10.51	10.62	4.39	8.78	4.33	3
7L7	2.65	1.61	8.27	5.55	6.98	4.67	8.22	10.10	9.28	9.94	5.93	8.16	4.70	3
7L8	3.20	1.77	8.89	5.03	6.26	4.11	7.03	9.30	10.13	10.67	4.74	8.87	4.15	3
7L9	2.52	1.47	7.89	5.50	6.73	3.79	7.20	8.62	9.83	9.86	4.85	8.29	3.93	3

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
7L10	2.67	1.52	8.02	5.50	6.34	4.29	7.34	8.62	10.36	8.67	4.69	8.46	4.34	3
7L11	3.07	1.62	8.66	6.17	6.33	4.54	7.44	8.70	10.40	8.71	4.13	7.83	3.51	3
7L12	2.87	1.43	8.06	4.14	7.10	4.31	6.97	8.82	10.72	10.26	3.06	7.66	4.00	3
7L13	3.46	1.14	7.43	4.72	6.76	3.97	6.63	8.09	10.55	8.31	4.09	9.28	3.98	3
7L14	3.80	1.58	7.88	5.42	6.56	3.44	6.93	8.22	9.34	8.60	4.75	9.78	4.46	3
7L15	4.01	1.71	7.26	4.52	6.77	3.91	6.42	6.68	8.69	9.19	5.31	9.38	4.48	3
7L16	2.63	0.34	7.51	3.94	6.77	3.82	6.44	8.76	8.70	7.80	3.92	8.59	4.11	3
7L17	2.99	0.90	8.19	4.94	6.08	3.81	6.53	8.27	8.56	8.48	4.04	8.52	4.27	3
7L18	3.10	0.82	7.69	4.10	6.91	4.40	5.77	5.99	9.98	7.51	4.11	6.00	4.71	3
7L19	3.40	2.25	9.17	5.60	7.48	4.41	6.85	10.45	10.66	10.11	4.19	7.94	4.43	4
7L20	3.15	2.05	7.49	4.78	5.21	3.46	5.64	8.23	8.69	9.33	4.15	9.93	4.31	3
8L1	3.01	1.69	7.00	4.59	6.71	3.77	6.23	8.95	9.35	9.71	5.47	6.55	4.97	3
8L2	2.23	1.58	7.37	4.78	6.23	3.80	7.06	8.66	10.23	9.31	3.76	7.34	3.29	3
8L3	2.26	1.23	6.96	4.32	5.53	3.88	7.57	7.95	10.20	8.55	3.00	7.28	2.87	3
8L4	1.54	0.91	6.83	4.05	5.94	3.78	7.14	8.56	10.70	9.36	4.16	7.14	3.62	3
8L5	1.40	0.96	7.09	5.03	5.57	4.35	7.27	8.52	9.47	8.79	4.55	6.51	3.69	3
8L6	2.71	1.44	6.61	3.96	5.36	3.74	6.60	7.91	9.63	8.57	3.88	6.27	3.48	3
8L7	1.04	0.30	6.39	4.06	5.77	3.02	6.27	9.73	8.80	8.54	3.73	6.27	3.20	3
8L8	2.36	0.09	7.12	5.49	6.08	3.42	7.90	9.82	7.07	9.28	6.84	7.21	4.09	3
8L9	1.09	0.79	6.96	4.91	5.72	3.92	7.19	7.38	9.60	9.10	4.45	6.36	3.64	3
8L10	3.27	1.40	6.87	4.21	5.86	3.10	5.80	7.52	10.18	9.59	3.81	6.63	4.04	3
8L11	2.33	0.60	7.36	3.74	5.82	3.21	5.71	7.53	8.55	10.63	4.15	6.50	3.50	3
8L12	1.98	0.62	7.35	4.40	5.55	3.50	6.11	7.90	9.43	8.62	4.62	6.62	3.50	3
8L13	2.76	1.04	7.02	3.54	5.57	3.59	5.74	8.52	7.34	8.71	3.40	7.04	3.63	3
8L14	1.89	0.65	6.14	3.91	5.73	2.83	5.20	8.21	8.28	7.99	4.42	7.40	3.34	3
8L15	2.30	0.69	6.79	3.93	5.75	3.34	5.59	8.13	8.02	8.09	4.13	7.64	3.67	3
8L16	2.27	0.85	6.85	3.53	5.03	3.34	5.80	7.85	7.09	8.72	4.08	6.21	3.17	3
8L17	2.26	0.31	6.57	4.12	4.98	3.22	4.88	8.38	6.34	7.70	4.15	6.60	3.67	0
9L1	1.94	0.37	6.88	4.15	5.19	2.27	5.57	9.53	7.99	7.83	3.08	5.88	2.53	0
9L2	1.41	0.54	6.77	3.88	4.40	2.95	5.57	8.09	6.95	9.13	2.42	6.70	3.38	0
9L3	2.02	0.81	6.55	3.68	4.63	3.42	4.51	7.40	8.68	6.46	3.23	8.25	4.75	0
9L4	1.94	0.21	6.55	3.13	4.81	3.53	5.64	7.52	6.82	9.36	3.93	6.87	4.21	0

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
9L5	1.53	0.17	5.91	3.89	4.15	2.85	4.40	6.01	6.35	7.54	4.04	7.32	3.90	0
9L6	2.69	0.78	6.50	3.68	4.83	3.14	4.93	6.90	7.28	7.51	5.42	7.69	4.66	0
9L7	1.65	0.75	6.46	3.83	4.54	2.78	5.74	7.67	7.19	8.52	4.41	7.19	3.91	0
9L8	0.91	0.42	6.14	3.86	4.62	2.33	5.36	8.69	7.12	7.39	3.94	6.27	3.52	0
9L9	2.12	0.80	6.69	3.75	4.18	3.12	5.92	7.71	7.24	7.96	4.18	6.89	4.01	0
9L10	2.10	0.75	7.12	4.23	4.39	2.64	4.90	6.93	6.71	8.72	4.75	8.01	4.85	0
9L11	2.15	1.02	6.90	3.86	4.47	2.84	5.76	8.57	6.88	8.57	4.82	6.99	4.74	0
9L12	2.00	1.27	6.36	4.00	4.78	4.13	6.77	8.07	7.92	9.18	4.86	7.36	4.52	0

**SUMMARY FHSM VP 2073 *P. rugosus* Lower dentition**

Medials

N=11

Minimum	15.86	11.5	19.56	15.68	19.63	15.53	16.59	19.08	23.59	18.51	13.45	22.59	14.20	5
Maximum	18.6	13.9	24.49	17.35	24.39	18.29	18.58	24.75	28.15	26.09	16.55	25.98	17.07	
Arithmetic Mean	17.582	12.984	23.04	16.40	22.87	16.97	17.50	22.51	25.84	24.30	14.87	24.19	15.60	
Standard Deviation	0.867	0.643	1.42	0.52	1.28	0.88	0.50	1.54	1.26	2.09	0.90	0.96	0.79	

RPM

N=4

Minimum	14.75	10.42	21.03	13.99	19.29	12.64	14.42	20.57	22.79	20.57	12.12	22.32	12.42	5
Maximum	15.54	12.69	21.95	16.13	22.29	15.83	16.05	21.72	23.84	23.64	13.87	23.95	15.92	
Arithmetic Mean	15.053	11.41	21.62	14.81	20.93	14.59	15.23	21.38	23.39	22.27	13.18	23.42	14.59	
Standard Deviation	0.349	1.087	0.41	0.95	1.29	1.37	0.81	0.54	0.51	1.36	0.78	0.77	1.58	

R2

N=13

Minimum	9.5	7.7	19.54	12.17	15.62	10.68	12.45	20.47	22.24	15.39	10.03	18.62	10.90	5
Maximum	13.4	10.14	23.09	14.14	19.28	13.16	14.62	24.54	26.51	19.85	12.16	22.12	17.57	
Arithmetic Mean	12.695	9.231	21.03	13.39	18.03	11.98	13.48	22.70	24.60	17.90	11.10	19.72	12.27	
Standard Deviation	1.057	0.632	0.92	0.54	0.99	0.80	0.67	1.27	1.31	1.13	0.81	0.96	1.69	

R3

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	r Crown F-G	r Tooth B-C	Tooth E-D	Tooth B-E	Crown F-I	Tooth C-D	Crown G-H	
N=15														
Minimum	9.65	6.65	15.91	9.01	13.63	7.94	10.27	17.13	19.86	13.20	5.92	14.28	8.93	5
Maximum	11.11	8.28	18.49	11.46	16.38	10.54	12.76	21.88	22.63	16.65	9.54	18.24	10.91	
Arithmetic Mean	10.439	7.251	16.99	10.40	14.95	9.70	11.74	19.09	21.06	14.86	7.98	16.20	9.85	
Standard Deviation	0.451	0.432	0.65	0.74	0.83	0.70	0.56	1.35	0.80	1.08	1.02	1.22	0.69	
R4														
N=12														
Minimum	7.81	6.17	12.40	8.83	11.91	8.08	10.83	15.30	17.85	13.00	6.08	11.56	7.70	4
Maximum	10.15	6.85	16.72	10.66	13.64	9.73	12.75	17.84	22.47	15.49	7.94	17.38	10.46	
Arithmetic Mean	8.807	6.457	13.88	9.71	12.91	8.87	11.72	16.49	19.08	14.09	7.04	14.61	8.56	
Standard Deviation	0.579	0.223	1.09	0.56	0.52	0.62	0.50	0.73	1.19	0.88	0.65	1.53	0.68	
R5														
N=14														
Minimum	6.91	4.97	10.46	7.58	10.29	6.70	9.49	13.33	14.63	10.37	5.30	11.60	6.54	4
Maximum	9.99	6.97	15.60	11.20	13.24	9.31	11.85	15.90	19.30	14.22	7.96	15.38	9.26	
Arithmetic Mean	7.8	5.663	12.13	8.87	11.77	8.11	10.85	14.70	16.61	11.99	6.36	13.09	7.83	
Standard Deviation	0.831	0.553	1.40	0.90	0.78	0.80	0.74	0.93	1.39	1.11	0.74	1.11	0.75	
R6														
N=20														
Minimum	3.74	2.46	7.61	5.59	8.03	4.93	8.14	10.08	10.03	8.21	4.01	9.53	5.33	4
Maximum	6.82	4.74	11.32	8.38	11.84	7.60	10.83	13.72	15.74	11.96	7.16	12.63	7.98	
Arithmetic Mean	5.631	3.755	9.41	6.82	9.93	6.30	9.36	12.11	13.98	10.09	5.16	11.16	6.39	
Standard Deviation	0.786	0.686	0.91	0.75	0.95	0.78	0.61	0.94	1.27	1.09	0.76	0.88	0.72	
R7														
N=12														
Minimum	2.56	1.59	6.42	3.29	6.43	3.66	5.99	8.35	8.74	7.71	2.63	4.95	4.02	3
Maximum	5.04	3.39	9.67	6.88	9.36	5.81	9.62	12.88	14.00	11.84	7.80	10.60	9.15	
Arithmetic Mean	3.759	2.288	7.95	5.44	7.80	4.70	7.73	10.55	11.47	9.05	4.55	8.79	5.42	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Standard Deviation	0.931	0.642	1.03	1.10	1.04	0.72	1.09	1.30	1.69	1.27	1.28	1.50	1.45	
R8														
N=6														
Minimum	2.55	1.47	6.28	4.53	6.22	3.36	6.71	8.84	8.66	6.14	2.85	7.94	4.14	3
Maximum	3.43	2.21	7.87	5.45	10.57	5.79	8.65	12.13	11.42	8.99	4.01	14.10	5.54	
Arithmetic Mean	3.09	1.942	7.01	4.92	7.58	4.47	7.82	10.31	10.41	7.71	3.46	10.12	4.78	
Standard Deviation	0.315	0.277	0.67	0.36	1.64	0.84	0.68	1.09	0.95	1.14	0.41	2.13	0.57	
R9														
N=3														
Minimum	1.64	0.55	4.63	3.29	6.23	3.32	6.13	7.81	7.95	7.58	3.03	7.34	3.22	0
Maximum	2.46	0.61	5.34	3.86	6.39	4.00	6.23	7.85	8.93	7.92	3.20	8.25	4.38	
Arithmetic Mean	1.96	0.573	4.99	3.58	6.31	3.66	6.18	7.83	8.44	7.75	3.12	7.80	3.80	
Standard Deviation	0.439	0.032	0.35	0.28	0.08	0.34	0.05	0.02	0.49	0.17	0.08	0.45	0.58	
LPM														
N=3														
Minimum	15.55	9.65	20.51	13.65	23.07	15.43	14.47	21.10	22.57	23.74	14.07	23.47	13.44	5
Maximum	16.24	11.96	20.70	14.78	23.43	15.47	15.67	22.17	25.42	23.96	14.57	24.87	15.29	
Arithmetic Mean	15.877	11.087	20.61	14.28	23.31	15.45	14.89	21.76	24.29	23.84	14.25	24.29	14.35	
Standard Deviation	0.346	1.254	0.09	0.58	0.21	0.02	0.68	0.58	1.51	0.11	0.28	0.73	0.93	
L2														
N=13														
Minimum	12.01	6.85	15.66	10.03	19.06	11.25	13.02	20.21	22.42	17.99	10.10	15.21	9.53	5
Maximum	14.84	10.77	18.57	13.71	23.00	14.70	15.88	24.05	27.81	20.21	12.12	18.36	12.75	
Arithmetic Mean	13.378	9.304	17.67	11.80	21.22	13.38	14.21	22.51	25.64	19.24	11.11	16.79	11.30	
Standard Deviation	0.784	1.174	0.92	1.16	1.25	0.99	0.80	1.13	1.70	0.67	0.62	0.89	0.96	
L3														
N=25														

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Minimum	8.11	5.7	13.64	8.97	14.65	9.24	10.50	16.12	20.11	12.97	8.04	10.19	7.72	5
Maximum	12.61	9.14	16.80	12.32	18.65	12.63	13.11	21.83	26.56	18.79	10.91	18.70	12.47	
Arithmetic Mean	10.848	7.726	15.19	10.68	16.72	10.52	12.10	18.57	22.04	16.44	9.34	14.47	9.11	
Standard Deviation	1.004	0.696	0.85	0.82	0.96	0.90	0.67	1.20	1.38	1.20	0.77	1.86	0.99	
L4														
N=25														
Minimum	4.49	4.47	10.58	7.03	10.92	6.64	9.41	12.14	14.18	9.44	5.35	10.91	5.88	4
Maximum	10.76	7	14.61	10.15	15.18	9.51	12.03	18.36	20.75	16.06	9.43	14.08	8.69	
Arithmetic Mean	8.537	5.984	13.18	8.94	13.29	8.45	10.77	15.87	18.41	14.60	7.62	12.39	7.30	
Standard Deviation	1.668	0.717	1.02	0.71	1.22	0.73	0.65	1.43	1.59	1.83	0.99	0.95	0.76	
L5														
N=29														
Minimum	3.28	2.41	9.94	6.16	9.21	4.77	7.85	10.32	12.39	10.83	4.89	7.33	5.04	4
Maximum	9.14	6.28	13.90	9.58	13.61	8.89	10.95	16.71	17.44	15.56	17.69	12.18	11.97	
Arithmetic Mean	6.909	4.672	11.72	7.84	11.07	7.01	9.56	12.99	15.28	13.20	6.96	10.03	6.45	
Standard Deviation	1.376	0.83	1.00	0.67	1.03	0.95	0.75	1.50	1.15	1.10	2.24	1.02	1.23	
L6														
N=23														
Minimum	1.23	1.04	7.31	4.87	4.67	2.81	5.70	8.21	8.77	4.50	4.18	6.29	4.35	3
Maximum	5.49	3.53	9.93	6.82	10.03	12.07	8.95	13.05	15.97	12.16	9.35	11.94	9.20	
Arithmetic Mean	3.81	2.675	8.72	6.01	8.03	5.47	7.97	10.22	12.06	9.88	5.83	8.38	5.34	
Standard Deviation	1.255	0.602	0.72	0.57	1.07	1.70	0.76	1.28	1.73	1.65	1.19	1.38	0.95	
L7														
N=20														
Minimum	2.52	0.34	7.26	3.72	5.21	3.44	5.64	5.99	8.56	7.51	3.06	6.00	3.51	3
Maximum	4.82	2.44	9.43	6.19	8.24	5.37	8.62	10.91	11.46	10.67	6.02	9.93	5.56	
Arithmetic Mean	3.286	1.567	8.16	5.02	6.79	4.23	6.98	9.01	10.11	9.40	4.57	8.46	4.33	
Standard Deviation	0.573	0.538	0.62	0.71	0.68	0.52	0.70	1.37	0.94	0.95	0.75	0.85	0.48	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges	
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Crown	Tooth		Crown
			r tooth	r crown	r tooth	r crown	r Crown	r Tooth	Tooth	Tooth	Crown	Crown	Tooth	Crown	
			edge	edge	edge	edge	Width	Width	Width	Length	Length	Length	Length		
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
L8															
N=17															
Minimum	1.04	0.09	6.14	3.53	4.98	2.83	4.88	7.38	6.34	7.70	3.01	6.21	2.88	3	
Maximum	3.27	1.69	7.37	5.49	6.71	4.35	7.90	9.82	10.70	10.63	6.84	7.64	4.97		
Arithmetic Mean	2.159	0.891	6.90	4.27	5.72	3.52	6.36	8.32	8.84	8.90	4.27	6.80	3.61		
Standard Deviation	0.623	0.462	0.34	0.54	0.41	0.39	0.87	0.70	1.30	0.71	0.86	0.46	0.46		

L9														
N=12														
Minimum	0.91	0.17	5.91	3.13	4.15	2.27	4.40	6.01	6.35	6.46	2.42	5.88	2.53	0
Maximum	2.69	1.27	7.12	4.23	5.19	4.13	6.77	9.53	8.68	9.36	5.42	8.25	4.85	
Arithmetic Mean	1.872	0.657	6.57	3.83	4.58	3.00	5.42	7.76	7.26	8.18	4.09	7.12	4.08	
Standard Deviation	0.448	0.327	0.34	0.28	0.30	0.52	0.66	0.93	0.65	0.88	0.86	0.68	0.70	

Tooth Files	FHSM VP 2222 <i>P. rugosus</i> upper dentition													
M1	3.25	2.07	7.13	4.16	6.83	4.74	7.04	7.00	8.44	2.41	9.20	12.05	4.02	1
M2	3.40	1.88	5.79	3.26	4.99	3.57	5.48	3.67	7.95	3.63	8.99	11.60	3.52	1
M3	2.65	1.30	5.10	2.70	4.98	3.10	5.08	5.66	6.87	3.40	8.38	12.41	3.07	1
M4	3.20	1.81	5.89	3.49	5.71	4.12	6.35	5.47	7.70	3.01	8.49	11.15	3.92	1
M5	3.52	1.83	6.35	3.44	6.63	3.44	5.11	4.07	8.27	3.19	9.76	11.06	3.14	1
M6	3.39	1.70	7.53	3.63	7.55	3.88	5.15	5.74	6.72	3.71	10.26	11.93	3.40	1
M7	3.70	1.61	6.18	3.01	7.24	3.93	5.48	8.02	6.36	3.36	6.83	10.98	3.64	1
M8	3.25	1.54	6.80	3.19	7.17	3.61	4.88	10.08	5.65	3.28	7.14	10.92	3.37	1
M9	2.66	1.21	5.43	2.71	6.61	2.82	4.46	9.68	6.02	3.30	5.19	10.36	3.58	1
M10	2.72	1.33	5.87	2.36	5.67	2.55	3.82	7.06	9.53	2.92	7.58	7.11	3.11	1
M11	2.67	1.31	6.27	3.04	5.78	2.88	5.02	5.65	6.11	2.38	10.45	10.38	3.25	1
M12	1.83	1.27	6.09	3.01	6.10	3.30	4.65	4.99	8.64	2.91	7.99	8.87	3.04	1
M13	3.23	1.46	6.30	2.93	6.66	3.17	4.53	8.42	8.84	3.77	6.82	8.43	3.33	1
M14	2.03	1.29	5.45	2.20	5.75	3.52	4.74	4.95	10.45	3.39	5.28	10.13	3.08	1
M15	2.67	1.01	6.89	2.40	6.89	2.57	4.12	6.04	8.88	2.76	10.32	7.68	3.24	1
M16	2.97	1.29	5.63	2.27	6.55	3.37	4.70	7.34	7.00	3.59	7.32	10.49	3.09	1

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
M17	2.73	0.93	5.79	2.14	4.88	2.27	3.63	6.48	5.84	3.49	7.52	9.27	2.78	1
M18	3.73	2.48	7.20	5.01	8.85	5.21	7.61	11.56	6.44	4.49	9.33	9.35	3.89	1
RPM1	15.04	9.66	23.96	16.75	22.26	15.77	16.68	21.45	20.71	9.61	21.14	26.09	12.68	4
RPM2	14.37	11.27	22.29	15.25	21.29	14.52	15.36	23.98	23.50	10.15	19.59	24.68	10.24	4
RPM3	14.70	11.71	20.31	15.99	19.35	14.25	16.04	17.35	15.11	11.56	21.05	28.25	11.50	4
RPM4	15.32	13.36	23.62	16.90	21.87	16.49	16.25	21.09	18.72	6.18	23.38	24.59	11.21	4
RPM5	13.97	11.42	21.58	13.23	20.13	13.66	12.52	22.61	22.84	8.72	21.74	22.72	12.87	4
RPM6	14.90	11.59	22.68	14.20	21.62	14.46	14.20	23.99	22.13	7.09	20.48	23.86	11.54	4
RPM7	15.40	11.88	23.39	14.77	21.75	14.89	14.41	19.46	21.05	7.68	21.19	24.82	11.29	4
RPM8	14.37	11.91	21.46	14.57	20.56	15.87	14.69	18.58	15.96	6.21	18.97	27.89	11.23	4
RPM9	15.97	12.58	23.31	17.90	21.20	13.87	16.20	20.12	20.08	5.42	19.93	24.80	9.27	4
RPM10	14.37	11.50	21.53	22.04	19.50	14.94	26.06	17.88	17.17	9.55	20.82	25.71	12.32	4
2R1	12.99	10.35	21.30	22.71	18.13	12.30	26.13	21.43	16.77	9.54	18.87	26.09	10.32	4
2R2	12.90	9.37	23.82	22.21	17.81	11.25	25.32	25.63	16.93	11.04	17.91	21.03	9.13	3
2R3	11.98	7.81	20.29	12.04	16.59	10.08	13.38	20.41	17.74	8.94	19.11	22.11	10.33	4
2R4	12.93	9.28	20.79	12.60	17.20	12.13	14.17	19.70	16.61	9.44	18.57	24.17	9.33	4
2R5	11.13	8.29	21.36	12.92	16.65	10.11	13.27	22.29	14.57	9.53	25.03	18.38	9.97	3
2R6	12.50	8.78	19.31	12.56	17.70	10.91	13.61	19.71	14.36	8.20	17.11	26.85	7.89	3
2R7	12.57	8.79	22.19	11.66	16.84	11.68	13.64	22.73	13.34	7.85	18.09	25.51	9.43	4
2R8	12.51	8.09	21.44	12.10	17.87	10.58	13.21	21.10	16.48	7.82	19.25	24.44	9.36	4
2R9	12.45	8.65	20.04	12.20	18.03	10.75	12.99	19.55	17.57	8.36	18.12	26.46	8.71	3
2R10	11.23	7.58	19.76	10.90	15.72	9.93	12.81	20.22	15.58	7.32	15.66	24.58	8.58	3
2R11	12.09	8.36	20.91	11.66	15.85	10.74	12.94	19.84	13.70	6.88	17.49	25.63	9.10	3
2R12	13.65	8.89	23.83	13.75	17.55	11.00	13.95	23.38	15.33	8.18	16.69	24.01	10.09	4
2R13	12.44	8.55	20.74	12.72	16.91	10.49	13.31	17.23	14.92	9.54	19.50	22.63	9.94	4
2R14	10.88	7.97	17.55	11.72	14.90	10.57	13.93	16.73	15.74	8.78	16.70	23.86	8.92	3
2R15	13.58	8.77	21.92	12.46	17.43	11.22	13.69	21.18	16.71	7.09	17.49	25.01	8.98	3
2R16	11.51	8.85	13.96	12.13	13.89	11.05	13.80	12.64	13.92	8.73	16.43	25.49	9.50	3
3R1	10.38	6.61	17.44	9.20	14.34	8.62	10.29	13.37	14.00	6.54	16.66	19.48	9.94	4
3R2	9.95	6.51	16.55	9.98	13.94	8.61	11.65	15.75	14.11	6.58	15.65	17.28	7.79	4
3R3	9.54	6.56	17.59	9.57	12.58	8.52	10.79	18.12	10.53	6.40	12.70	20.61	6.74	4
3R4	10.31	6.71	16.74	10.11	15.03	10.43	13.04	16.53	13.75	6.52	15.43	20.30	8.85	4



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
3R5	9.99	7.40	15.75	11.03	14.08	9.61	12.89	16.25	13.59	6.45	13.44	19.82	7.42	3
3R6	9.83	6.05	12.60	8.43	13.85	9.04	11.55	8.51	19.06	6.85	15.13	19.58	8.01	3
3R7	10.09	6.82	18.52	9.56	14.13	8.76	10.32	17.86	10.87	7.31	15.30	21.37	8.44	4
3R8	9.05	5.77	16.12	9.31	13.12	8.44	11.21	17.46	12.86	7.91	14.48	21.53	9.52	4
3R9	8.48	6.23	16.93	9.86	12.98	8.68	12.87	18.46	10.52	5.76	20.63	14.73	7.92	4
3R10	8.56	5.78	15.45	9.45	12.63	9.11	12.58	17.99	12.31	6.73	12.60	20.41	8.62	3
3R11	9.70	6.92	17.32	10.38	14.27	10.67	13.30	16.47	12.73	6.59	15.86	21.34	9.11	4
3R12	9.95	5.83	18.41	9.77	13.65	7.64	11.71	18.57	13.12	6.27	14.57	20.17	7.61	4
3R13	10.30	7.05	17.91	9.71	15.15	9.81	11.50	17.39	11.87	7.27	14.22	21.97	7.56	4
3R14	10.09	6.90	16.25	10.10	13.86	9.45	12.58	16.47	12.92	6.65	15.23	21.77	8.30	4
3R15	9.38	5.76	17.88	9.83	14.13	8.87	11.45	18.07	12.97	7.22	15.96	19.83	9.20	4
3R16	10.14	6.79	18.90	10.58	14.47	8.47	11.35	17.53	13.77	6.00	15.69	21.65	7.53	4
3R17	6.93	0.93	8.76	381.29	9.56	381.29	0.00	11.28	6.60	0.00	7.65	9.70	0.00	3
3R18	3.73	2.48	9.47	382.80	8.15	382.80	0.00	9.92	6.67	0.00	9.12	7.96	0.00	3
4R1	15.04	9.66	14.37	9.87	12.21	8.25	11.16	15.20	16.53	12.57	8.07	13.64	8.37	4
4R2	14.37	11.27	14.80	9.84	12.62	8.73	10.58	15.44	15.71	12.39	7.59	13.89	9.44	4
4R3	14.70	11.71	14.03	9.57	12.43	9.14	10.31	15.29	19.07	11.27	7.79	13.84	9.37	4
4R4	15.32	13.36	15.35	8.99	13.40	7.79	9.48	15.15	17.53	12.11	7.14	13.70	8.85	4
4R5	13.97	11.42	15.10	8.84	11.86	7.18	9.72	15.56	15.59	12.22	7.22	13.85	8.77	4
4R6	14.90	11.59	14.24	9.02	10.24	6.93	10.77	16.50	18.74	11.01	6.76	11.07	7.33	4
4R7	15.40	11.88	14.93	9.37	12.48	7.84	10.07	15.33	16.95	12.34	6.90	14.54	8.95	4
4R8	14.37	11.91	15.65	10.20	11.60	7.62	10.14	16.04	17.48	10.63	6.82	12.97	8.29	4
4R9	15.97	12.58	14.03	8.78	12.13	8.09	9.67	15.97	17.04	11.13	7.11	14.41	9.46	4
4R10	14.37	11.50	16.49	9.31	12.32	7.73	9.51	17.54	17.10	11.01	6.77	13.92	9.19	4
4R11	12.99	10.35	15.67	8.30	11.43	7.05	9.93	16.05	17.16	11.97	6.96	14.58	9.24	4
4R12	12.90	9.37	15.21	9.15	12.76	7.72	9.73	15.67	15.88	11.58	6.89	13.97	8.08	4
4R13	11.98	7.81	16.15	9.07	12.86	7.53	8.86	17.35	15.07	11.81	6.81	14.31	9.49	4
4R14	12.93	9.28	15.60	9.85	11.40	5.93	9.73	16.48	19.03	12.66	7.06	13.13	7.75	4
4R15	11.13	8.29	14.42	9.72	13.31	8.36	10.13	14.32	16.47	11.99	6.14	13.77	8.18	4
4R16	12.50	8.78	14.44	9.10	12.14	6.59	9.31	16.30	18.81	11.04	6.45	13.45	7.46	4
4R17	12.57	8.79	15.92	9.29	11.84	8.23	10.28	16.26	18.53	11.09	6.39	10.19	8.34	4
4R18	12.51	8.09	12.00	6.66	11.63	6.47	7.55	13.70	14.42	11.02	5.94	13.35	8.06	3

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
5R1	12.45	8.65	12.06	7.48	10.36	6.36	8.94	13.49	15.55	9.39	5.27	11.14	6.19	3
5R2	11.23	7.58	13.45	7.52	11.11	7.19	8.61	14.59	14.64	10.56	6.39	13.38	7.98	3
5R3	12.09	8.36	14.17	8.48	11.17	6.95	8.66	15.51	15.27	10.38	6.76	13.52	8.04	3
5R4	13.65	8.89	11.84	7.43	11.42	7.73	8.51	13.83	14.16	10.43	5.88	11.97	7.28	3
5R5	12.44	8.55	11.81	6.80	10.17	5.15	7.74	13.21	16.36	10.02	5.40	12.15	5.84	3
5R6	10.88	7.97	13.19	7.93	11.20	6.77	9.20	14.15	14.87	11.08	5.88	11.62	7.48	3
5R7	13.58	8.77	11.56	7.31	11.10	6.41	7.86	13.56	14.73	10.31	6.21	12.36	7.03	3
5R8	11.51	8.85	12.48	8.60	10.82	6.20	8.46	13.36	13.67	9.15	6.49	12.44	6.81	3
5R9	6.75	3.26	12.79	7.72	11.41	6.52	7.89	13.50	14.94	10.80	6.19	12.68	6.12	3
5R10	7.78	3.27	13.13	7.22	10.96	6.82	9.08	15.27	15.71	9.90	4.91	11.31	6.94	3
5R11	9.35	4.02	13.44	7.48	11.40	6.12	7.80	14.64	15.17	10.11	5.58	11.50	6.45	3
5R12	5.88	3.33	11.79	7.06	11.22	6.56	7.77	13.65	15.26	10.42	5.40	11.30	6.90	3
5R13	8.54	4.41	12.86	8.08	11.39	7.45	8.96	13.89	14.36	9.96	5.71	11.98	7.28	3
5R14	7.00	0.99	11.85	8.08	10.76	5.59	8.27	11.92	15.22	9.59	5.87	13.11	6.61	3
5R15	7.04	3.79	13.74	8.73	12.00	7.06	8.75	14.39	15.48	10.50	5.74	12.79	7.71	3
5R16	7.08	2.69	12.61	7.93	10.71	7.20	8.76	13.51	15.72	9.82	5.79	11.78	7.23	3
5R17	8.08	2.63	12.18	6.99	10.33	5.39	7.89	13.12	14.25	10.10	5.07	11.51	6.18	3
5R18	7.36	3.84	11.40	5.92	9.31	4.47	7.92	13.95	13.13	8.80	4.85	10.79	5.77	3
6R1	5.85	3.29	12.00	6.06	10.00	5.58	7.34	12.85	14.55	9.30	5.50	11.13	6.11	3
6R2	6.13	3.00	11.62	5.63	9.64	5.29	7.24	13.66	13.38	9.20	5.07	11.55	5.62	3
6R3	5.06	3.14	11.69	6.96	8.90	4.92	7.45	12.90	14.29	9.33	5.26	10.65	6.22	3
6R4	4.83	2.89	11.94	5.99	9.36	5.49	8.50	14.65	12.46	7.78	4.04	10.65	5.68	3
6R5	5.07	2.14	9.89	5.60	10.05	5.10	7.21	11.40	13.13	7.59	3.84	11.45	5.42	3
6R6	5.73	3.55	10.76	6.07	8.96	6.09	8.02	13.12	14.03	8.35	4.00	10.74	6.66	3
6R7	4.62	2.36	10.79	6.81	8.75	4.90	8.53	12.18	13.92	9.36	4.02	9.23	5.24	3
6R8	5.80	2.76	10.68	6.57	9.39	5.46	8.32	12.88	13.60	7.09	4.14	10.52	5.47	3
6R9	6.03	2.58	11.76	6.82	9.27	4.79	8.15	12.86	13.71	7.97	4.24	10.01	4.53	3
6R10	5.06	2.39	11.64	6.93	7.84	4.05	8.21	13.26	12.80	8.82	4.46	9.94	5.22	3
6R11	5.99	2.54	11.02	5.29	8.17	3.82	6.83	14.04	12.88	6.49	3.92	9.65	4.90	3
6R12	4.93	1.84	11.11	5.89	9.19	4.38	6.98	12.04	12.89	8.64	4.35	9.68	4.90	3
6R13	5.80	1.69	10.88	6.57	9.10	5.76	7.93	12.51	12.96	8.79	4.58	9.65	6.89	3
6R14	6.30	2.06	8.96	4.21	8.14	4.32	6.66	11.80	10.79	7.65	3.14	9.96	4.17	3

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
6R15	4.50	2.31	9.28	4.84	7.67	4.20	7.32	12.00	11.90	8.47	3.24	9.58	4.65	3
7R1	5.41	1.82	10.94	5.88	9.20	5.70	7.66	12.48	11.91	8.88	3.88	11.37	6.18	2
7R2	4.02	2.17	9.11	4.56	7.38	4.09	7.36	10.84	12.63	7.45	2.59	9.30	4.02	2
7R3	4.62	1.75	8.98	4.44	8.43	4.25	7.08	10.55	12.28	9.24	3.04	9.13	3.92	2
7R4	4.10	1.58	8.52	4.52	7.89	4.36	6.24	10.15	11.00	8.42	3.67	10.49	4.55	2
7R5	4.18	1.86	8.09	4.57	7.94	4.89	6.84	9.80	10.50	8.64	3.72	10.15	5.14	2
7R6	5.69	3.64	9.36	4.77	6.85	3.78	6.73	10.68	12.54	7.04	3.01	8.78	4.75	2
7R7	3.90	1.71	8.47	4.16	7.92	4.45	6.86	11.24	11.48	7.13	3.59	9.59	4.03	2
7R8	4.22	1.75	9.23	5.04	7.01	4.34	7.21	10.86	12.23	7.66	3.32	9.43	5.22	2
7R9	4.54	1.52	8.57	4.74	7.82	4.34	7.02	10.92	11.03	8.75	4.15	9.41	4.34	2
7R10	4.50	2.19	7.98	4.79	7.11	4.24	7.43	9.83	11.76	8.10	3.26	10.46	5.31	2
7R11	3.66	1.36	8.66	4.99	7.49	4.93	7.79	10.65	11.58	6.07	3.02	8.65	4.68	2
7R12	3.94	1.32	11.41	5.39	9.11	6.61	8.16	14.21	12.53	7.06	3.76	9.47	5.49	2
8R1	4.15	2.89	8.66	4.78	7.55	5.21	7.24	9.56	12.25	6.18	3.62	9.16	5.11	1
8R2	4.60	1.81	8.09	4.85	7.66	4.01	6.18	8.96	10.87	8.71	3.36	9.25	4.63	1
8R3	4.43	1.86	9.32	5.01	7.72	3.78	6.24	11.11	10.46	7.61	3.68	10.02	4.90	1
8R4	3.11	7.81	8.12	5.24	6.35	3.61	6.89	9.16	10.43	6.46	3.20	9.94	4.60	1
8R5	3.63	2.28	7.33	3.74	6.75	3.73	5.98	8.26	11.61	7.24	2.59	9.07	4.08	1
8R6	3.73	2.48	7.14	4.64	7.08	4.17	6.61	9.12	10.97	5.56	3.41	8.24	3.53	1
8R7	4.50	2.19	7.95	4.14	5.85	3.69	6.48	9.68	9.44	6.96	2.20	8.21	3.90	1
9R1	1.97	0.98	8.24	4.72	5.46	3.50	7.40	10.98	10.41	6.25	3.33	7.68	4.23	0
9R2	2.46	1.46	8.11	4.18	5.95	3.73	6.41	10.93	9.96	6.35	3.14	7.49	3.89	0
9R3	2.64	1.69	7.32	4.68	6.19	3.64	6.92	10.30	8.58	7.60	2.38	8.66	4.44	0
9R4	2.23	1.46	7.71	4.00	5.86	3.42	6.21	10.28	9.39	6.53	3.04	6.70	3.88	0
9R5	2.63	1.26	7.23	4.33	6.22	4.78	7.36	9.96	8.60	7.56	3.71	8.77	5.34	0
9R6	2.28	1.66	5.76	4.28	5.83	4.35	6.67	8.25	9.34	7.63	3.11	6.16	4.36	0
10R1	2.30	0.88	6.78	4.09	5.94	3.75	5.83	9.18	10.10	4.83	3.04	6.57	4.04	0
10R2	2.20	1.19	6.68	4.60	4.72	2.99	6.53	9.68	10.19	4.66	2.72	4.20	2.92	0
10R3	1.34	0.79	4.36	3.07	5.35	3.77	5.25	7.65	8.30	5.75	3.62	6.00	3.84	0
10R4	2.66	1.11	5.32	2.96	5.44	3.27	5.31	7.72	10.39	5.18	2.53	5.50	3.26	0
10R5	1.89	0.71	5.41	2.71	5.59	3.69	5.91	8.48	9.66	5.62	2.57	4.38	2.86	0
10R6	1.32	0.62	6.35	3.46	5.08	3.31	6.34	9.89	9.19	4.79	2.54	5.13	2.87	0

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
10R7	1.61	0.74	6.04	4.32	5.50	2.92	6.56	9.83	8.51	4.70	2.80	5.46	2.79	0
10R8	2.02	1.16	5.70	4.18	5.91	3.42	6.53	8.92	9.15	4.81	2.52	5.41	3.02	0
10R9	1.84	0.68	5.70	2.71	5.16	3.53	5.67	8.28	8.30	5.84	2.58	5.28	3.37	0
10R10	1.45	0.36	5.53	3.69	5.50	3.04	6.06	8.56	7.59	5.92	3.18	5.78	2.51	0
LPM1	15.24	10.11	20.84	14.63	20.74	15.43	15.39	20.31	20.78	10.80	18.98	24.06	10.22	5
LPM2	16.14	9.73	20.06	14.58	21.58	13.82	14.78	14.96	20.05	10.29	18.94	25.98	10.22	4
LPM3	15.06	10.49	20.87	14.05	22.30	14.47	14.68	22.35	22.04	9.66	19.56	20.20	10.01	4
LPM4	14.49	9.52	20.52	12.69	21.62	15.32	14.76	20.22	24.22	10.20	22.96	20.90	12.55	4
LPM5	14.35	10.16	21.08	14.08	23.74	14.87	16.87	24.76	20.85	9.74	20.42	26.63	11.11	4
LPM6	15.54	10.39	21.80	13.86	24.53	16.31	15.60	25.95	21.60	9.89	17.88	26.96	10.64	4
LPM7	16.26	10.56	21.50	14.79	22.78	15.52	15.79	23.03	22.03	9.97	19.94	20.53	8.63	5
LPM8	15.32	10.30	20.42	12.83	21.56	15.09	14.92	20.48	20.32	8.97	20.04	24.57	10.41	4
LPM9	15.42	10.09	21.39	13.95	22.40	15.82	15.53	21.19	22.35	10.17	20.68	21.71	9.93	4
LPM10	14.91	10.81	21.17	14.99	23.05	15.94	17.48	23.75	20.26	10.70	18.63	26.38	8.63	4
2L1	13.79	9.80	18.71	12.62	20.37	14.40	15.21	18.68	20.46	8.54	19.75	22.41	7.95	4
2L2	12.80	8.33	17.60	11.03	21.11	11.42	12.63	19.75	19.12	8.36	16.33	26.50	7.07	4
2L3	11.77	7.97	17.03	10.87	22.93	11.11	12.78	22.42	18.31	9.30	14.39	25.64	6.36	4
2L4	12.38	8.04	16.64	10.74	22.26	10.93	12.25	23.50	18.19	8.86	18.30	23.91	8.62	4
2L5	11.73	8.00	15.87	10.39	19.51	12.84	13.41	19.76	15.49	8.70	16.20	25.63	9.62	4
2L6	13.44	7.92	17.95	10.35	20.51	12.91	13.94	20.16	19.04	8.57	17.09	25.29	7.96	4
2L7	12.34	7.09	16.88	9.71	19.34	11.50	12.67	20.25	19.48	9.25	19.03	25.37	7.63	4
2L8	12.73	7.48	16.98	10.50	21.87	11.39	12.73	21.07	18.71	8.90	13.25	25.88	7.76	4
2L9	12.28	8.02	16.55	10.98	21.10	12.64	12.98	19.36	17.35	9.78	16.18	25.45	372.61	4
2L10	11.81	7.38	16.48	9.59	23.30	11.46	11.90	22.70	16.52	7.82	13.06	25.21	7.76	4
2L11	11.89	7.69	17.14	10.30	19.73	12.99	13.58	19.40	17.27	9.06	17.00	28.58	9.31	4
2L12	11.26	4.11	16.42	10.62	20.75	13.07	13.52	18.09	18.93	7.71	13.13	27.57	15.41	4
2L13	11.30	6.98	15.88	9.93	20.07	10.90	12.35	19.51	17.06	9.68	15.25	25.43	8.12	4
2L14	11.72	6.77	15.62	9.22	21.04	10.67	11.64	20.20	16.46	8.67	14.22	23.77	7.55	4
2L15	12.95	7.76	16.45	10.05	19.53	10.51	11.69	15.65	16.77	7.73	18.19	24.89	7.79	4
2L16	10.82	5.08	16.08	9.28	22.34	9.47	11.11	24.36	17.05	8.16	16.37	26.28	8.67	4
3L1	8.02	5.41	13.30	7.54	17.04	7.84	9.31	17.76	16.21	8.53	15.33	18.84	7.07	3
3L2	9.44	6.19	15.14	8.84	17.05	10.17	11.29	17.19	10.36	6.82	19.76	16.78	8.53	3

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
3L3	9.76	5.81	14.48	9.52	17.19	9.18	12.43	19.05	14.96	7.40	12.88	20.12	6.66	3
3L4	9.23	5.66	13.27	7.90	18.15	8.27	10.66	18.74	14.89	6.64	14.72	21.51	6.29	3
3L5	8.93	5.36	12.90	7.54	16.82	8.65	10.54	18.36	15.34	6.25	12.92	19.29	7.33	3
3L6	9.90	5.74	14.03	7.89	17.09	8.49	10.50	17.61	13.12	6.34	13.87	22.71	8.52	3
3L7	10.81	6.63	14.88	8.83	16.59	9.93	11.82	16.88	13.99	6.27	12.46	22.20	4.95	3
3L8	9.21	6.13	13.98	7.97	17.58	9.67	10.75	18.02	15.11	6.23	13.50	22.73	6.70	3
3L9	8.08	4.50	13.47	7.18	16.45	9.37	11.44	17.15	13.92	6.79	13.72	21.20	5.70	3
3L10	8.99	5.55	13.15	7.31	15.40	9.35	10.95	15.95	15.63	6.72	15.60	18.87	7.42	3
3L11	9.97	5.55	14.25	8.22	16.88	8.63	10.45	16.08	16.39	8.17	13.57	18.90	7.23	3
3L12	9.30	5.60	13.97	8.48	17.32	9.02	11.24	17.79	15.38	7.34	15.40	20.91	6.97	3
3L13	8.69	6.11	13.26	8.08	18.27	9.59	10.86	18.17	8.66	6.38	14.95	19.75	7.01	3
3L14	8.89	5.82	14.97	8.53	17.13	10.08	11.81	18.54	14.53	6.63	13.99	16.64	7.12	3
3L15	10.10	5.94	13.94	8.23	14.91	8.87	10.63	16.06	15.38	7.94	14.36	20.53	6.49	3
3L16	9.64	4.69	13.70	7.72	16.40	9.24	10.63	17.40	12.60	6.41	13.62	22.25	11.43	3
3L17	10.01	6.63	13.90	8.54	15.72	9.94	11.57	16.59	13.28	5.53	15.05	21.53	5.66	3
3L18	9.01	5.59	12.39	8.10	15.73	8.14	10.26	19.55	12.33	5.51	9.39	18.41	5.41	3
4L1	7.42	4.29	12.10	6.74	14.74	7.63	9.33	15.57	9.10	5.81	13.16	20.88	6.41	3
4L2	8.11	4.37	12.52	6.24	13.73	8.39	10.31	15.15	8.27	6.59	13.25	22.17	6.12	3
4L3	9.05	4.89	13.45	7.83	15.17	9.00	11.30	15.74	11.44	5.19	11.97	20.20	4.22	3
4L4	7.76	4.51	13.14	6.91	14.08	8.00	8.90	15.72	11.72	6.10	12.58	19.34	6.37	3
4L5	8.66	3.14	12.77	6.88	14.63	8.30	10.26	16.46	14.58	6.24	12.64	18.05	8.10	3
4L6	7.96	3.04	3.80	5.68	23.04	12.79	10.35	20.10	11.90	6.25	12.77	13.35	7.16	3
4L7	7.72	4.76	12.10	7.21	14.95	8.29	10.23	16.31	13.32	6.60	11.71	17.84	6.06	3
4L8	9.58	4.63	13.13	8.21	14.32	8.95	10.49	15.17	12.37	5.83	12.13	18.66	5.64	3
4L9	9.05	4.62	12.55	7.32	14.57	6.99	9.17	16.86	14.51	6.90	12.06	17.97	6.14	3
4L10	8.69	4.93	13.02	7.13	16.02	9.13	10.00	15.94	13.67	6.10	11.63	16.97	6.76	3
4L11	8.79	4.62	13.23	6.79	13.96	9.07	9.83	15.16	13.54	6.02	12.26	17.56	7.43	3
4L12	7.88	4.60	11.81	6.33	14.41	7.91	9.31	15.45	12.67	4.87	10.98	16.49	5.69	3
4L13	9.11	4.96	13.03	7.65	14.92	8.83	10.26	15.84	13.73	6.74	12.32	18.92	5.59	3
4L14	9.38	5.02	13.57	7.70	14.62	8.26	9.50	15.56	14.61	5.65	12.16	16.96	5.58	4
4L15	9.72	6.59	12.01	10.08	14.96	8.90	13.09	10.49	14.25	6.19	13.59	18.77	5.73	3
4L16	7.16	4.27	13.26	7.41	14.68	8.69	9.35	15.65	14.57	6.75	17.88	9.43	7.25	4

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
4L17	7.66	4.95	12.81	7.16	15.00	8.59	9.99	17.06	15.08	6.09	17.45	8.93	6.26	4
4L18	11.77	5.93	13.53	8.43	12.42	10.24	11.52	7.58	12.49	6.65	12.96	23.02	6.57	3
4L19	7.66	4.81	11.86	7.49	13.50	7.06	9.14	14.27	13.49	6.63	10.91	17.15	7.24	3
5L1	7.24	3.36	10.65	5.72	12.81	5.28	6.98	9.90	11.69	4.84	11.69	15.87	5.61	4
5L2	7.11	3.95	9.66	5.90	12.01	6.63	7.93	10.49	11.58	5.03	10.32	13.26	5.41	3
5L3	5.63	3.45	10.08	6.27	12.11	6.54	8.28	9.71	11.78	5.98	11.00	13.88	6.09	3
5L4	6.16	3.32	10.68	5.89	13.92	7.76	7.93	12.83	13.19	6.63	16.65	7.66	7.29	4
5L5	7.79	3.91	10.38	5.68	10.74	7.21	8.67	8.39	12.93	5.52	11.34	13.81	6.49	3
5L6	8.18	3.70	10.82	6.13	11.81	7.09	8.56	11.87	9.82	5.36	9.58	16.90	6.40	3
5L7	6.52	3.43	9.88	5.87	10.09	6.19	8.60	11.19	13.51	6.42	10.26	12.84	6.60	3
5L8	6.85	3.90	9.67	5.67	12.24	6.95	8.14	11.08	11.09	5.08	10.27	13.37	6.13	3
5L9	6.64	4.04	11.33	5.85	13.17	7.14	7.93	13.45	8.98	4.45	14.13	12.39	5.55	3
5L10	6.13	3.39	10.63	5.78	12.96	6.65	8.00	12.63	9.95	5.20	15.31	11.56	6.51	3
5L11	6.94	3.45	11.54	5.11	13.32	6.77	7.47	13.04	13.04	5.41	15.98	8.07	6.32	3
5L12	6.53	3.19	10.70	5.29	12.96	7.42	8.29	11.75	8.28	5.87	15.94	6.11	5.48	4
5L13	6.76	3.88	11.49	5.76	12.61	8.05	8.46	12.35	11.30	5.88	15.34	9.83	5.74	4
5L14	6.83	3.61	10.76	6.14	13.40	5.86	7.85	10.91	12.79	4.65	14.89	7.38	4.84	3
5L15	6.20	2.02	10.86	5.90	13.52	6.92	8.05	11.93	12.71	6.00	15.73	7.69	5.96	3
5L16	6.43	3.10	10.77	5.25	13.49	5.50	6.59	11.99	12.94	5.09	16.10	7.67	6.09	3
6L1	4.95	2.11	10.15	4.79	11.06	4.76	6.71	13.45	7.53	4.77	14.58	4.19	4.81	2
6L2	4.71	1.76	9.01	3.36	10.98	5.04	6.67	11.60	10.82	4.10	13.78	8.38	5.03	2
6L3	5.27	1.54	9.37	3.38	11.00	5.12	6.12	10.82	12.70	5.13	13.74	5.03	6.05	2
6L4	5.51	2.02	9.83	5.29	10.24	4.37	6.35	10.96	9.19	3.43	11.44	8.81	4.17	2
6L5	5.30	2.12	8.78	3.98	11.67	5.24	6.56	12.49	10.92	4.37	13.55	7.88	4.69	2
6L6	5.01	2.57	8.87	4.22	11.56	5.19	6.21	11.11	9.91	4.93	13.46	7.98	5.60	2
6L7	4.70	2.03	8.70	4.40	10.10	4.39	6.16	10.08	10.88	4.52	13.09	6.95	5.28	2
6L8	3.89	1.88	10.27	5.23	10.87	4.00	6.82	11.91	10.68	4.91	13.95	10.16	4.20	2
6L9	4.41	2.05	6.46	3.90	10.67	4.12	5.78	5.34	9.14	4.46	12.64	7.13	373.72	2
6L10	5.33	2.06	8.90	4.17	9.88	5.82	7.14	10.01	10.00	4.41	12.75	8.03	4.56	2
6L11	4.46	1.84	7.96	3.67	10.34	4.21	5.68	10.68	10.91	5.01	12.58	7.49	5.59	2
6L12	4.28	1.98	8.89	4.37	9.69	3.93	5.86	9.17	9.95	3.26	12.90	9.05	4.19	2
6L13	4.35	1.69	9.04	4.10	7.73	4.46	6.04	4.85	11.28	4.39	13.47	8.73	5.22	2

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
6L14	1.34	2.45	6.06	4.87	11.12	8.29	6.26	5.24	11.10	5.16	11.69	7.28	5.06	2
6L15	4.73	1.96	8.18	4.72	11.08	4.96	7.21	5.53	10.82	3.79	13.66	9.63	3.90	2
6L16	4.55	1.96	9.45	3.98	11.54	4.16	5.83	11.56	11.75	4.03	12.75	6.97	4.37	2
6L17	1.99	1.21	5.44	377.57	4.86	377.57	0.00	6.62	4.69	0.00	4.62	6.43	0.00	2
7L1	5.90	1.02	8.03	3.47	10.43	3.31	4.51	10.01	8.65	3.63	11.97	7.72	3.61	2
7L2	4.18	1.86	8.08	3.79	9.38	3.04	4.59	9.57	10.51	4.16	12.14	7.15	4.34	2
7L3	5.28	0.73	7.87	3.60	8.77	3.50	5.53	8.17	9.04	3.00	8.82	12.00	2.96	2
7L4	6.23	2.78	8.30	4.10	9.87	3.34	4.95	10.88	11.09	3.66	10.74	6.06	3.46	2
7L5	6.17	1.93	6.09	4.07	10.19	4.60	6.79	9.50	9.29	4.81	12.50	8.14	4.79	2
7L6	4.50	2.19	7.95	3.27	9.26	3.11	4.63	9.40	6.21	4.23	11.57	11.59	4.02	2
7L7	6.48	1.55	8.28	0.00	8.75	373.72	0.00	11.81	8.93	0.00	10.70	6.77	0.00	2
7L8	6.11	0.80	8.10	0.00	10.05	371.76	0.00	11.12	9.15	0.00	10.13	10.60	0.00	2
7L9	6.17	0.96	9.04	0.00	8.53	374.28	0.00	8.95	9.81	0.00	8.37	12.67	0.00	2
8L1	6.52	1.35	7.74	0.00	8.10	373.39	0.00	7.30	10.45	0.00	10.45	9.00	0.00	1
8L2	6.25	1.24	7.90	0.00	7.90	372.38	0.00	9.37	9.68	0.00	7.89	11.77	0.00	1
8L3	6.50	1.90	6.31	0.00	9.04	370.33	0.00	8.29	7.25	0.00	10.94	8.23	0.00	1
8L4	4.78	2.54	7.49	0.00	7.51	372.61	0.00	8.04	9.99	0.00	11.05	6.49	0.00	1
8L5	4.68	0.94	7.91	0.00	8.74	373.25	0.00	10.67	10.31	0.00	11.38	6.99	0.00	1
8L6	4.12	1.11	7.48	0.00	9.26	373.62	0.00	10.91	7.78	0.00	9.82	7.63	0.00	1
9L1	3.57	0.65	5.75	0.00	5.96	373.51	0.00	7.41	6.59	0.00	8.42	6.82	0.00	0
9L2	5.14	1.77	6.25	0.00	6.10	371.88	0.00	8.13	5.95	0.00	9.40	3.19	0.00	0
9L3	1.89	2.10	6.45	0.00	7.46	372.82	0.00	7.32	9.32	0.00	10.13	5.93	0.00	0
9L4	4.83	0.79	6.91	0.00	7.29	373.18	0.00	8.67	8.78	0.00	9.32	4.97	0.00	0
9L5	4.93	2.00	6.98	0.00	7.82	373.64	0.00	9.35	7.68	0.00	9.83	6.98	0.00	0
9L6	5.07	1.66	6.64	0.00	7.63	373.00	0.00	10.03	10.03	0.00	10.00	4.98	0.00	0
9L7	5.10	1.02	6.01	0.00	8.05	374.72	0.00	9.42	7.70	0.00	9.80	5.83	0.00	0
9L8	4.36	1.59	6.75	0.00	8.25	375.81	0.00	10.49	5.12	0.00	8.62	9.36	0.00	0
9L9	3.63	2.28	7.35	0.00	7.54	376.41	0.00	8.90	8.66	0.00	8.54	5.67	0.00	0
10L1	1.52	0.55	5.50	0.00	6.53	376.53	0.00	8.35	5.56	0.00	5.41	8.66	0.00	0
10L2	1.61	0.74	5.96	0.00	4.59	377.23	0.00	7.40	6.17	0.00	6.87	6.72	0.00	0
10L3	5.92	0.12	5.01	0.00	4.66	375.95	0.00	7.34	6.19	0.00	5.85	6.83	0.00	0

0, 200-300 values=missing data

Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges	
			left	left	right	right	r Crown	r Tooth	Tooth	Tooth	Crown	Crown	Tooth		Crown
			posterior	posterior	posterior	posterior	Width	Width	Width	Length	Length	Length	Length		
		r tooth	r crown	r tooth	r crown	r Crown	r Tooth	Tooth	Tooth	Crown	Crown	Tooth	Crown		
		edge	edge	edge	edge	Width	Width	Width	Length	Length	Length	Length	Length		
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H			
<b>FHSM VP 2222 <i>P. rugosus</i> upper dentition summary</b>															
<b>Medial</b>															
N=18															
Minimum	1.83	0.928	5.10	2.14	4.88	2.27	3.64	3.67	5.65	2.38	5.19	7.11	2.78	1.00	
Maximum	3.733	2.48	7.53	5.01	8.85	5.21	7.61	11.56	10.45	4.49	10.45	12.41	4.02	1.00	
Arithmetic Mean	2.978	1.517	6.21	3.05	6.38	3.45	5.10	6.77	7.54	3.28	8.16	10.23	3.36	1.00	
Standard Deviation	0.529	0.389	0.68	0.73	1.01	0.75	1.03	2.12	1.40	0.51	1.60	1.50	0.34	0.00	
<b>RPM</b>															
N=10															
Minimum	13.967	9.658	20.31	13.23	19.35	13.66	12.52	17.35	15.11	5.42	18.97	22.72	9.27	4.00	
Maximum	15.97	13.356	23.96	22.04	22.26	16.49	26.06	23.99	23.50	11.56	23.38	28.25	12.87	4.00	
Arithmetic Mean	14.841	11.686	22.41	16.16	20.95	14.87	16.24	20.65	19.73	8.22	20.83	25.34	11.42	4.00	
Standard Deviation	0.605	0.947	1.18	2.50	1.02	0.92	3.67	2.39	2.90	2.01	1.23	1.71	1.09	0.00	
<b>R2</b>															
N=16															
Minimum	10.876	7.578	13.96	10.90	13.89	9.93	12.81	12.64	13.34	6.88	15.66	18.38	7.89	3.00	
Maximum	13.651	10.354	23.83	22.71	18.13	12.30	26.13	25.63	17.74	11.04	25.03	26.85	10.33	4.00	
Arithmetic Mean	12.334	8.649	20.58	13.52	16.82	10.92	15.01	20.23	15.64	8.58	18.25	24.14	9.35	3.44	
Standard Deviation	0.824	0.674	2.35	3.55	1.20	0.68	4.20	2.98	1.40	1.09	2.12	2.20	0.67	0.51	
<b>R3</b>															
N=18															
Minimum	3.733	0.928	8.76	8.44	8.15	7.64	0.00	8.51	6.60	0.00	7.65	7.97	0.00	3.00	
Maximum	10.38	7.403	18.90	382.80	15.15	382.80	13.30	18.57	19.06	7.91	20.63	21.97	9.94	4.00	
Arithmetic Mean	9.245	5.949	16.03	51.17	13.33	50.49	10.50	15.89	12.35	5.95	14.46	18.86	7.37	3.72	
Standard Deviation	1.623	1.641	2.90	120.38	1.79	120.62	3.93	3.05	2.79	2.22	2.82	4.06	2.80	0.46	
<b>R4</b>															
N=18															
Minimum	11.134	7.811	12.00	6.66	10.24	5.93	7.55	13.70	14.42	10.63	5.94	10.19	7.33	3.00	



Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown	Posterior Tooth	Anterior Tooth	Labial Tooth	Labial Crown	Lingual Tooth	Lingual Crown	# of Ridges		
			r tooth edge	r crown edge	r tooth edge	r crown edge	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown		Tooth	Crown
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H			
Maximum	15.97	13.356	16.49	10.20	13.40	9.14	11.16	17.54	19.07	12.66	8.07	14.58	9.49	4.00		
Arithmetic Mean	13.773	10.424	14.91	9.16	12.15	7.62	9.83	15.79	17.06	11.66	6.93	13.48	8.59	3.94		
Standard Deviation	1.364	1.692	1.03	0.78	0.75	0.82	0.79	0.94	1.40	0.65	0.54	1.14	0.70	0.24		
R5 N=18																
Minimum	5.878	0.991	11.40	5.92	9.31	4.47	7.74	11.92	13.13	8.80	4.85	10.79	5.77	3.00		
Maximum	13.651	8.888	14.17	8.73	12.00	7.73	9.20	15.51	16.36	11.08	6.76	13.52	8.04	3.00		
Arithmetic Mean	9.593	5.547	12.57	7.60	10.94	6.44	8.39	13.86	14.92	10.07	5.74	12.07	6.88	3.00		
Standard Deviation	2.613	2.781	0.82	0.69	0.61	0.85	0.51	0.83	0.79	0.58	0.54	0.79	0.69	0.00		
R6 N=15																
Minimum	4.502	1.694	8.96	4.21	7.67	3.82	6.66	11.40	10.79	6.49	3.14	9.23	4.17	3.00		
Maximum	6.298	3.552	12.00	6.96	10.05	6.09	8.53	14.65	14.55	9.36	5.50	11.55	6.89	3.00		
Arithmetic Mean	5.445	2.569	10.94	6.02	8.96	4.94	7.65	12.81	13.15	8.32	4.25	10.29	5.45	3.00		
Standard Deviation	0.597	0.536	0.94	0.81	0.73	0.68	0.62	0.87	0.97	0.88	0.66	0.72	0.78	0.00		
R7 N=12																
Minimum	3.664	1.321	7.98	4.16	6.85	3.78	6.24	9.80	10.50	6.07	2.59	8.65	3.92	2.00		
Maximum	5.693	3.64	11.41	5.88	9.20	6.61	8.16	14.21	12.63	9.24	4.15	11.37	6.18	2.00		
Arithmetic Mean	4.399	1.89	9.11	4.82	7.84	4.67	7.20	11.02	11.79	7.87	3.42	9.69	4.80	2.00		
Standard Deviation	0.61	0.614	1.06	0.46	0.76	0.79	0.52	1.23	0.69	0.95	0.45	0.79	0.69	0.00		
R8 N=7																
Minimum	3.106	1.815	7.14	3.74	5.85	3.61	5.99	8.26	9.44	5.56	2.20	8.21	3.54	1.00		
Maximum	4.599	7.811	9.32	5.24	7.72	5.21	7.25	11.11	12.25	8.71	3.68	10.02	5.11	1.00		
Arithmetic Mean	4.02	3.045	8.09	4.63	6.99	4.03	6.52	9.41	10.86	6.96	3.15	9.13	4.40	1.00		
Standard Deviation	0.551	2.134	0.75	0.52	0.72	0.56	0.44	0.88	0.90	1.03	0.55	0.72	0.57	0.00		

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
<b>R9</b>														
N=6														
Minimum	1.97	0.98	5.76	4.00	5.47	3.42	6.22	8.25	8.58	6.25	2.38	6.16	3.88	0.00
Maximum	2.636	1.688	8.24	4.72	6.22	4.78	7.40	10.98	10.41	7.63	3.71	8.77	5.34	0.00
Arithmetic Mean	2.368	1.419	7.40	4.36	5.92	3.90	6.83	10.12	9.38	6.99	3.12	7.58	4.36	0.00
Standard Deviation	0.259	0.265	0.90	0.28	0.28	0.54	0.49	1.00	0.73	0.67	0.44	1.04	0.54	0.00
<b>R10</b>														
N=10														
Minimum	1.319	0.361	4.36	2.71	4.72	2.92	5.25	7.65	7.59	4.66	2.52	4.20	2.51	0.00
Maximum	2.657	1.187	6.78	4.60	5.94	3.77	6.56	9.89	10.39	5.92	3.62	6.57	4.04	0.00
Arithmetic Mean	1.863	0.824	5.79	3.58	5.42	3.37	6.00	8.82	9.14	5.21	2.81	5.37	3.15	0.00
Standard Deviation	0.443	0.264	0.72	0.70	0.37	0.32	0.49	0.82	0.95	0.52	0.36	0.70	0.49	0.00
<b>LPM</b>														
N=10														
Minimum	14.346	9.515	20.06	12.69	20.74	13.82	14.68	14.96	20.05	8.97	17.88	20.20	8.63	4.00
Maximum	16.261	10.813	21.80	14.99	24.53	16.31	17.48	25.95	24.22	10.80	22.96	26.96	12.55	5.00
Arithmetic Mean	15.272	10.216	20.96	14.04	22.43	15.26	15.58	21.70	21.45	10.04	19.80	23.79	10.24	4.20
Standard Deviation	0.621	0.387	0.53	0.78	1.14	0.73	0.94	3.08	1.28	0.53	1.40	2.72	1.14	0.42
<b>L2</b>														
N=16														
Minimum	10.819	4.107	15.62	9.22	19.34	9.47	11.11	15.65	15.49	7.71	13.06	22.41	6.36	4.00
Maximum	13.787	9.8	18.71	12.62	23.30	14.40	15.21	24.36	20.46	9.78	19.75	28.58	372.61	4.00
Arithmetic Mean	12.187	7.401	16.77	10.39	20.98	11.76	12.77	20.30	17.89	8.69	16.11	25.49	31.26	4.00
Standard Deviation	0.808	1.303	0.81	0.82	1.25	1.26	1.01	2.16	1.34	0.64	2.10	1.44	91.05	0.00
<b>L3</b>														
N=18														
Minimum	8.015	4.499	12.39	7.18	14.91	7.84	9.31	15.95	8.66	5.51	9.39	16.64	4.95	3.00
Maximum	10.812	6.631	15.14	9.52	18.27	10.17	12.43	19.55	16.39	8.53	19.76	22.73	11.43	3.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior r tooth edge	posterior r crown edge	posterior r tooth edge	posterior r crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Arithmetic Mean	9.331	5.718	13.83	8.13	16.76	9.14	10.95	17.60	14.00	6.77	14.17	20.18	7.03	3.00
Standard Deviation	0.71	0.549	0.74	0.59	0.89	0.70	0.71	1.05	2.03	0.83	2.01	1.88	1.45	0.00
L4														
N=19														
Minimum	7.16	3.04	3.8	5.68	12.42	6.99	8.9	7.58	8.27	4.87	10.91	8.93	4.22	3
Maximum	11.77	6.59	13.57	10.08	23.04	12.79	13.09	20.1	15.08	6.9	17.88	23.02	8.1	4
Arithmetic Mean	8.586	4.681	12.299	7.326	14.933	8.685	10.123	15.267	12.911	6.168	12.864	17.508	6.333	3.158
Standard Deviation	1.092	0.786	2.136	0.945	2.102	1.25	1.005	2.54	1.838	0.538	1.833	3.632	0.879	0.375
L5														
N=16														
Minimum	5.631	2.021	9.66	5.11	10.09	5.28	6.59	8.39	8.28	4.45	9.58	6.11	4.84	3.00
Maximum	8.18	4.041	11.54	6.28	13.92	8.05	8.67	13.45	13.51	6.63	16.65	16.90	7.29	4.00
Arithmetic Mean	6.746	3.481	10.62	5.76	12.57	6.75	7.98	11.47	11.60	5.46	13.41	11.14	6.03	3.25
Standard Deviation	0.635	0.486	0.58	0.32	1.04	0.76	0.57	1.36	1.61	0.62	2.62	3.37	0.59	0.45
L6														
N=17														
Minimum	1.34	1.213	5.44	3.36	4.86	3.94	0.00	4.85	4.69	0.00	4.62	4.19	0.00	2.00
Maximum	5.509	2.567	10.27	377.57	11.67	377.57	7.21	13.45	12.70	5.16	14.58	10.16	373.72	2.00
Arithmetic Mean	4.399	1.954	8.55	26.24	10.26	26.80	5.97	9.49	10.13	4.16	12.63	7.65	26.26	2.00
Standard Deviation	1.121	0.311	1.38	90.54	1.68	90.40	1.60	2.84	1.82	1.21	2.21	1.53	89.55	0.00
L7														
N=9														
Minimum	4.178	0.729	6.09	0.00	8.53	3.04	0.00	8.17	6.21	0.00	8.37	6.06	0.00	2.00
Maximum	6.482	2.779	9.04	4.10	10.43	374.28	6.79	11.81	11.09	4.81	12.50	12.67	4.79	2.00
Arithmetic Mean	5.67	1.536	7.97	2.48	9.47	126.74	3.44	9.94	9.19	2.61	10.77	9.19	2.58	2.00
Standard Deviation	0.827	0.709	0.78	1.88	0.70	184.89	2.67	1.15	1.37	2.02	1.46	2.52	2.00	0.00

L8

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
N=6														
Minimum	4.117	0.94	6.31	0.00	7.51	370.33	0.00	7.30	7.25	0.00	7.89	6.49	0.00	1.00
Maximum	6.523	2.536	7.91	0.00	9.26	373.62	0.00	10.91	10.45	0.00	11.38	11.77	0.00	1.00
Arithmetic Mean	5.476	1.515	7.47	0.00	8.42	372.60	0.00	9.10	9.24	0.00	10.26	8.35	0.00	1.00
Standard Deviation	1.068	0.598	0.60	0.00	0.69	1.21	0.00	1.47	1.38	0.00	1.28	1.89	0.00	0.00
L9														
N=9														
Minimum	1.893	0.649	5.76	0.00	5.96	371.88	0.00	7.32	5.13	0.00	8.42	3.19	0.00	0.00
Maximum	5.143	2.276	7.35	0.00	8.25	376.41	0.00	10.49	10.03	0.00	10.13	9.36	0.00	0.00
Arithmetic Mean	4.281	1.539	6.57	0.00	7.35	373.89	0.00	8.86	7.76	0.00	9.34	5.97	0.00	0.00
Standard Deviation	1.084	0.589	0.50	0.00	0.80	1.48	0.00	1.10	1.62	0.00	0.66	1.70	0.00	0.00
L10														
N=3														
Minimum	1.52	0.125	5.01	0.00	4.59	375.95	0.00	7.34	5.56	0.00	5.41	6.72	0.00	0.00
Maximum	5.919	0.742	5.96	0.00	6.53	377.23	0.00	8.35	6.19	0.00	6.87	8.66	0.00	0.00
Arithmetic Mean	3.015	0.472	5.49	0.00	5.26	376.57	0.00	7.70	5.97	0.00	6.04	7.41	0.00	0.00
Standard Deviation	2.515	0.316	0.48	0.00	1.10	0.64	0.00	0.57	0.36	0.00	0.75	1.09	0.00	0.00
<b>0, 200-300 values=missing data</b>														
<b>Tooth Files FHSM VP 2223 <i>P. rugosus</i> Lower dentition</b>														
M1	19.50	12.57	27.77	17.79	26.47	16.67	17.50	25.45	26.98	16.17	24.95	24.77	14.82	4
M2	19.82	14.07	27.33	18.19	27.28	20.24	19.91	25.66	24.57	13.87	24.80	26.21	13.11	3
M3	19.77	14.18	26.05	18.66	26.35	19.26	18.82	23.39	23.66	14.98	24.52	27.43	14.87	3
M4	19.51	14.80	25.94	19.98	27.04	18.87	19.16	24.49	24.28	15.52	24.84	26.54	14.34	4
M5	19.23	12.99	25.57	16.42	26.63	18.14	17.92	25.12	26.42	15.11	25.06	24.76	13.29	3
M6	21.00	14.53	27.68	18.74	28.23	18.90	18.68	27.79	22.84	12.84	23.40	26.12	13.93	3
M7	19.48	13.52	25.52	17.20	26.04	17.54	17.84	22.88	24.45	13.09	23.15	25.26	12.88	4
M8	19.51	13.32	25.82	17.82	25.65	18.51	18.31	32.96	23.25	12.32	24.39	25.87	12.67	4
M9	17.59	12.04	23.34	15.20	24.48	15.80	16.20	20.59	25.43	12.29	23.61	24.44	11.47	4
RPM1	15.59	11.22	23.90	16.63	21.83	14.82	16.01	22.58	20.77	10.67	21.09	26.64	12.49	4
RPM2	13.73	9.50	25.11	14.65	20.43	14.56	15.47	22.80	19.77	11.32	21.00	24.34	12.65	4

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
RPM3	14.52	8.58	25.07	12.08	20.30	13.83	14.90	24.59	21.06	10.12	21.39	22.55	11.30	4
RPM4	15.11	9.83	24.11	14.22	19.92	13.68	15.08	22.63	18.22	9.43	20.45	28.28	11.48	3
RPM5	15.16	9.72	26.64	12.87	19.65	13.30	13.70	25.73	19.96	10.73	19.57	25.45	10.57	3
RPM6	15.23	9.71	24.81	14.32	20.14	13.59	15.49	23.95	19.54	10.40	19.99	26.96	11.81	4
RPM7	14.51	9.49	26.08	12.99	21.07	12.96	14.49	27.52	18.18	9.31	20.62	26.93	10.24	4
RPM8	14.27	8.66	22.54	12.31	18.66	11.34	14.31	21.90	20.66	10.57	20.90	26.15	10.59	4
RPM9	15.39	9.23	25.17	14.16	19.05	13.27	14.94	25.01	18.54	10.25	17.67	26.15	9.91	5
RPM10	13.41	4.71	22.90	13.37	17.41	13.48	14.93	22.11	20.28	10.57	19.62	21.66	11.23	4
RPM11	15.62	8.95	24.97	14.18	20.32	12.38	15.24	24.49	20.71	9.39	20.81	22.44	12.26	4
RPM12	13.91	9.26	23.22	13.58	19.29	12.62	15.07	22.75	18.94	10.11	22.04	24.15	10.60	4
RPM13	13.44	8.03	23.59	12.81	19.75	13.89	14.55	23.43	19.18	9.88	19.22	21.28	10.71	4
RPM14	14.03	10.06	22.60	13.81	20.78	14.08	14.43	21.73	15.04	10.96	18.80	27.06	11.52	4
2R1	12.61	5.06	19.32	10.83	15.00	19.44	7.63	14.77	16.01	8.52	17.10	18.62	22.92	4
2R2	11.61	7.25	19.05	10.26	15.04	10.11	12.85	16.71	13.74	8.01	17.29	21.81	9.88	4
2R3	11.54	7.83	18.78	10.38	16.21	11.45	13.73	20.37	15.22	8.81	16.66	21.41	8.86	4
2R4	11.46	8.18	18.93	12.06	15.14	11.56	13.91	15.77	14.80	7.13	17.12	18.70	8.80	4
2R5	12.60	7.72	19.58	10.61	15.52	10.13	12.35	14.92	14.30	7.40	16.98	21.42	7.74	4
2R6	10.92	7.02	18.67	9.81	16.37	10.09	12.31	21.80	13.55	7.38	18.66	20.39	11.41	4
2R7	11.32	6.23	19.96	11.80	16.82	9.22	13.85	21.16	13.98	6.92	17.45	21.62	8.37	4
2R8	11.33	7.13	17.30	9.34	15.81	10.14	12.30	17.94	14.39	7.07	17.60	22.45	8.53	4
2R9	0.79	2.38	12.28	8.09	19.30	18.97	13.38	7.37	19.07	8.29	16.68	18.95	8.59	4
2R10	11.88	8.13	19.27	11.10	16.13	10.95	12.49	19.09	15.93	8.36	16.31	18.84	8.20	4
2R11	11.83	7.81	19.65	10.92	16.83	10.13	12.20	19.83	13.42	8.91	17.22	21.49	8.37	4
2R12	11.98	8.32	17.49	11.14	15.61	10.37	12.18	15.84	13.75	9.01	16.97	20.42	8.19	4
2R13	12.00	7.71	19.82	12.53	16.39	10.98	12.92	15.23	16.36	8.73	17.27	17.42	9.97	4
2R14	11.67	8.71	19.56	12.76	14.96	11.63	14.01	19.02	12.01	10.76	15.76	21.30	10.42	4
2R15	11.05	7.37	18.64	10.47	16.48	10.69	12.72	19.73	13.41	7.52	15.96	20.32	8.66	4
2R16	11.74	8.64	18.19	12.26	15.82	11.72	14.25	17.60	14.27	8.60	17.22	17.66	9.97	4
2R17	12.50	8.64	20.32	12.14	16.30	10.97	11.97	19.92	14.19	7.32	15.41	19.12	9.40	4
3R1	10.51	6.67	18.03	9.81	13.82	9.37	10.54	13.55	12.24	6.92	14.83	18.83	7.72	4
3R2	9.71	5.71	16.61	9.09	14.07	7.33	10.40	17.33	13.33	5.31	14.00	16.91	6.71	4
3R3	10.05	6.89	16.47	9.90	13.03	8.22	10.03	15.67	10.60	7.46	13.10	19.42	7.76	4

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
3R4	9.76	6.03	16.70	8.16	15.28	9.02	10.81	19.34	12.77	6.50	16.05	16.95	8.27	4
3R5	8.49	4.00	16.82	8.15	14.22	8.63	11.12	17.68	12.30	6.30	15.19	18.45	9.31	4
3R6	9.60	6.05	16.81	8.54	14.13	9.11	11.39	18.58	11.13	6.74	14.90	20.90	8.31	4
3R7	9.06	6.05	16.92	9.32	14.24	8.99	10.86	19.80	10.64	7.64	10.31	20.55	9.66	4
3R8	9.17	5.27	16.59	10.08	14.14	6.92	11.23	19.65	11.50	7.07	9.48	20.70	6.03	4
3R9	9.94	6.64	16.34	9.47	14.26	9.55	11.09	17.03	12.11	6.20	11.08	19.46	7.88	4
3R10	9.34	6.07	16.13	9.10	13.27	8.16	11.11	15.28	11.43	6.17	15.15	18.78	8.12	4
3R11	8.39	5.55	14.74	9.24	13.19	7.25	10.50	16.51	10.56	6.32	13.28	20.26	7.86	4
3R12	8.38	6.37	15.73	9.34	13.68	9.71	12.26	17.32	11.91	6.52	16.41	18.55	8.93	4
3R13	8.81	5.53	15.43	7.08	14.70	8.91	10.70	16.19	12.84	6.12	16.23	17.72	6.59	4
3R14	8.76	6.13	14.56	9.31	13.97	8.81	11.54	15.83	12.56	7.82	14.89	18.04	7.59	4
3R15	8.51	6.31	16.31	10.09	14.01	8.97	12.10	16.62	12.48	5.82	15.18	19.60	7.80	4
3R16	9.53	6.42	15.03	9.16	13.83	9.23	11.91	15.80	12.18	6.82	14.63	17.41	8.59	4
3R17	8.69	6.32	14.12	9.19	13.13	8.69	11.10	14.30	11.67	5.34	13.59	16.47	6.51	4
4R1	8.45	4.65	12.93	7.09	11.38	6.93	8.76	12.49	11.20	5.06	11.38	14.67	6.00	4
4R2	7.94	5.03	13.40	8.11	10.89	8.19	10.86	11.51	15.13	3.88	6.65	16.90	6.49	4
4R3	6.98	4.13	13.28	6.32	11.19	6.57	9.58	14.25	7.46	5.41	11.85	16.88	5.90	4
4R4	7.26	5.13	11.59	8.23	12.20	7.82	10.30	11.65	11.67	5.26	13.84	14.24	7.22	4
4R5	7.04	4.33	11.45	7.05	11.77	6.86	10.07	12.11	11.59	4.85	13.48	15.66	6.66	4
4R6	6.35	4.42	12.07	7.28	11.97	7.52	10.18	13.16	8.48	5.16	13.80	15.06	6.76	4
4R7	5.42	4.56	13.04	7.95	10.16	6.74	9.93	9.85	14.63	6.32	6.82	18.48	6.67	4
4R8	7.17	4.71	13.08	8.03	11.71	7.41	10.32	13.95	11.60	5.80	12.43	15.58	7.38	4
4R9	6.69	3.94	12.05	5.91	11.89	7.60	9.65	13.42	10.45	5.18	13.13	15.25	6.72	4
4R10	7.12	5.47	11.39	8.18	11.92	8.07	9.96	14.09	9.81	6.68	10.06	15.21	6.15	4
4R11	7.48	4.55	11.99	8.29	11.12	6.46	10.10	13.45	11.91	5.82	7.62	18.51	5.89	4
4R12	6.99	4.42	11.89	7.08	11.59	7.30	10.25	12.63	8.40	5.83	13.47	13.72	7.40	4
4R13	7.29	4.41	10.60	6.14	12.52	7.89	9.26	14.10	14.98	6.52	3.61	18.32	7.50	4
4R14	6.28	4.14	11.56	7.08	14.09	6.79	9.80	18.34	10.97	5.53	14.91	16.16	5.91	4
4R15	7.45	4.63	13.14	7.44	9.48	6.41	9.75	15.42	10.47	4.11	7.65	14.93	5.61	4
4R16	6.34	4.73	11.29	7.08	10.87	6.90	9.45	12.44	8.31	5.26	12.14	15.54	5.13	4
4R17	5.14	3.04	11.75	5.76	9.82	6.71	9.34	14.38	12.52	4.87	2.81	17.59	6.00	4
4R18	6.32	5.39	12.19	6.84	11.67	9.03	21.93	13.41	13.98	3.46	18.05	13.05	2.38	4

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
4R19	6.60	6.33	10.53	6.97	10.18	8.71	19.69	12.48	14.09	3.52	13.57	21.70	4.69	4
4R20	6.40	0.98	10.90	7.09	9.53	7.42	19.47	10.22	12.20	18.33	18.29	22.00	4.03	4
5R1	5.88	6.69	9.36	18.80	10.38	8.93	23.42	11.45	16.37	4.26	14.59	24.80	4.63	3
5R2	5.94	6.11	11.21	14.90	10.21	8.98	19.56	14.96	13.10	4.79	17.00	22.73	5.57	3
5R3	6.38	5.59	10.29	18.87	10.48	8.73	24.33	13.71	13.33	7.52	13.72	22.50	6.44	3
5R4	7.77	6.61	12.11	18.65	11.08	8.27	21.72	12.60	14.38	3.90	16.07	25.65	5.07	3
5R5	7.93	6.50	12.76	20.31	10.86	8.27	24.27	13.06	14.77	6.05	13.14	23.79	4.71	3
5R6	7.54	4.50	11.08	20.82	10.36	9.13	26.40	12.59	14.55	5.07	11.30	24.00	3.34	3
5R7	6.89	5.17	10.25	20.86	10.34	8.53	25.49	12.34	15.80	6.71	11.80	26.67	5.14	3
5R8	7.13	5.98	10.09	17.76	11.19	8.23	21.24	11.52	16.17	4.90	9.27	25.89	4.92	3
5R9	6.43	4.91	10.34	16.00	11.26	8.10	20.81	12.76	12.03	4.45	18.02	25.23	4.18	3
5R10	7.37	5.62	10.12	18.40	10.82	9.52	22.97	10.83	17.73	2.11	13.23	27.26	4.21	3
6R1	4.95	5.45	8.12	18.32	8.28	7.58	22.02	12.33	11.48	4.05	10.70	13.80	3.13	3
6R2	4.99	3.93	7.85	15.18	8.98	5.79	18.44	11.19	12.68	2.40	14.95	16.50	2.92	3
6R3	7.85	6.66	10.57	18.97	11.96	7.98	21.37	8.36	16.40	4.45	15.03	18.73	3.90	3
6R4	5.70	3.55	9.14	17.84	8.18	6.96	21.46	8.25	15.35	1.71	13.80	25.44	2.90	3
6R5	3.94	3.50	10.02	21.33	8.13	15.04	6.51	5.14	15.11	8.89	7.53	25.43	18.40	3
6R6	5.69	5.35	9.25	25.45	9.06	7.84	28.91	12.48	13.86	11.63	11.82	15.52	3.61	3
6R7	1.25	0.01	8.99	20.99	6.80	15.69	5.38	5.16	14.38	8.09	8.22	25.80	19.19	3
6R8	5.78	5.85	10.06	19.68	9.38	10.70	16.72	11.07	12.98	6.58	18.06	12.20	9.60	3
6R9	23.68	1.82	9.25	19.72	8.85	9.70	17.60	9.25	14.03	5.98	12.51	19.18	7.96	3
6R10	3.00	1.72	5.15	19.41	10.65	12.54	6.96	5.68	17.56	18.96	2.67	24.29	8.02	3
6R11	3.33	1.68	8.76	20.46	8.81	7.15	23.67	10.61	19.46	7.76	2.67	31.08	3.48	3
6R12	2.56	1.82	8.84	18.52	8.74	6.72	21.53	11.81	13.56	6.30	9.44	23.18	2.77	3
7R1	3.08	2.03	9.18	16.43	8.58	7.71	19.56	9.45	12.96	5.34	18.08	17.12	4.34	3
7R2	2.68	1.59	9.41	19.20	8.17	8.26	23.70	12.41	14.65	8.62	14.94	20.83	3.54	3
7R3	3.31	2.12	10.00	17.49	7.72	7.11	21.72	6.52	14.10	5.82	5.68	24.81	2.99	3
7R4	3.22	2.13	9.13	19.37	8.77	7.11	23.15	8.33	14.47	4.04	12.90	20.92	4.14	3
7R5	2.94	1.47	9.37	17.26	8.77	6.69	20.00	11.23	12.86	4.36	14.46	17.48	3.37	3
7R6	2.55	1.93	8.75	15.75	9.09	6.31	19.00	13.19	11.38	3.56	14.67	16.92	3.47	3
7R7	3.09	1.79	8.41	17.35	8.33	7.09	21.01	9.60	13.21	7.31	2.17	21.66	3.08	3
7R8	3.43	2.21	9.06	17.92	8.17	7.85	21.84	10.93	13.83	5.96	12.22	27.36	3.55	3

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
7R9	1.78	0.61	4.30	15.68	7.23	6.72	19.14	5.74	14.95	6.42	1.10	20.42	2.51	3
8R1	4.17	3.88	7.85	18.39	7.56	6.65	21.98	11.21	18.63	8.67	13.56	28.65	2.75	2
8R2	4.91	4.34	9.05	15.15	8.97	6.90	18.99	11.85	11.55	7.02	16.24	19.00	2.94	2
8R3	4.13	2.67	7.93	12.61	8.45	4.92	15.12	11.07	12.73	3.13	15.40	16.90	2.65	2
8R4	5.71	4.41	8.78	16.49	8.75	7.37	20.41	10.77	12.69	4.37	13.11	22.05	3.51	2
8R5	4.68	3.26	8.79	14.59	7.49	5.21	16.17	13.13	12.54	5.42	1.54	15.97	2.62	2
8R6	4.04	2.43	7.31	14.88	7.69	6.62	17.39	9.49	13.26	4.03	16.12	19.23	2.81	2
8R7	4.57	2.77	8.09	15.78	6.99	6.51	18.63	10.03	12.88	2.03	13.95	15.91	2.68	2
9R1	2.95	1.73	6.30	14.88	8.26	5.85	16.89	12.99	13.51	5.95	15.63	3.43	2.53	2
9R2	4.98	3.85	6.59	16.15	7.01	7.95	22.02	7.85	12.39	7.18	18.43	3.36	2.94	2
9R3	5.10	3.10	7.80	17.01	7.78	5.40	20.37	10.38	11.69	6.73	17.26	4.15	2.91	2
9R4	4.86	4.41	6.89	16.01	7.79	6.40	19.76	10.41	12.53	6.62	14.43	11.89	2.79	2
9R5	4.68	3.26	7.06	16.01	5.19	6.34	19.76	10.26	10.55	6.62	14.28	18.92	2.79	2
9R6	4.04	2.43	9.41	16.34	7.04	5.31	19.96	11.53	8.61	6.66	10.74	23.81	2.83	2
9R7	4.57	2.77	7.70	16.07	5.74	5.89	19.79	10.29	13.56	6.63	11.76	19.92	2.80	2
9R8	1.15	0.57	7.00	16.21	8.58	6.19	19.88	8.62	10.99	6.64	10.06	22.58	2.82	2
9R9	1.74	0.72	6.39	16.16	6.26	5.93	19.85	8.90	11.05	6.64	13.91	17.44	2.81	2
10R1	2.28	1.37	5.97	3.16	5.67	4.18	6.08	8.45	9.81	6.31	3.16	6.05	3.75	0
10R2	2.18	1.17	5.28	4.13	5.78	4.15	7.29	8.56	9.79	6.65	2.97	6.13	3.57	0
10R3	0.93	0.59	5.84	3.99	6.51	4.36	7.56	9.01	11.07	5.64	2.81	7.28	3.24	0
10R4	1.42	0.51	5.83	3.90	6.78	4.55	7.49	10.00	9.95	6.39	3.15	5.75	2.92	0
10R5	1.94	1.13	6.17	4.73	5.93	4.17	7.85	9.68	9.71	5.49	2.93	5.61	3.40	0
10R6	2.07	1.11	6.07	3.59	6.01	3.90	6.50	8.72	10.25	6.66	2.86	5.57	3.30	0
10R7	1.82	0.70	6.27	3.84	6.09	4.13	6.86	9.06	9.87	6.12	2.23	6.01	3.35	0
10R8	1.15	0.57	5.39	3.37	6.71	4.55	6.39	9.08	10.38	5.22	2.37	5.20	3.97	0
10R9	1.74	0.72	5.47	3.41	5.37	3.51	6.41	8.87	9.99	6.18	2.59	5.13	3.15	0
LPM1	10.90	7.95	24.06	23.42	26.36	13.57	26.42	29.00	25.04	13.70	25.47	29.94	9.04	4
LPM2	10.56	7.63	22.60	26.33	26.83	15.95	29.52	24.13	23.91	14.61	26.03	33.63	9.41	3
LPM3	11.18	7.97	22.66	26.07	26.65	15.87	29.35	26.18	23.17	13.42	21.47	35.12	10.23	4
LPM4	10.54	7.96	21.59	23.13	25.59	14.52	26.00	24.87	22.28	11.23	24.58	30.57	8.96	4
LPM5	12.10	8.17	21.86	21.64	24.20	15.94	25.19	22.23	20.69	9.04	24.05	36.56	8.76	3
LPM6	8.11	5.70	22.80	24.43	26.85	15.09	28.41	26.98	22.94	12.34	26.36	33.42	9.00	4



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
LPM7	11.59	7.84	21.55	25.48	27.43	16.10	29.09	24.63	20.10	14.09	26.42	35.75	9.62	4
LPM8	11.37	8.20	20.45	23.48	25.82	14.69	27.58	22.83	23.85	14.67	28.28	26.12	9.32	4
LPM9	10.02	7.26	21.39	21.88	24.62	15.83	24.84	22.50	21.86	10.08	27.05	28.83	8.34	4
LPM10	9.74	7.37	20.26	20.99	25.75	14.72	22.77	23.54	16.06	9.49	24.46	33.34	7.77	4
LPM11	9.44	7.09	21.36	23.96	25.45	15.61	25.99	18.46	22.28	13.43	18.54	32.33	8.33	4
LPM12	9.79	7.32	20.92	25.87	24.78	13.97	28.75	21.67	21.89	13.94	20.06	32.51	8.56	4
LPM13	10.59	7.30	19.91	19.73	25.12	15.21	22.82	23.33	22.01	8.80	18.93	32.34	5.64	4
2L1	11.29	7.83	16.64	9.89	16.70	11.38	12.92	16.65	15.43	7.92	14.56	22.94	9.15	3
2L2	10.94	8.76	15.45	9.79	17.66	10.38	12.45	20.25	13.90	8.18	14.63	23.74	9.29	4
2L3	12.34	9.14	15.66	9.40	18.41	10.82	12.34	19.82	15.85	7.42	12.87	21.39	8.50	4
2L4	11.23	8.62	15.43	8.71	20.56	10.51	12.75	28.15	16.18	7.40	4.08	20.63	7.83	3
2L5	12.61	8.44	15.83	9.49	20.94	10.63	12.96	28.30	10.24	6.95	15.05	17.47	7.37	4
2L6	9.67	6.46	16.29	9.13	20.94	10.45	11.71	27.86	16.36	8.32	12.38	20.67	8.49	4
2L7	9.44	6.28	16.03	9.92	18.00	10.58	12.56	21.30	16.72	8.65	10.01	21.81	7.33	4
2L8	4.49	5.78	17.16	11.11	19.22	10.83	14.19	21.09	16.53	8.02	12.88	22.08	8.10	4
2L9	9.96	6.47	16.11	10.47	18.91	11.16	13.34	19.04	17.72	9.32	12.97	20.99	7.88	3
2L10	8.85	5.92	16.52	10.16	19.85	10.22	12.98	20.97	17.02	9.78	10.12	21.76	8.70	4
2L11	8.12	6.25	17.52	10.15	20.96	12.13	13.41	27.23	15.66	7.73	3.32	21.09	7.77	4
2L12	9.56	5.96	15.13	8.32	17.41	10.91	12.81	23.08	15.37	6.24	6.75	20.67	7.27	4
2L13	9.48	6.18	17.34	10.13	17.86	10.92	12.41	18.35	16.33	7.65	11.27	20.34	8.10	4
2L14	9.59	6.44	17.02	9.82	19.31	12.25	13.73	20.59	15.65	5.93	13.88	21.36	6.10	4
2L15	9.89	6.02	17.13	9.67	19.20	10.15	12.13	18.14	15.01	8.52	12.65	20.82	6.63	3
2L16	9.55	6.60	16.06	9.86	18.24	11.93	13.07	19.04	15.97	7.30	9.45	22.10	9.27	4
2L17	10.76	6.88	16.16	9.28	18.85	13.10	13.30	23.04	16.00	7.75	3.85	20.67	8.59	4
3L1	9.49	6.89	14.26	8.42	17.33	9.13	9.90	17.41	14.77	6.95	10.35	19.51	6.58	4
3L2	9.69	7.00	14.31	8.17	15.11	8.84	10.53	15.96	14.69	6.81	11.86	17.85	6.56	4
3L3	10.10	6.13	13.85	7.92	15.38	8.11	10.46	16.24	13.24	6.57	11.87	19.00	7.17	4
3L4	6.72	4.47	14.71	9.07	15.47	8.65	10.51	18.48	13.86	6.16	10.96	17.78	5.88	4
3L5	5.83	4.48	14.62	7.96	16.12	8.45	10.20	17.11	13.69	6.78	10.11	19.29	6.26	4
3L6	6.74	4.47	14.35	8.31	15.88	8.64	10.62	18.52	15.15	6.99	10.80	17.80	7.04	4
3L7	8.26	5.78	13.49	7.46	14.33	9.02	10.27	14.55	14.34	5.93	12.85	18.65	6.28	4
3L8	7.80	5.42	13.90	8.10	14.41	8.56	10.11	16.13	14.06	5.00	11.81	18.69	6.62	4

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
3L9	4.62	5.05	13.63	8.14	16.43	9.49	11.56	17.33	8.63	5.73	19.08	14.13	6.30	4
3L10	9.21	6.12	14.24	7.24	14.54	8.58	10.48	16.33	13.57	6.14	9.63	19.77	6.45	4
3L11	8.19	6.20	13.34	7.91	16.15	9.78	10.81	17.29	14.26	5.02	12.42	17.73	6.23	4
3L12	8.66	6.46	13.72	7.77	15.17	9.09	10.05	18.62	4.39	6.84	12.26	21.29	4.97	4
3L13	8.75	5.89	13.02	8.13	14.91	9.61	10.69	14.86	13.71	6.43	11.26	17.02	6.60	4
3L14	6.80	5.28	11.70	8.44	13.60	8.68	10.71	12.29	13.44	5.19	12.24	18.94	5.33	4
3L15	8.46	5.68	11.31	7.33	15.14	7.06	9.90	16.87	12.68	6.27	9.35	18.31	5.66	4
3L16	7.79	6.28	14.41	7.67	16.33	7.27	10.32	18.48	15.22	6.27	9.85	19.47	5.47	4
3L17	8.66	2.41	12.18	7.49	15.01	8.66	10.51	16.74	14.35	5.61	11.58	18.05	6.84	4
3L18	7.79	5.20	14.07	7.89	15.23	8.66	10.66	15.82	10.11	7.46	11.11	20.33	6.57	4
4L1	7.45	5.07	12.27	6.21	12.32	5.76	8.31	15.61	13.47	5.29	8.06	14.73	5.08	4
4L2	6.70	4.84	9.99	5.22	13.18	5.92	8.45	11.13	13.04	4.86	7.95	16.55	4.85	4
4L3	7.68	4.93	10.43	5.54	11.28	7.05	8.93	9.95	12.26	4.55	10.14	16.07	5.25	4
4L4	6.07	5.18	11.04	7.36	13.45	7.21	8.49	13.32	12.25	5.65	10.52	15.51	5.40	4
4L5	6.71	3.91	9.98	5.05	13.86	5.36	7.87	17.96	14.34	5.27	3.81	12.97	4.80	4
4L6	5.45	4.11	10.83	5.84	12.20	6.79	8.70	12.34	11.75	4.86	14.35	9.57	4.71	4
4L7	7.37	4.92	11.52	5.84	13.14	7.17	8.49	15.17	12.52	4.66	9.51	14.97	4.32	4
4L8	6.62	5.42	10.92	6.46	12.07	6.45	8.78	14.16	12.48	4.97	8.74	14.32	4.96	4
4L9	7.21	5.18	11.07	5.97	12.35	7.39	9.02	12.23	10.36	14.81	9.16	17.05	8.61	4
4L10	6.95	4.44	11.13	5.71	12.99	7.21	9.00	12.26	8.45	4.76	8.22	18.05	5.49	4
4L11	7.44	4.57	11.25	6.04	12.20	7.12	8.96	11.89	6.79	6.13	9.11	19.43	5.18	4
4L12	3.28	4.25	11.18	5.83	12.97	7.78	9.28	15.23	4.87	5.98	8.05	19.94	8.92	4
4L13	4.41	3.83	10.35	6.34	12.45	7.90	9.92	11.62	12.82	5.42	8.55	14.89	4.76	4
4L14	5.49	3.20	11.85	7.17	15.80	8.13	9.25	16.08	10.48	5.10	8.24	18.37	5.33	4
4L15	6.34	4.66	10.79	5.61	12.54	7.14	8.75	14.04	11.43	4.67	10.53	14.57	4.42	4
4L16	8.61	5.70	10.95	6.25	14.37	7.51	8.79	16.66	11.52	5.77	13.58	10.12	4.95	4
4L17	9.14	5.50	11.07	6.76	12.28	5.74	8.46	19.62	12.39	5.68	4.37	8.41	4.82	4
5L1	8.56	5.63	11.03	5.66	12.59	6.18	8.24	15.08	11.08	3.26	6.81	14.44	5.18	4
5L2	7.29	4.68	9.68	5.07	11.58	4.77	7.20	15.99	11.09	4.26	5.99	14.60	3.95	4
5L3	8.17	4.27	9.44	6.00	9.55	4.36	7.99	9.47	10.33	4.54	10.88	15.69	4.25	4
5L4	6.85	4.56	9.05	4.33	12.21	4.30	6.31	16.44	11.75	3.89	7.11	12.54	4.54	4
5L5	6.38	4.04	9.38	4.17	12.53	4.17	6.28	17.01	9.73	4.79	2.14	14.81	3.32	4

Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			left	left	right	right	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			posterior	posterior	posterior	posterior	Width	Width	Width	Length	Length	Length	Length	
		edge	edge	edge	edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
5L6	4.28	3.86	8.95	5.93	13.07	5.90	8.06	12.06	9.55	3.58	9.46	11.40	5.51	4
5L7	6.41	3.89	8.68	4.71	9.42	4.96	7.59	9.64	9.49	2.96	10.31	15.35	3.57	4
5L8	4.79	3.53	9.21	4.52	11.25	5.57	7.39	14.53	10.67	3.08	8.37	12.43	4.26	4
5L9	4.34	3.49	7.55	3.97	13.51	5.59	8.18	15.63	5.64	3.86	9.38	13.73	3.92	4
5L10	4.55	2.99	8.79	3.95	10.77	4.29	6.30	13.59	10.62	4.14	5.52	12.24	3.97	4
5L11	2.93	1.88	7.15	2.79	11.14	5.08	6.80	11.42	7.80	3.18	6.52	14.84	3.29	4
5L12	2.85	2.80	8.31	3.74	10.66	4.83	6.12	12.18	10.69	3.86	8.64	12.96	3.53	4
5L13	3.42	3.19	8.45	3.45	9.90	5.09	6.53	12.55	11.47	4.24	5.51	13.28	4.11	4
6L1	5.49	3.37	3.00	4.62	11.36	4.91	7.60	14.22	6.45	4.60	7.00	17.81	3.45	3
6L2	5.40	3.11	9.28	4.62	9.17	5.11	6.59	10.32	10.72	3.89	9.45	14.08	4.56	3
6L3	5.20	3.20	9.49	5.00	10.55	4.67	6.91	13.25	11.29	4.66	4.28	13.04	3.89	3
6L4	4.97	2.70	8.43	3.92	8.32	4.42	6.43	8.55	10.28	5.42	10.04	12.90	3.16	3
6L5	1.97	2.30	8.08	4.35	12.53	5.36	7.25	15.52	6.56	4.03	2.66	16.84	4.02	3
6L6	2.65	2.05	8.41	4.12	8.03	5.75	6.83	6.52	10.11	3.94	10.81	12.81	4.41	3
6L7	1.73	1.95	9.15	4.82	11.37	5.04	7.28	16.19	5.63	4.13	3.51	17.20	4.16	3
6L8	5.10	3.06	7.64	4.02	8.83	4.73	7.51	10.66	10.66	5.47	8.83	11.91	4.14	3
6L9	3.51	1.04	7.28	3.25	8.49	3.88	5.83	9.27	9.91	3.21	8.76	12.56	3.56	3
6L10	3.10	2.68	8.72	4.60	9.01	5.28	7.95	11.56	8.44	3.46	7.75	14.67	3.88	3
6L11	2.82	2.41	7.37	4.83	9.69	3.87	7.13	11.93	8.64	3.86	7.09	12.22	2.13	3
6L12	3.32	2.76	7.38	3.47	11.93	3.86	5.64	15.84	7.59	3.82	6.79	9.68	2.68	3
6L13	4.62	3.18	7.81	3.78	10.89	3.47	6.13	16.58	7.55	3.95	3.18	12.63	3.53	3
6L14	3.86	2.27	8.64	3.95	8.13	3.78	5.95	12.42	8.86	3.40	6.97	11.42	3.71	3
7L1	5.22	2.48	7.67	3.57	10.60	2.98	5.89	15.82	5.53	7.63	3.07	14.28	2.96	2
7L2	1.23	2.24	8.13	3.65	8.07	3.14	5.43	9.16	9.56	2.60	8.08	9.99	2.64	2
7L3	4.56	2.84	7.68	4.13	8.67	3.05	5.63	10.79	10.22	4.15	3.89	11.06	3.37	2
7L4	3.59	2.38	7.37	3.87	9.22	1.67	4.60	13.04	9.35	3.75	3.26	11.98	2.66	2
7L5	3.87	1.78	7.07	4.28	9.39	2.55	5.51	13.60	4.26	3.62	3.28	14.51	2.93	2
7L6	3.24	1.23	7.00	3.65	8.26	2.84	5.26	10.19	8.78	2.54	6.06	10.75	2.08	2
7L7	4.82	2.44	7.02	3.19	8.08	2.53	5.04	10.09	8.94	2.74	6.13	11.50	2.57	2
7L8	2.86	1.19	7.58	3.61	8.00	2.49	4.26	10.33	8.81	2.44	6.43	11.65	2.41	2
7L9	3.81	2.10	7.94	4.21	6.73	1.91	4.95	8.95	8.42	2.98	6.74	10.54	2.73	2
7L10	2.65	1.61	7.88	3.41	9.14	2.73	4.95	14.14	8.22	1.97	5.34	8.13	2.31	2

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
7L11	3.20	1.77	6.24	4.12	9.68	4.42	6.39	10.65	7.81	3.26	7.81	9.91	2.90	2
8L1	2.52	1.47	8.16	4.43	9.75	3.34	6.16	13.79	10.09	4.54	7.62	10.43	3.31	0
8L2	2.67	1.52	8.10	4.64	10.71	2.95	5.03	14.79	5.88	4.89	3.49	15.52	3.67	0
8L3	3.07	1.62	8.31	4.40	9.23	3.70	5.29	12.85	5.15	4.56	3.80	14.65	3.98	0
8L4	2.87	1.43	7.78	4.99	10.37	3.20	7.04	13.93	6.15	3.87	4.24	13.66	2.64	0
8L5	3.46	1.14	8.14	3.66	6.02	2.60	4.68	8.29	10.49	9.30	2.75	7.03	2.77	0
9L1	3.80	1.58	7.26	3.74	6.19	2.90	5.10	8.83	9.92	7.77	3.64	6.71	3.48	0
9L2	4.01	1.71	5.18	3.97	4.68	2.54	5.30	7.03	9.33	6.75	3.91	6.79	3.90	0
9L3	2.63	0.34	6.94	3.77	5.72	3.67	6.17	9.03	10.25	6.61	2.87	6.47	3.93	0
9L4	2.99	0.90	5.96	3.12	6.05	4.12	6.45	8.43	8.87	8.18	3.42	6.55	2.62	0
9L5	3.10	0.82	4.22	3.52	10.16	1.56	4.43	12.67	6.78	1.93	5.44	6.84	1.64	0
10L1	3.40	2.25	6.57	4.38	4.84	3.21	6.67	8.42	10.00	6.55	3.58	6.97	3.76	0
10L2	3.15	2.05	6.45	3.84	4.86	3.16	6.30	8.78	8.14	7.53	3.57	4.39	2.85	0
10L3	3.01	1.69	5.42	3.93	4.88	3.69	6.12	8.23	10.38	4.95	2.66	5.57	3.72	0
10L4	2.23	1.58	5.82	3.63	5.15	3.19	5.98	9.21	8.96	6.58	4.00	4.38	3.33	0
10L5	2.26	1.23	5.93	3.81	4.49	2.95	5.36	7.17	9.00	6.59	4.27	5.24	2.94	0
10L6	1.54	0.91	5.40	3.37	5.21	3.07	5.83	7.82	9.56	6.65	3.00	5.60	2.55	0
10L7	1.40	0.96	6.04	3.66	4.60	3.17	6.19	8.08	9.42	6.73	3.52	5.83	3.78	0
10L8	2.71	1.44	6.18	5.12	4.79	2.57	6.45	8.41	8.85	6.50	3.79	5.51	4.10	0
10L9	1.04	0.30	5.79	3.57	4.52	3.10	5.49	7.33	8.93	5.27	2.90	5.05	3.27	0
10L10	2.36	0.09	6.22	3.96	4.62	3.11	6.22	8.22	9.29	6.88	3.53	5.49	3.35	0
10L11	1.09	0.79	5.91	4.31	5.75	4.00	6.88	8.76	8.98	6.22	3.25	5.23	2.92	0
10L12	3.27	1.40	5.86	4.23	4.67	2.89	6.01	7.70	8.89	5.25	3.47	5.90	3.30	0

SUMMARY FHSM VP 2223 *P. rugosus*

Medial														
N=9														
Minimum	17.59	12.04	23.34	15.20	24.48	15.80	16.20	20.59	22.84	12.29	23.15	24.44	11.47	3.00
Maximum	21	14.8	27.77	19.98	28.23	20.24	19.91	32.96	26.98	16.17	25.06	27.43	14.87	4.00
Arithmetic Mean	19.49	13.558	26.11	17.78	26.46	18.21	18.26	25.37	24.66	14.02	24.30	25.71	13.49	3.56
Standard Deviation	0.876	0.922	1.38	1.39	1.06	1.36	1.07	3.49	1.40	1.46	0.73	0.98	1.11	0.53

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
RPM														
N=14														
Minimum	13.41	4.71	22.54	12.08	17.41	11.34	13.70	21.73	15.04	9.31	17.67	21.28	9.91	3.00
Maximum	15.62	11.22	26.64	16.63	21.83	14.82	16.01	27.52	21.06	11.32	22.04	28.28	12.65	5.00
Arithmetic Mean	14.566	9.068	24.34	13.71	19.90	13.42	14.90	23.66	19.35	10.27	20.23	25.00	11.24	3.93
Standard Deviation	0.787	1.466	1.28	1.15	1.09	0.90	0.58	1.66	1.57	0.60	1.16	2.27	0.85	0.48
R2														
N=17														
Minimum	0.79	2.38	12.28	8.09	14.96	9.22	7.63	7.37	12.01	6.92	15.41	17.42	7.74	4.00
Maximum	12.61	8.71	20.32	12.76	19.30	19.44	14.25	21.80	19.07	10.76	18.66	22.45	22.92	4.00
Arithmetic Mean	11.108	7.302	18.64	10.97	16.10	11.68	12.65	17.48	14.61	8.16	16.92	20.11	9.90	4.00
Standard Deviation	2.704	1.57	1.83	1.23	1.03	2.91	1.50	3.44	1.58	0.98	0.76	1.56	3.49	0.00
R3														
N=17														
Minimum	8.38	4	14.12	7.08	13.03	6.92	10.03	13.55	10.56	5.31	9.48	16.47	6.03	4.00
Maximum	10.51	6.89	18.03	10.09	15.28	9.71	12.26	19.80	13.33	7.82	16.41	20.90	9.66	4.00
Arithmetic Mean	9.218	6.001	16.08	9.12	13.94	8.64	11.10	16.85	11.90	6.53	14.02	18.76	7.86	4.00
Standard Deviation	0.651	0.672	1.01	0.77	0.58	0.81	0.61	1.78	0.83	0.72	2.03	1.39	0.99	0.00
R4														
N=20														
Minimum	5.14	0.98	10.53	5.76	9.48	6.41	8.76	9.85	7.46	3.46	2.81	13.05	2.38	4.00
Maximum	8.45	6.33	13.40	8.29	14.09	9.03	21.93	18.34	15.13	18.33	18.29	22.00	7.50	4.00
Arithmetic Mean	6.835	4.449	12.01	7.20	11.30	7.37	11.43	13.17	11.49	5.84	11.28	16.47	6.02	4.00
Standard Deviation	0.778	1.051	0.89	0.77	1.11	0.74	3.90	1.84	2.30	3.08	4.24	2.39	1.25	0.00
R5														
N=10														
Minimum	5.88	4.5	9.36	14.90	10.21	8.10	19.56	10.83	12.03	2.11	9.27	22.50	3.34	3.00
Maximum	7.93	6.69	12.76	20.86	11.26	9.52	26.40	14.96	17.73	7.52	18.02	27.26	6.44	3.00

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	r Crown Width F-G	r Tooth Width B-C	Tooth Width E-D	Tooth Length B-E	Crown Length F-I	Tooth Length C-D	Crown Length G-H	
Arithmetic Mean	6.926	5.768	10.76	18.54	10.70	8.67	23.02	12.58	14.82	4.98	13.81	24.85	4.82	3.00
Standard Deviation	0.741	0.746	1.03	1.95	0.39	0.47	2.18	1.19	1.73	1.52	2.69	1.59	0.84	0.00
R6														
N=12														
Minimum	1.25	0.01	5.15	15.18	6.80	5.79	5.38	5.14	11.48	1.71	2.67	12.20	2.77	3.00
Maximum	23.68	6.66	10.57	25.45	11.96	15.69	28.91	12.48	19.46	18.96	18.06	31.08	19.19	3.00
Arithmetic Mean	6.06	3.445	8.83	19.66	8.98	9.48	17.55	9.28	14.74	7.24	10.62	20.93	7.16	3.00
Standard Deviation	5.824	2.071	1.40	2.45	1.30	3.33	7.48	2.76	2.22	4.63	4.78	5.78	5.93	0.00
R7														
N=9														
Minimum	1.78	0.61	4.30	15.68	7.23	6.31	19.00	5.74	11.38	3.56	1.10	16.92	2.51	3.00
Maximum	3.43	2.21	10.00	19.37	9.09	8.26	23.70	13.19	14.95	8.62	18.08	27.36	4.34	3.00
Arithmetic Mean	2.898	1.764	8.62	17.38	8.32	7.21	21.01	9.71	13.60	5.71	10.69	20.84	3.44	3.00
Standard Deviation	0.506	0.501	1.68	1.33	0.58	0.63	1.72	2.53	1.12	1.62	6.12	3.53	0.56	0.00
R8														
N=7														
Minimum	4.04	2.43	7.31	12.61	6.99	4.92	15.12	9.50	11.55	2.03	1.55	15.91	2.62	2.00
Maximum	5.71	4.41	9.05	18.39	8.98	7.37	21.98	13.13	18.63	8.68	16.24	28.65	3.51	2.00
Arithmetic Mean	4.601	3.394	8.26	15.41	7.99	6.31	18.38	11.08	13.47	4.95	12.85	19.67	2.85	2.00
Standard Deviation	0.585	0.819	0.63	1.78	0.74	0.90	2.38	1.19	2.34	2.29	5.14	4.52	0.31	0.00
R9														
N=9														
Minimum	1.15	0.57	6.30	14.88	5.19	5.31	16.89	7.85	8.61	5.95	10.06	3.36	2.53	2.00
Maximum	5.1	4.41	9.41	17.01	8.59	7.95	22.02	12.99	13.56	7.18	18.43	23.81	2.94	2.00
Arithmetic Mean	3.786	2.538	7.24	16.09	7.07	6.14	19.81	10.14	11.65	6.63	14.06	13.94	2.80	2.00
Standard Deviation	1.484	1.321	0.97	0.55	1.16	0.78	1.31	1.55	1.57	0.31	2.84	8.42	0.12	0.00

R10

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
N=9														
Minimum	0.93	0.51	5.28	3.16	5.37	3.51	6.08	8.45	9.72	5.22	2.23	5.13	2.92	0.00
Maximum	2.28	1.37	6.27	4.73	6.78	4.55	7.85	10.00	11.07	6.66	3.16	7.28	3.97	0.00
Arithmetic Mean	1.726	0.874	5.81	3.79	6.09	4.17	6.94	9.05	10.09	6.07	2.78	5.86	3.41	0.00
Standard Deviation	0.467	0.319	0.35	0.48	0.48	0.32	0.63	0.51	0.43	0.51	0.33	0.64	0.32	0.00
LPM														
N=13														
Minimum	8.11	5.7	19.91	19.73	24.20	13.57	22.77	18.46	16.06	8.80	18.54	26.12	5.64	3.00
Maximum	12.1	8.2	24.06	26.33	27.43	16.10	29.52	29.00	25.04	14.67	28.28	36.56	10.23	4.00
Arithmetic Mean	10.456	7.52	21.65	23.57	25.80	15.16	26.67	23.87	22.01	12.22	23.98	32.34	8.69	3.85
Standard Deviation	1.051	0.662	1.16	2.08	0.98	0.82	2.34	2.63	2.22	2.20	3.21	2.90	1.11	0.38
L2														
N=17														
Minimum	4.49	5.78	15.13	8.32	16.70	10.15	11.71	16.65	10.24	5.93	3.32	17.47	6.10	3.00
Maximum	12.61	9.14	17.52	11.11	20.96	13.10	14.19	28.30	17.72	9.78	15.05	23.74	9.29	4.00
Arithmetic Mean	9.869	6.943	16.32	9.72	19.00	11.08	12.89	21.94	15.64	7.83	10.63	21.21	8.02	3.77
Standard Deviation	1.822	1.132	0.72	0.65	1.31	0.82	0.61	3.78	1.63	0.97	3.91	1.32	0.90	0.44
L3														
N=18														
Minimum	4.62	2.41	11.31	7.24	13.60	7.06	9.90	12.29	4.39	5.01	9.35	14.13	4.97	4.00
Maximum	10.1	7	14.71	9.07	17.33	9.78	11.56	18.62	15.22	7.46	19.08	21.29	7.17	4.00
Arithmetic Mean	7.976	5.512	13.62	7.97	15.36	8.68	10.46	16.61	13.01	6.23	11.63	18.53	6.27	4.00
Standard Deviation	1.406	1.093	0.99	0.45	0.90	0.70	0.39	1.61	2.72	0.71	2.12	1.52	0.60	0.00
L4														
N=17														
Minimum	3.28	3.2	9.98	5.05	11.28	5.36	7.87	9.95	4.87	4.55	3.81	8.41	4.32	4.00
Maximum	9.14	5.7	12.27	7.36	15.80	8.13	9.92	19.62	14.34	14.81	14.35	19.94	8.92	4.00
Arithmetic Mean	6.642	4.689	10.98	6.07	12.91	6.92	8.79	14.07	11.25	5.79	8.99	15.03	5.40	4.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Standard Deviation	1.434	0.668	0.59	0.62	1.05	0.81	0.46	2.60	2.46	2.38	2.61	3.30	1.31	0.00
L5														
N=13														
Minimum	2.85	1.88	7.15	2.79	9.42	4.17	6.12	9.47	5.64	2.96	2.14	11.40	3.29	4.00
Maximum	8.56	5.63	11.03	6.00	13.51	6.18	8.24	17.01	11.75	4.79	10.88	15.69	5.51	4.00
Arithmetic Mean	5.448	3.755	8.90	4.49	11.40	5.01	7.15	13.51	9.99	3.82	7.43	13.72	4.11	4.00
Standard Deviation	1.943	0.951	0.97	0.97	1.33	0.65	0.81	2.51	1.67	0.58	2.40	1.34	0.67	0.00
L6														
N=14														
Minimum	1.73	1.04	7.28	3.25	8.03	3.47	5.64	6.52	5.63	3.21	2.66	9.69	2.13	3.00
Maximum	5.49	3.37	9.49	5.00	12.53	5.75	7.95	16.58	11.29	5.47	10.81	17.81	4.56	3.00
Arithmetic Mean	3.839	2.577	8.33	4.24	9.88	4.58	6.79	12.35	8.76	4.13	6.94	13.55	3.66	3.00
Standard Deviation	1.295	0.632	0.74	0.54	1.53	0.71	0.72	3.10	1.80	0.69	2.63	2.33	0.66	0.00
L7														
N=11														
Minimum	1.23	1.19	6.24	3.19	6.73	1.67	4.26	8.95	4.27	1.97	3.07	8.13	2.08	2.00
Maximum	5.22	2.84	8.13	4.28	10.60	4.42	6.39	15.82	10.22	7.63	8.08	14.51	3.37	2.00
Arithmetic Mean	3.55	2.005	7.42	3.79	8.71	2.75	5.26	11.52	8.17	3.43	5.46	11.30	2.69	2.00
Standard Deviation	1.117	0.533	0.55	0.36	1.04	0.72	0.60	2.25	1.77	1.54	1.83	1.86	0.35	0.00
L8														
N=5														
Minimum	2.52	1.14	7.78	3.66	6.02	2.61	4.68	8.29	5.15	3.87	2.75	7.04	2.64	0.00
Maximum	3.46	1.62	8.31	4.99	10.71	3.70	7.04	14.79	10.49	9.30	7.62	15.52	3.98	0.00
Arithmetic Mean	2.918	1.436	8.10	4.42	9.21	3.16	5.64	12.73	7.55	5.43	4.38	12.26	3.27	0.00
Standard Deviation	0.367	0.18	0.19	0.49	1.87	0.41	0.96	2.57	2.53	2.20	1.89	3.50	0.57	0.00
L9														
N=5														



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Minimum	2.63	0.34	4.22	3.12	4.68	1.56	4.43	7.03	6.78	1.93	2.87	6.47	1.64	0.00
Maximum	4.01	1.71	7.26	3.97	10.16	4.12	6.45	12.67	10.25	8.18	5.44	6.84	3.93	0.00
Arithmetic Mean	3.306	1.07	5.91	3.62	6.56	2.96	5.49	9.20	9.03	6.25	3.85	6.67	3.11	0.00
Standard Deviation	0.579	0.569	1.25	0.33	2.10	1.00	0.82	2.09	1.37	2.51	0.97	0.16	0.98	0.00
L10														
N=12														
Minimum	1.04	0.09	5.40	3.37	4.49	2.57	5.36	7.17	8.14	4.95	2.66	4.38	2.55	0.00
Maximum	3.4	2.25	6.57	5.12	5.75	4.00	6.88	9.21	10.38	7.53	4.27	6.97	4.10	0.00
Arithmetic Mean	2.288	1.224	5.97	3.98	4.87	3.18	6.13	8.18	9.20	6.31	3.46	5.43	3.32	0.00
Standard Deviation	0.852	0.65	0.36	0.47	0.36	0.37	0.44	0.60	0.59	0.76	0.46	0.69	0.46	0.00

Tooth Files	SMU 69002 <i>P. rugosus</i> Upper dentition													
M1	3.36	1.40	9.15	3.68	9.40	3.45	6.51	15.16	16.94	6.44	3.43	5.96	4.30	0.00
M2	2.81	1.74	9.54	2.64	10.50	3.58	5.18	12.12	13.92	12.02	3.95	9.74	4.27	0.00
M3	3.56	1.87	10.79	4.16	10.76	3.27	5.39	4.78	13.56	11.86	2.89	15.58	3.67	0.00
M4	2.49	1.76	10.37	4.05	10.19	4.09	6.78	8.49	12.06	12.69	3.54	12.02	3.56	0.00
M5	1.73	0.23	9.34	3.17	11.11	4.23	6.14	9.13	8.17	15.26	2.71	12.43	4.00	0.00
M6	1.18	0.33	9.14	4.54	10.43	3.69	7.25	14.98	17.31	7.55	3.93	3.94	3.92	0.00
M7	1.03	0.34	9.48	4.09	9.68	3.00	5.95	12.61	16.71	11.93	3.36	5.47	3.69	0.00
M8	0.93	0.58	10.67	3.51	9.53	3.49	5.18	17.67	15.85	18.32	4.94	17.01	3.88	0.00
M9	0.93	0.36	8.92	3.07	10.06	3.86	6.24	10.70	9.58	12.73	3.10	10.01	3.91	0.00
M10	2.42	1.38	9.79	4.21	10.14	3.74	6.73	13.32	16.77	10.32	4.09	6.64	4.17	0.00
M11	1.32	0.66	8.85	4.52	9.72	4.31	6.79	15.30	14.87	7.39	4.88	5.72	4.80	0.00
M12	1.52	0.55	8.09	3.24	8.20	3.08	5.36	14.23	14.27	12.19	3.64	8.59	4.16	0.00
RPM1	1.04	0.37	28.69	15.70	18.80	14.47	19.76	31.29	31.75	24.17	14.14	25.28	18.25	4.00
RPM2	1.22	0.37	24.49	14.18	25.54	14.36	20.01	31.29	36.17	27.27	10.18	27.15	13.84	4.00
RPM3	1.82	0.98	23.00	15.52	23.83	16.22	21.68	27.55	37.24	26.56	13.49	26.81	15.59	4.00
RPM4	1.29	0.48	23.13	13.08	25.77	16.59	23.11	30.38	37.60	27.12	12.93	28.88	16.83	4.00
RPM5	1.64	0.58	20.38	14.14	24.17	13.91	20.22	26.78	38.31	20.96	11.20	26.94	14.69	4.00
RPM6	6.77	3.94	23.55	15.52	25.81	14.84	21.03	30.91	42.83	26.63	12.95	16.31	14.78	4.00
RPM7	7.45	3.86	25.76	15.40	13.73	9.71	18.57	28.41	30.05	29.14	12.62	21.23	11.59	4.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
RPM8	8.88	5.65	21.95	13.30	27.59	16.17	21.04	29.42	37.25	28.74	10.51	27.15	12.16	4.00
RPM9	10.84	4.53	23.10	12.44	21.50	11.93	19.76	25.47	38.31	28.56	11.42	27.35	14.68	4.00
2R1	10.56	3.85	20.19	11.54	20.82	12.48	15.70	24.78	32.19	21.04	9.14	22.50	11.72	4.00
2R2	11.58	6.95	20.22	12.13	20.93	12.53	15.37	24.70	28.55	20.65	11.32	22.23	12.43	4.00
2R3	12.16	7.01	20.02	12.27	18.47	12.21	16.19	24.21	28.86	19.84	10.23	20.54	12.53	4.00
2R4	11.45	7.14	18.72	10.87	19.61	10.01	14.73	24.65	16.55	25.10	11.18	22.72	12.43	4.00
2R5	9.30	5.77	20.31	11.69	21.63	11.42	15.45	26.95	28.02	20.85	10.48	21.43	12.52	4.00
2R6	9.16	4.15	19.78	11.55	21.23	12.16	16.64	26.26	14.65	27.69	8.33	23.77	13.14	4.00
2R7	9.81	4.09	18.59	11.37	19.92	10.26	14.31	23.75	14.70	26.54	10.81	22.60	12.45	4.00
2R8	11.09	2.29	19.79	11.53	19.56	11.54	16.29	23.33	30.50	22.24	10.09	21.18	13.18	4.00
2R9	11.64	7.55	19.96	11.73	21.88	11.95	16.81	24.71	28.53	20.26	9.14	21.97	11.86	4.00
2R10	10.04	4.82	21.98	13.33	21.16	11.78	17.48	24.41	32.40	19.85	10.15	23.14	12.12	4.00
2R11	9.85	1.59	18.48	12.67	17.92	11.72	17.74	23.10	31.54	17.96	8.01	20.03	11.72	4.00
2R12	9.34	4.33	19.84	10.87	19.58	12.33	16.42	24.84	33.45	18.45	10.22	21.04	14.09	4.00
2R13	10.11	4.72	20.10	12.33	18.36	9.95	15.69	23.60	34.17	19.47	9.72	20.58	13.05	4.00
2R14	8.81	5.54	19.16	11.72	18.18	10.10	15.68	25.76	30.61	16.35	9.90	20.18	11.64	4.00
2R15	9.13	4.42	20.14	9.94	18.78	10.99	15.36	26.12	33.79	17.47	7.90	20.61	11.01	4.00
2R16	9.04	5.90	21.05	10.45	20.47	11.70	16.98	24.91	34.44	21.29	9.61	21.71	11.87	4.00
2R17	8.43	4.38	19.60	10.41	18.83	10.11	15.02	26.45	35.58	14.19	7.44	14.97	10.70	4.00
2R18	8.67	4.10	20.12	12.63	18.64	11.07	17.93	28.13	36.04	17.41	10.62	15.13	13.23	4.00
3R 1	8.46	6.04	17.69	11.88	17.10	12.39	18.44	18.44	25.50	17.88	9.65	18.00	11.88	4.00
3R 2	9.56	6.78	18.92	12.12	18.09	13.13	16.18	16.18	26.71	13.45	11.15	18.57	13.43	4.00
3R 3	8.79	5.79	17.18	10.12	18.60	11.92	14.97	14.97	29.12	17.08	10.59	18.25	13.74	4.00
3R 4	8.87	5.85	20.73	11.42	16.59	11.64	15.79	15.79	26.37	16.12	10.98	19.21	14.20	4.00
3R 5	8.80	5.29	18.32	10.25	15.77	10.53	15.18	15.18	25.99	16.62	9.69	18.43	12.53	4.00
3R 6	9.03	5.72	17.84	11.02	16.18	11.08	15.24	15.24	29.04	16.70	8.78	15.69	11.75	4.00
3R 7	6.47	2.43	15.16	10.62	16.81	9.43	16.38	16.38	25.53	16.41	10.96	18.55	12.96	4.00
3R 8	7.93	5.62	16.80	10.30	15.24	10.35	14.86	14.86	27.01	16.76	9.48	16.49	12.73	4.00
3R 9	7.59	5.76	15.20	10.32	14.04	9.68	13.69	13.69	22.70	15.52	9.24	15.25	11.62	4.00
3R 10	8.63	6.24	17.74	11.72	15.84	11.07	15.06	15.06	24.21	17.40	11.25	19.73	14.81	4.00
3R 11	7.06	4.78	16.80	9.82	13.57	8.57	14.23	14.23	19.08	15.63	10.01	16.90	11.60	4.00
3R 12	8.20	5.60	20.64	11.56	16.04	11.13	16.46	16.46	23.32	15.70	9.70	18.36	13.11	4.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
3R 13	7.37	4.77	13.59	9.96	14.83	10.41	15.80	15.80	21.07	16.50	9.23	14.13	10.42	4.00
3R 14	8.96	5.72	18.11	11.28	17.16	10.41	15.74	15.74	24.03	15.92	8.57	16.80	10.01	4.00
3R 15	7.86	5.40	13.97	11.39	15.06	10.83	15.92	15.92	26.04	17.26	11.32	17.63	14.18	4.00
3R 16	6.94	5.74	16.41	11.31	14.91	11.65	15.64	15.64	20.91	17.46	9.35	14.36	11.24	4.00
3R 17	8.24	6.12	17.69	11.98	15.92	10.19	15.17	15.17	26.53	14.45	9.20	16.21	10.81	4.00
3R 18	10.43	7.12	20.80	12.84	18.34	12.97	18.61	18.61	29.61	15.87	10.67	16.44	11.94	4.00
3R 19	8.65	5.39	18.92	11.76	14.51	9.58	15.92	15.92	26.85	14.56	8.66	16.92	11.59	4.00
4R1	8.20	3.50	16.83	9.12	14.91	7.37	13.32	23.48	25.49	8.47	7.42	13.53	8.12	3.00
4R2	7.68	3.33	15.66	9.40	15.64	9.86	13.49	23.19	26.62	15.63	7.82	13.64	9.54	3.00
4R3	6.94	3.48	16.53	9.41	16.93	10.49	14.43	22.66	25.58	8.28	10.31	17.70	9.80	3.00
4R4	7.58	4.83	12.40	9.54	15.81	8.84	13.94	19.88	21.07	7.16	8.67	16.59	7.80	3.00
4R5	7.09	4.40	14.59	9.67	17.13	11.41	14.63	21.87	22.87	7.31	9.82	16.14	9.70	3.00
4R6	6.99	4.42	15.01	8.99	15.43	9.22	14.20	21.78	25.61	10.42	8.58	17.07	8.92	3.00
4R7	7.54	3.68	13.74	8.56	17.46	7.92	13.07	23.62	23.50	14.04	7.44	14.12	8.41	3.00
4R8	7.59	3.73	15.27	10.43	14.53	9.31	14.60	20.76	19.14	19.00	8.26	10.89	8.97	3.00
4R9	7.68	3.43	16.96	9.60	15.08	7.91	13.43	23.40	26.71	13.99	9.08	15.83	10.69	3.00
4R10	8.52	5.67	15.85	11.07	16.05	11.07	14.99	22.53	24.26	16.32	8.90	16.40	10.87	3.00
4R11	7.03	4.51	14.88	9.49	15.27	9.80	14.39	20.54	22.92	16.08	7.18	16.45	10.51	3.00
4R12	7.71	3.42	14.17	8.69	16.31	9.13	13.94	20.75	25.94	13.04	8.04	13.69	9.20	3.00
4R13	7.46	4.38	14.99	10.77	18.24	9.70	14.30	21.47	25.29	11.14	9.46	14.61	10.24	3.00
4R14	7.53	4.48	14.57	9.19	15.85	10.99	14.98	20.12	24.68	16.94	7.29	16.35	10.23	3.00
4R15	6.70	3.46	15.55	10.26	15.62	8.33	15.19	20.25	24.67	18.05	5.63	15.51	7.81	3.00
4R16	8.08	4.91	15.60	10.52	13.92	7.82	15.13	21.76	29.12	14.45	9.02	12.82	7.64	3.00
4R17	7.54	3.77	14.99	8.89	16.02	8.68	13.97	21.68	25.95	12.04	7.14	16.75	9.38	3.00
4R18	6.57	4.59	14.23	11.22	12.94	7.21	14.67	19.28	24.01	17.41	9.59	16.12	7.93	3.00
4R19	7.98	4.64	15.80	9.73	15.95	8.38	13.70	21.69	25.24	14.27	5.92	13.53	9.26	3.00
4R20	6.71	3.59	12.33	7.56	15.55	9.30	13.79	18.77	21.99	12.60	6.78	16.11	8.33	3.00
4R21	6.07	4.27	14.70	10.31	14.70	8.27	14.33	19.41	24.76	18.24	7.28	16.98	8.70	3.00
4R22	7.19	3.78	14.64	11.00	14.69	8.38	14.66	20.19	26.18	12.72	9.03	15.03	7.93	3.00
4R23	8.39	4.01	16.30	8.24	16.15	8.87	13.02	22.64	25.39	14.10	8.23	16.15	8.75	3.00
5R1	7.43	3.12	12.62	8.04	13.80	7.33	11.53	17.73	21.99	13.48	9.10	16.04	7.49	3.00
5R2	6.66	3.54	13.03	7.55	13.98	8.59	11.86	17.95	23.12	14.16	7.90	15.02	6.85	3.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
5R3	5.47	3.07	12.44	6.64	12.24	7.26	11.30	20.39	19.95	10.40	6.26	10.18	6.73	3.00
5R4	5.95	3.11	12.02	7.77	11.62	6.47	11.92	16.81	20.42	12.81	7.07	12.70	5.68	3.00
5R5	7.31	4.06	11.37	8.20	13.39	17.65	10.28	18.64	21.37	18.82	19.37	13.48	12.13	3.00
5R6	7.00	2.58	14.32	7.79	13.46	7.60	12.39	21.38	20.57	13.55	7.20	11.46	7.09	3.00
5R7	6.27	3.34	12.56	8.05	14.27	7.79	11.74	18.50	21.79	10.80	6.13	16.90	8.42	3.00
5R8	7.11	3.03	11.55	7.63	14.57	7.91	12.64	17.67	23.39	11.01	6.50	15.15	7.35	3.00
5R9	7.59	4.45	12.68	8.43	13.43	8.94	13.78	17.37	22.04	12.64	6.74	14.74	8.96	3.00
5R10	5.86	3.07	12.15	9.10	12.15	7.48	14.55	17.93	22.00	13.96	6.76	13.92	6.28	3.00
5R11	6.74	4.22	12.34	8.55	13.42	8.26	13.65	18.06	22.33	11.22	6.99	15.01	8.13	3.00
5R12	6.28	3.01	12.17	8.21	14.42	8.18	14.10	18.19	16.50	17.32	6.19	17.31	7.74	3.00
5R13	6.50	3.10	12.91	7.83	11.71	6.82	12.39	15.17	18.51	17.30	6.28	14.33	8.19	3.00
5R14	6.78	2.93	14.05	8.54	14.74	7.96	13.40	19.94	16.45	18.07	6.31	13.88	8.47	3.00
5R15	6.09	3.13	10.75	6.88	15.00	8.23	12.61	18.82	15.91	15.18	7.19	16.32	7.63	3.00
5R16	6.45	3.04	13.20	7.45	14.56	7.26	11.78	18.51	22.90	15.93	7.07	13.08	7.11	3.00
5R17	6.59	3.58	12.96	7.89	15.71	8.71	13.22	20.34	14.75	17.08	6.52	14.76	8.01	3.00
5R18	5.60	3.82	12.02	8.24	13.35	8.57	13.66	18.98	16.80	15.98	7.08	14.74	8.76	3.00
6R1	4.41	1.60	11.23	5.99	11.75	5.07	10.07	17.91	12.93	13.24	4.16	11.57	3.63	3.00
6R2	3.83	1.31	10.28	5.40	9.14	3.85	8.22	14.77	11.76	13.55	3.76	10.12	3.57	3.00
6R3	6.07	3.27	14.37	8.40	11.56	6.92	11.82	13.25	18.04	14.37	6.33	13.74	8.12	3.00
6R4	4.50	2.46	9.97	6.94	7.73	5.87	11.42	12.31	13.91	13.15	5.85	11.56	5.22	3.00
6R5	5.30	3.41	12.92	7.75	13.50	7.96	11.78	18.79	9.25	9.48	6.38	23.40	6.11	3.00
6R6	3.33	3.37	10.95	7.69	12.32	6.09	10.16	17.27	17.83	14.18	6.89	12.56	5.40	3.00
6R7	4.38	2.34	10.57	7.29	11.93	6.83	11.28	17.74	12.46	14.92	6.38	12.40	6.15	3.00
6R8	4.01	1.58	10.41	6.45	11.82	5.29	10.67	16.34	14.81	13.73	5.88	10.72	3.87	3.00
6R9	3.68	1.95	10.57	6.78	7.83	5.47	10.72	15.20	13.61	13.41	6.21	9.38	5.60	3.00
6R10	4.51	2.05	11.01	6.21	8.47	6.84	11.58	14.19	14.41	12.22	5.02	10.86	6.28	3.00
6R11	3.82	1.37	11.53	6.85	7.84	3.27	9.04	15.50	13.48	13.39	5.57	9.51	5.26	3.00
6R12	4.41	2.06	11.52	6.50	10.96	6.91	10.41	16.88	17.40	12.13	5.26	7.17	5.91	3.00
6R13	4.64	2.83	10.20	8.51	10.30	6.98	13.32	16.34	20.30	12.79	6.52	9.20	6.13	3.00
6R14	2.71	0.97	9.08	5.37	9.06	4.42	8.98	14.85	15.05	13.30	4.60	11.29	5.21	3.00
6R15	4.69	2.96	10.39	6.32	9.51	5.53	10.21	17.36	15.01	10.08	4.88	9.75	6.61	3.00
6R16	5.32	2.70	11.13	7.64	13.10	5.85	11.34	18.82	16.31	14.73	6.01	10.66	7.26	3.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
6R17	4.11	1.37	11.62	4.27	9.72	3.81	5.57	17.04	10.12	6.66	5.61	21.12	11.54	3.00
6R18	3.62	2.68	12.59	7.05	11.69	7.19	11.65	19.72	14.18	13.19	7.61	14.13	6.75	3.00
6R19	3.15	2.39	9.28	6.25	10.21	5.87	10.09	13.86	14.89	14.64	5.80	12.28	5.76	3.00
6R20	4.59	2.69	11.15	7.38	12.14	6.49	12.21	19.78	23.54	7.78	5.63	7.05	6.01	3.00
6R21	2.93	1.83	11.11	6.13	12.55	6.65	11.49	18.01	9.70	8.58	6.54	25.12	5.28	3.00
6R22	4.70	3.04	11.06	7.16	13.29	8.43	12.94	16.53	14.98	16.12	6.68	12.03	6.78	3.00
6R23	3.44	2.91	12.25	8.63	11.84	7.23	13.35	16.71	11.05	10.20	10.29	20.74	5.92	3.00
6R24	2.19	1.73	11.30	6.24	12.04	6.51	12.17	18.83	11.15	12.52	4.12	14.16	5.33	3.00
6R25	3.65	2.14	12.33	6.21	13.02	6.54	10.67	19.53	13.59	12.27	4.16	12.77	5.71	3.00
6R26	4.24	2.77	10.83	6.49	12.06	7.87	11.96	18.48	15.72	12.29	5.65	13.93	5.82	3.00
6R27	2.25	3.52	8.57	6.87	13.38	7.50	10.94	13.82	19.87	16.34	6.20	11.73	6.29	3.00
7R1	3.65	4.06	10.76	6.08	9.24	6.66	10.64	10.64	13.49	11.82	5.66	11.42	7.14	2.00
7R2	2.75	1.57	10.44	4.86	10.11	7.84	10.83	10.83	14.47	9.89	5.23	10.79	7.10	2.00
7R3	3.14	1.51	8.09	4.45	9.20	5.92	8.68	8.68	12.75	10.82	5.47	10.46	7.05	2.00
7R4	3.03	1.48	8.92	4.15	10.00	7.01	9.34	9.34	16.28	11.10	6.68	10.34	6.87	2.00
7R5	3.07	1.45	10.38	6.70	9.35	6.51	11.12	11.12	15.01	9.78	5.55	8.72	5.50	2.00
7R6	3.88	2.38	11.39	7.67	8.36	4.86	11.18	11.18	16.27	10.43	4.81	8.23	5.62	2.00
7R7	3.83	2.33	12.34	6.36	8.75	5.96	10.81	10.81	16.01	10.06	5.16	8.01	5.87	2.00
7R8	2.93	1.20	10.46	5.01	9.97	5.47	9.21	9.21	13.65	10.61	4.93	9.78	5.20	2.00
7R9	2.22	1.01	9.05	5.98	10.42	6.61	10.47	10.47	14.89	10.18	4.85	10.15	6.35	2.00
7R10	3.04	1.77	9.57	6.54	9.53	6.68	12.06	12.06	16.91	10.31	6.43	9.63	5.93	2.00
7R11	4.00	2.48	11.14	7.76	12.45	8.12	13.04	13.04	16.99	10.55	6.57	10.58	7.46	2.00
7R12	3.35	1.72	9.25	5.59	9.62	5.92	9.86	9.86	14.43	9.55	4.56	7.71	4.94	2.00
7R13	1.68	0.77	9.49	7.38	9.16	5.07	11.65	11.65	13.36	8.53	4.27	10.22	5.40	2.00
7R14	3.51	1.85	8.91	5.74	9.07	5.79	9.93	9.93	14.19	10.20	5.01	9.69	4.62	2.00
7R15	2.95	1.54	8.99	6.04	8.53	5.73	9.66	9.66	14.09	9.62	5.53	8.62	5.34	2.00
7R16	2.80	1.40	10.01	5.86	9.19	6.02	9.61	9.61	14.63	10.86	5.79	11.16	6.75	2.00
7R17	2.72	1.46	9.40	4.09	9.17	5.53	8.29	8.29	12.36	10.57	5.14	11.24	6.30	2.00
7R18	2.41	0.99	9.92	5.65	9.75	5.94	10.80	10.80	15.00	9.61	3.95	9.30	5.56	2.00
7R19	2.10	1.38	8.32	5.65	8.67	5.76	9.62	9.62	12.37	8.19	4.34	8.83	4.00	2.00
7R20	1.47	0.62	9.10	3.61	8.91	5.66	7.37	7.37	12.87	9.21	6.20	9.74	4.10	2.00
7R21	4.07	2.23	11.48	7.11	8.90	5.80	10.11	10.11	14.21	9.04	4.69	7.76	4.81	2.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
8R1	2.65	1.31	9.74	5.72	7.30	4.20	8.84	8.84	14.68	9.39	4.58	8.38	4.97	0.00
8R2	1.46	0.53	6.69	4.02	8.33	6.37	9.18	9.18	12.87	8.45	4.36	9.09	5.84	0.00
8R3	2.03	1.21	8.89	7.36	7.74	5.01	11.15	11.15	12.97	9.22	4.01	7.55	4.63	0.00
8R4	2.80	1.59	8.97	6.06	8.32	5.99	9.70	9.70	13.38	9.24	4.58	8.97	5.81	0.00
8R5	1.84	1.02	8.18	6.96	11.01	6.06	11.34	11.34	17.05	9.88	4.78	9.39	4.43	0.00
8R6	3.31	1.80	9.37	4.93	8.31	6.07	9.58	9.58	15.21	9.32	3.95	8.71	4.43	0.00
8R7	3.68	1.78	11.54	6.90	9.50	5.33	10.36	10.36	15.20	9.37	3.73	9.22	4.69	0.00
8R8	2.89	1.15	8.01	5.24	7.25	5.08	8.56	8.56	13.73	8.67	3.87	7.43	3.87	0.00
8R9	2.71	1.25	9.85	6.83	9.57	6.32	11.65	11.65	14.31	8.92	4.63	10.36	6.00	0.00
8R10	3.59	1.94	10.67	6.32	8.63	5.79	10.23	10.23	13.38	9.65	4.65	9.63	6.42	0.00
8R11	2.15	0.85	7.98	5.16	7.76	4.98	8.22	8.22	11.93	9.01	3.86	8.70	5.54	0.00
8R12	2.46	1.23	9.97	5.84	8.72	5.95	9.81	9.81	13.09	10.01	5.00	9.76	6.30	0.00
8R13	1.17	0.46	5.98	4.08	8.97	6.69	10.06	10.06	12.94	7.04	3.27	7.21	4.22	0.00
8R14	1.74	0.50	5.85	3.49	9.41	6.93	9.54	9.54	11.91	8.29	2.95	9.73	5.32	0.00
8R15	2.77	0.77	8.90	4.75	8.46	5.12	8.58	8.58	11.42	9.85	3.80	10.12	5.21	0.00
8R16	1.61	0.32	6.12	5.42	8.52	5.60	8.14	8.14	9.94	9.35	3.81	8.52	3.91	0.00
8R17	2.05	0.71	7.51	4.34	9.22	6.51	9.38	9.38	10.84	8.38	4.57	10.20	6.60	0.00
8R18	2.01	0.90	7.83	5.39	8.28	5.84	8.93	8.93	11.50	9.64	5.15	8.89	5.71	0.00
8R19	2.16	1.29	6.70	5.01	6.38	4.36	7.07	7.07	12.23	6.43	4.03	6.41	4.09	0.00
8R20	2.67	1.44	7.22	5.63	8.01	6.10	9.56	9.56	11.60	8.45	5.17	8.57	5.78	0.00
8R21	1.49	0.41	5.75	4.20	7.41	4.98	8.68	8.68	11.67	6.03	4.01	7.69	3.55	0.00
9R1	2.67	1.44	7.62	5.41	7.33	4.83	8.83	8.83	11.05	8.51	4.10	6.97	3.76	0.00
9R2	1.49	0.41	8.18	5.52	7.94	5.05	9.18	9.18	11.84	7.22	4.09	7.62	4.62	0.00
9R3	1.84	0.20	5.54	3.89	7.42	5.01	7.48	7.48	10.39	8.62	5.55	7.62	4.49	0.00
9R4	2.23	1.05	6.97	4.90	8.21	5.77	9.58	9.58	12.24	7.88	3.88	9.68	4.39	0.00
9R5	1.70	0.24	9.73	4.81	9.00	5.02	7.39	7.39	14.15	8.86	3.71	10.40	5.75	0.00
9R6	1.15	0.70	7.04	4.88	6.93	5.37	7.65	7.65	12.83	7.02	4.36	6.19	3.86	0.00
9R7	2.96	1.58	7.16	4.65	8.69	5.91	8.05	8.05	11.14	9.32	3.67	9.53	4.51	0.00
9R8	2.28	1.04	8.90	4.83	8.99	5.90	7.37	7.37	13.32	9.75	4.89	8.08	5.93	0.00
9R9	1.90	0.64	6.95	5.23	5.77	3.67	6.79	6.79	11.54	7.85	4.59	6.94	3.75	0.00
9R10	2.20	1.02	7.65	3.90	8.03	6.04	9.73	9.73	10.45	6.34	3.91	9.00	5.68	0.00
9R11	1.53	0.85	7.80	5.90	8.92	5.61	9.99	9.99	12.65	8.88	4.58	8.22	4.60	0.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
9R12	1.32	0.10	7.51	4.21	8.79	5.88	8.41	8.41	11.25	9.32	4.94	9.26	5.50	0.00
9R13	3.14	1.40	5.12	381.80	6.70	381.80	0.00	8.49	11.77	8.42	0.00	7.51	0.00	0.00
9R14	2.37	1.33	5.89	381.65	8.64	381.65	0.00	11.85	15.09	7.83	0.00	6.00	0.00	0.00
9R15	2.20	1.02	7.13	386.04	8.45	386.04	0.00	12.44	13.86	9.13	0.00	8.05	0.00	0.00
9R16	1.32	0.10	7.59	385.20	8.54	385.20	0.00	12.72	11.85	10.69	0.00	6.52	0.00	0.00
LPM1	15.53	8.60	25.00	17.34	25.92	14.61	23.20	32.02	39.29	25.21	13.71	26.08	15.60	4.00
LPM2	14.98	7.44	26.41	15.26	26.45	15.48	22.07	31.75	35.83	27.74	12.58	26.15	14.12	4.00
LPM3	14.07	7.23	21.99	14.03	25.85	14.63	21.08	28.22	34.79	27.15	14.02	26.45	14.51	4.00
LPM4	13.64	7.66	21.20	14.08	58.54	13.82	20.15	27.93	38.30	25.71	13.74	27.39	13.58	4.00
LPM5	13.64	7.66	21.21	14.93	25.64	14.08	22.38	30.69	36.64	27.27	13.77	25.97	12.26	4.00
LPM6	13.39	7.57	23.27	14.60	24.10	14.25	21.09	29.75	38.35	25.69	13.36	26.39	15.45	4.00
LPM7	12.31	7.59	26.86	16.01	330.20	13.13	20.85	27.28	39.78	26.55	14.04	27.74	17.30	4.00
LPM8	11.37	6.81	19.56	14.82	23.99	15.13	20.51	28.13	35.82	23.31	13.91	28.80	13.99	4.00
LPM9	10.88	7.13	14.16	10.66	23.65	14.26	17.48	23.07	36.72	22.56	15.55	26.60	16.34	4.00
LPM10	13.21	6.01	22.71	15.36	26.63	12.29	19.19	29.19	35.93	29.45	14.72	27.34	11.27	4.00
LPM11	12.08	5.32	20.01	12.84	26.47	15.23	20.16	30.84	39.98	24.00	9.30	28.39	9.98	4.00
LPM12	13.25	7.37	22.53	13.97	23.71	13.18	20.73	27.73	39.27	28.59	15.17	29.12	13.44	4.00
LPM13	12.49	6.34	20.54	13.53	22.44	12.85	18.94	24.75	42.19	23.99	13.86	26.19	12.22	4.00
2L1	10.96	3.81	19.91	10.48	19.76	10.86	16.44	24.23	30.69	25.10	10.62	21.50	11.08	4.00
2L2	10.14	6.56	19.83	14.00	23.03	12.10	19.93	26.81	37.22	15.67	13.25	22.70	10.44	4.00
2L3	11.24	5.69	20.59	12.53	20.62	10.94	17.21	25.35	32.35	18.73	11.88	21.36	9.88	4.00
2L4	10.39	5.55	21.84	12.57	25.04	13.47	19.32	31.20	31.65	22.76	10.47	24.87	11.74	4.00
2L5	11.87	6.22	21.02	11.75	18.90	11.01	17.09	25.84	32.93	18.02	11.17	19.13	11.00	4.00
2L6	14.07	6.60	21.47	13.26	20.98	13.06	19.62	26.70	34.67	22.15	13.42	23.14	10.83	4.00
2L7	10.93	5.46	20.08	10.21	18.11	11.14	15.47	25.99	31.72	22.08	11.11	19.65	10.28	4.00
2L8	12.01	6.01	20.57	12.09	20.78	10.86	17.22	25.90	32.46	19.12	10.72	19.75	11.04	4.00
2L9	8.56	3.84	18.96	8.59	20.29	9.46	13.17	26.15	28.64	20.39	10.54	21.16	9.14	4.00
2L10	11.22	2.16	20.38	11.18	19.29	10.99	15.72	24.95	27.79	20.28	12.59	21.13	12.20	4.00
2L11	9.57	5.50	21.95	12.36	23.81	10.08	16.07	29.77	30.73	21.82	11.30	19.43	9.46	4.00
2L12	9.85	6.28	17.79	9.08	19.79	10.56	14.48	23.82	34.42	15.88	11.55	21.33	10.60	4.00
2L13	10.45	5.68	18.38	10.26	18.85	11.31	16.89	26.21	22.06	23.40	7.88	19.11	9.59	4.00
2L14	10.79	5.90	20.39	13.23	21.00	10.33	16.86	25.94	32.96	16.85	11.69	18.82	9.71	4.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
2L15	9.75	4.65	17.78	10.43	17.66	10.25	16.29	25.36	33.62	14.37	11.75	18.14	9.20	4.00
2L16	8.84	3.90	17.97	9.41	18.51	10.82	15.90	24.70	30.22	20.96	10.13	18.38	8.80	4.00
2L17	11.40	5.91	17.62	11.54	18.95	10.57	16.17	23.38	33.91	16.93	10.87	18.00	8.89	4.00
2L18	9.80	5.10	17.47	9.90	20.64	10.85	15.10	26.41	31.49	20.50	10.71	19.62	8.79	4.00
2L19	11.37	4.16	19.54	10.32	21.04	10.34	15.95	27.82	35.42	21.19	10.81	18.27	10.90	4.00
2L20	10.20	5.75	19.19	11.31	21.80	10.28	16.28	31.15	38.12	5.87	11.93	16.74	10.18	4.00
2L21	8.10	3.55	18.09	8.85	18.16	8.51	13.78	23.43	27.08	19.66	7.40	18.98	7.15	4.00
3L1	9.28	3.75	17.84	9.03	17.16	9.74	13.85	23.93	28.91	16.78	9.00	17.68	8.85	3.00
3L2	7.44	3.59	16.34	8.64	17.72	8.21	13.08	22.80	30.24	17.25	9.21	16.19	8.42	3.00
3L3	9.16	4.75	18.15	10.20	21.48	11.58	17.22	27.01	28.57	18.29	8.70	19.47	8.90	3.00
3L4	8.60	3.51	19.02	10.46	18.38	8.49	13.39	24.72	28.76	18.46	10.16	17.27	8.14	3.00
3L5	5.81	4.00	14.53	10.23	18.52	8.79	14.28	22.26	24.73	20.02	9.61	17.81	6.37	3.00
3L6	9.51	5.59	17.43	10.46	19.29	11.28	15.56	23.32	27.96	17.60	9.39	20.88	8.76	3.00
3L7	7.84	3.75	15.39	8.12	17.29	7.82	12.90	22.36	30.48	8.15	9.79	16.86	8.08	3.00
3L8	7.66	4.14	13.24	9.04	15.60	9.39	15.55	21.92	28.52	16.65	7.49	16.05	8.03	3.00
3L9	6.67	3.14	17.37	9.68	16.68	8.77	14.41	23.83	31.58	9.17	8.47	15.88	7.98	3.00
4L1	3.22	1.73	16.12	7.10	16.24	5.89	11.49	23.94	14.53	12.80	6.11	17.94	6.43	3.00
4L2	6.75	3.26	16.87	9.11	17.36	8.26	13.64	23.36	29.13	10.56	8.04	15.14	7.16	3.00
4L3	7.78	3.27	17.20	8.48	19.05	8.84	13.96	26.05	28.78	14.34	8.60	16.63	7.53	3.00
4L4	9.35	4.02	17.03	8.71	16.43	8.40	14.48	23.14	30.62	15.06	7.17	17.00	6.74	3.00
4L5	5.88	3.33	16.34	9.20	15.69	8.75	14.62	24.27	31.39	11.43	8.02	16.07	7.11	3.00
4L6	8.54	4.41	16.23	10.12	16.84	9.16	14.79	22.88	31.99	7.97	9.82	17.03	6.83	3.00
4L7	7.00	0.99	15.08	8.22	17.34	8.46	13.05	22.69	14.54	12.78	7.89	18.36	8.21	3.00
4L8	7.04	3.79	16.47	8.96	18.96	9.51	12.80	23.86	26.87	15.34	9.03	17.74	9.97	3.00
4L9	7.08	2.69	15.82	8.79	19.36	7.30	14.09	27.05	25.67	13.06	7.06	16.69	7.48	3.00
4L10	8.08	2.63	16.83	8.48	15.30	7.86	12.51	22.59	27.78	11.44	7.84	14.50	6.66	3.00
4L11	7.36	3.84	15.64	8.18	16.36	8.76	12.77	19.33	26.10	16.02	9.03	16.46	8.08	3.00
4L12	7.29	3.41	17.48	9.12	16.70	8.18	13.19	23.31	33.07	7.53	9.27	19.26	7.24	3.00
4L13	8.50	3.94	17.17	9.20	17.07	8.14	13.52	21.32	33.48	9.76	9.72	17.53	7.74	3.00
4L14	6.81	3.43	16.35	10.51	18.23	8.22	13.15	24.54	26.69	11.07	9.51	14.36	8.85	3.00
4L15	7.60	2.41	16.95	6.44	16.00	9.34	12.75	22.56	22.86	18.00	8.38	15.03	7.96	3.00
4L16	8.13	3.90	14.97	8.57	16.39	10.11	14.72	20.97	13.58	17.99	7.03	18.79	8.29	3.00



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges	
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Crown	Tooth	Crown	Tooth		Crown
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
4L17	6.71	4.02	15.53	9.92	16.34	7.90	14.07	22.28	30.66	10.47	9.38	12.29	8.53	3.00	
4L18	3.31	2.36	15.80	7.89	16.03	8.11	12.82	21.42	26.57	16.85	15.54	6.83	6.25	3.00	
4L19	5.91	3.99	14.53	8.58	18.28	9.10	12.56	20.86	14.91	26.29	8.54	17.07	7.13	3.00	
4L20	7.78	4.30	16.76	10.32	16.51	9.60	15.47	24.21	26.91	18.35	9.74	17.52	8.60	3.00	
5L1	5.37	2.43	16.41	8.38	12.29	7.72	12.85	22.10	23.05	14.97	6.93	15.02	7.96	3.00	
5L2	6.29	2.98	14.25	8.35	15.26	8.29	12.36	20.10	22.48	5.98	7.21	18.61	7.22	3.00	
5L3	7.68	3.55	16.44	9.53	14.44	7.90	12.77	19.98	26.55	9.22	6.87	14.58	6.90	3.00	
5L4	8.00	2.39	14.17	6.52	12.78	7.44	11.39	19.36	23.72	14.41	4.14	13.91	5.10	3.00	
5L5	7.75	2.71	15.87	7.85	13.68	7.77	11.60	20.04	22.83	11.48	7.51	14.61	6.02	3.00	
5L6	9.11	2.67	15.40	8.32	14.08	7.54	12.23	20.07	15.67	11.21	6.85	5.63	5.57	3.00	
5L7	5.52	2.99	14.45	7.84	16.07	7.97	13.09	22.00	20.76	16.27	7.32	14.80	6.30	3.00	
5L8	7.27	3.22	15.99	8.62	14.35	8.91	13.29	21.84	21.46	14.34	7.50	12.24	7.43	3.00	
5L9	4.51	2.46	17.53	9.39	13.99	6.45	12.39	21.60	16.72	13.09	6.19	17.27	6.95	3.00	
5L10	5.82	2.77	13.98	7.35	12.02	7.25	11.47	17.97	20.50	14.11	7.59	14.41	6.89	3.00	
5L11	6.75	2.21	15.01	7.36	14.38	9.29	11.96	20.15	17.54	16.40	6.86	11.15	5.80	3.00	
5L12	7.25	2.36	16.89	7.76	14.61	8.10	12.75	22.69	21.48	16.65	6.05	12.41	6.16	3.00	
5L13	7.72	3.49	15.39	7.71	12.20	9.02	12.93	18.45	23.38	12.29	8.33	14.95	6.22	3.00	
5L14	5.00	1.85	14.97	7.74	12.49	6.44	11.85	20.79	22.69	5.36	6.51	16.18	5.96	3.00	
5L15	6.63	2.66	15.31	7.69	14.79	8.95	13.33	21.98	19.82	6.16	6.41	16.76	8.14	3.00	
5L16	5.67	3.20	11.84	7.04	11.40	8.70	12.86	16.31	27.56	9.86	7.81	12.94	7.97	3.00	
5L17	7.49	2.80	16.24	7.30	14.78	7.89	11.91	20.46	23.09	16.42	6.00	13.30	7.03	3.00	
5L18	4.78	2.20	13.77	7.62	12.79	6.82	11.57	19.44	20.92	4.84	5.40	14.00	6.24	3.00	
5L19	3.60	2.17	13.25	7.59	12.03	6.10	10.65	17.58	21.04	12.27	6.46	10.26	6.37	3.00	
6L1	3.75	1.73	12.21	6.98	11.38	6.67	11.27	16.60	24.28	5.63	5.99	11.36	5.36	2.00	
6L2	5.30	1.68	13.44	6.35	11.54	4.63	9.67	19.21	20.59	11.62	4.94	8.64	5.49	2.00	
6L3	4.03	0.59	11.91	4.79	10.19	5.06	8.89	17.24	18.24	11.62	4.31	10.53	4.25	2.00	
6L4	5.69	1.89	12.01	7.05	11.44	6.41	10.55	16.45	20.20	12.31	6.21	10.69	5.56	2.00	
6L5	5.89	1.73	14.88	8.23	13.03	8.03	12.88	21.72	18.33	8.83	7.11	14.54	5.55	2.00	
6L6	4.45	3.81	14.73	11.78	9.79	6.74	8.20	17.89	6.96	10.00	17.17	12.52	10.41	2.00	
6L7	5.45	1.92	14.45	7.65	10.90	5.32	9.95	18.15	18.73	11.21	5.96	12.74	5.53	2.00	
6L8	4.51	1.48	13.32	6.05	13.38	6.73	10.12	19.61	18.48	10.61	6.46	12.78	5.83	2.00	
6L9	5.40	1.57	13.07	5.23	12.09	6.23	10.28	18.93	16.86	9.30	6.70	13.03	5.92	2.00	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
6L10	5.76	2.43	11.71	6.76	10.80	7.36	10.90	17.51	19.28	12.34	6.71	10.17	7.68	2.00
6L11	6.54	3.56	13.01	9.86	14.67	5.91	8.50	19.39	9.34	22.06	13.55	10.23	10.81	2.00
6L12	3.49	1.60	12.33	6.23	13.57	6.96	10.41	19.56	19.84	12.59	4.96	10.50	6.15	2.00
6L13	3.33	0.87	10.23	5.48	10.95	6.76	10.27	16.66	15.35	12.42	6.98	12.52	6.78	2.00
6L14	3.48	0.69	12.20	6.77	11.22	5.92	9.39	16.78	15.80	12.42	6.51	10.85	5.71	2.00
6L15	5.25	2.15	12.78	6.67	11.20	5.90	10.96	17.39	17.31	11.64	5.06	11.27	5.62	2.00
6L16	4.21	1.69	14.26	7.56	12.84	7.26	11.19	18.66	19.86	13.05	6.41	13.38	6.68	2.00
6L17	4.42	1.60	11.28	4.33	11.51	5.78	8.27	18.08	15.60	11.49	5.14	10.08	5.61	2.00
6L18	3.99	1.50	12.40	6.61	8.24	5.95	10.44	16.02	15.63	11.34	6.77	11.74	5.95	2.00
7L1	4.73	3.51	12.14	6.87	8.94	6.87	10.23	16.53	20.60	7.75	6.29	6.28	5.95	1.00
7L2	5.81	4.00	13.86	6.90	11.43	5.52	10.37	19.18	17.54	13.25	7.54	13.18	6.63	1.00
7L3	9.51	5.59	12.43	9.07	10.15	13.91	10.22	17.04	17.03	11.99	6.76	11.33	6.16	1.00
7L4	7.84	3.75	10.88	6.65	9.78	6.30	10.22	16.63	17.50	12.07	6.11	11.01	5.86	1.00
7L5	7.66	4.14	12.05	6.18	11.10	6.65	9.91	15.94	15.15	12.78	6.34	12.84	5.68	1.00
7L6	6.67	3.14	13.22	7.84	10.83	7.27	11.04	15.79	21.89	8.87	7.22	4.74	6.45	1.00
7L7	3.22	1.73	14.21	7.33	10.02	5.05	10.18	17.61	24.45	7.95	6.66	12.90	7.20	1.00
7L8	6.75	3.26	13.84	6.55	11.78	5.52	9.51	18.26	16.14	14.04	5.51	13.25	6.55	1.00
7L9	7.78	3.27	12.71	6.07	11.32	5.63	9.19	15.22	20.50	10.72	6.44	11.04	5.03	1.00
7L10	9.35	4.02	12.60	5.77	11.68	6.37	9.62	17.62	17.85	9.38	5.49	12.95	5.71	1.00
7L11	5.88	3.33	11.46	6.45	10.18	6.80	11.01	16.63	19.07	11.46	5.88	10.86	4.64	1.00
7L12	8.54	4.41	13.42	7.29	13.81	6.93	10.94	18.60	18.82	13.40	5.91	11.96	5.56	1.00
7L13	7.00	0.99	12.18	6.34	11.68	6.49	10.56	18.63	18.79	11.26	5.58	9.46	5.95	1.00
7L14	7.04	3.79	10.45	6.78	11.08	6.78	0.00	16.94	15.85	12.85	0.00	11.72	0.00	1.00
7L15	7.08	2.69	10.55	7.64	10.21	7.64	0.00	17.24	15.94	10.78	0.00	12.02	0.00	1.00
7L16	8.08	2.63	12.13	6.46	10.68	6.46	0.00	17.07	26.76	3.50	0.00	10.75	0.00	1.00
7L17	7.36	3.84	13.13	8.38	13.11	8.38	0.00	17.55	19.62	14.68	0.00	13.45	0.00	1.00
7L18	7.29	3.41	12.76	10.65	11.03	10.65	0.00	18.34	15.58	12.44	0.00	9.45	0.00	1.00
7L19	8.50	3.94	12.43	12.63	7.72	12.63	0.00	14.59	14.66	10.51	0.00	12.82	0.00	1.00
8L1	2.98	2.43	10.78	294.62	8.51	294.62	0.00	13.91	16.88	4.23	0.00	12.09	0.00	0.00
8L2	6.29	2.98	8.11	288.18	9.47	288.18	0.00	12.44	19.07	8.46	0.00	9.85	0.00	0.00
8L3	7.68	3.55	9.75	285.97	9.46	285.97	0.00	15.29	18.73	5.26	0.00	10.36	0.00	0.00
8L4	8.00	2.39	10.45	283.14	11.27	283.14	0.00	16.78	6.92	16.13	0.00	9.74	0.00	0.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
8L5	7.75	2.71	11.44	277.42	9.61	277.42	0.00	16.46	16.20	11.51	0.00	9.42	0.00	0.00
8L6	9.11	2.67	9.38	273.19	10.73	273.19	0.00	16.54	12.84	10.94	0.00	9.69	0.00	0.00
8L7	5.52	2.99	10.25	270.69	9.77	270.69	0.00	12.33	10.80	15.74	0.00	7.01	0.00	0.00
8L8	7.27	3.22	9.15	267.23	11.87	267.23	0.00	18.40	53.77	44.25	0.00	9.87	0.00	0.00
8L9	4.51	2.46	9.51	267.92	7.62	267.92	0.00	13.37	12.60	8.32	0.00	9.24	0.00	0.00
8L10	5.82	2.77	10.17	266.10	10.04	266.10	0.00	15.08	35.46	26.04	0.00	9.96	0.00	0.00
8L11	6.75	2.21	9.84	267.08	9.04	267.08	0.00	14.02	10.75	10.87	0.00	10.86	0.00	0.00
8L12	7.25	2.36	10.39	263.95	9.08	263.95	0.00	16.80	17.50	4.42	0.00	5.81	0.00	0.00
8L13	7.72	3.49	9.99	263.22	8.43	263.22	0.00	13.99	13.89	10.01	0.00	8.61	0.00	0.00
8L14	5.00	1.85	8.84	264.96	9.45	264.96	0.00	12.47	10.85	10.50	0.00	10.46	0.00	0.00
8L15	6.63	2.66	9.10	266.70	5.84	266.70	0.00	12.76	14.24	8.18	0.00	6.84	0.00	0.00
8L16	5.67	3.20	11.01	267.27	8.97	267.27	0.00	16.23	13.74	7.23	0.00	10.37	0.00	0.00
8L17	7.49	2.80	10.02	45.05	8.77	267.12	257.35	13.20	4.44	18.80	257.35	6.59	0.00	0.00
8L18	4.78	2.20	10.98	95.98	9.87	269.51	263.04	14.62	16.80	8.71	263.04	9.64	0.00	0.00
8L19	3.60	2.17	8.62	65.20	7.37	272.40	257.35	11.81	14.90	7.07	257.35	9.02	0.00	0.00
8L20	3.75	1.73	9.94	99.83	9.42	274.71	262.81	14.12	13.91	10.93	262.81	11.56	0.00	0.00
8L21	5.30	1.68	11.12	89.47	9.94	277.10	257.35	15.14	11.70	12.19	257.35	9.98	0.00	0.00
8L22	4.03	0.59	9.63	102.83	8.35	281.67	257.35	13.86	13.93	8.63	257.35	10.45	0.00	0.00
8L23	5.69	1.89	8.87	103.82	8.38	286.30	260.54	12.31	15.23	9.44	260.54	11.38	0.00	0.00
9L1	5.89	1.73	8.16	129.33	8.09	270.62	261.23	12.83	11.32	8.74	261.23	7.76	0.00	0.00
9L2	4.45	3.81	9.07	254.38	7.35	254.38	0.00	12.58	12.90	8.98	0.00	8.85	0.00	0.00
9L3	5.45	1.92	9.81	266.04	5.84	266.04	0.00	12.17	11.12	8.60	0.00	8.77	0.00	0.00
9L4	4.51	1.48	7.71	261.40	7.32	261.40	0.00	11.71	15.85	4.46	0.00	8.23	0.00	0.00
9L5	5.40	1.57	7.99	257.16	9.18	257.16	0.00	14.51	11.33	7.61	0.00	7.41	0.00	0.00
9L6	5.76	2.43	9.37	254.64	8.20	254.64	0.00	13.74	13.20	9.47	0.00	8.42	0.00	0.00
9L7	6.54	3.56	9.16	254.35	7.19	254.35	0.00	12.89	10.75	8.04	0.00	8.35	0.00	0.00
9L8	3.49	1.60	10.29	250.65	8.66	250.65	0.00	16.79	14.18	8.13	0.00	5.35	0.00	0.00
9L9	3.33	0.87	10.61	250.06	5.40	250.06	0.00	11.97	13.00	9.57	0.00	9.91	0.00	0.00
9L10	3.48	0.69	10.33	250.10	7.62	250.10	0.00	12.58	13.50	10.84	0.00	9.27	0.00	0.00
9L11	5.25	2.15	7.85	246.31	4.78	246.31	0.00	9.89	11.06	9.68	0.00	10.10	0.00	0.00
9L12	4.21	1.69	9.51	246.42	8.78	246.42	0.00	14.75	12.91	9.32	0.00	8.01	0.00	0.00
9L13	4.42	1.60	8.73	248.66	10.18	248.66	0.00	12.94	13.12	9.91	0.00	9.38	0.00	0.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
9L14	3.99	1.50	8.05	250.66	4.75	250.66	0.00	9.37	14.73	7.13	0.00	10.64	0.00	0.00
9L15	4.73	3.51	8.31	252.35	8.56	252.35	0.00	12.83	11.56	11.04	0.00	9.98	0.00	0.00
9L16	5.81	4.00	9.41	254.60	7.86	254.60	0.00	10.66	13.74	9.42	0.00	7.88	0.00	0.00
9L17	9.51	5.59	8.82	255.91	5.36	255.91	0.00	11.28	14.55	9.23	0.00	9.71	0.00	0.00
9L18	7.84	3.75	9.61	261.76	5.42	261.76	0.00	10.52	10.76	10.91	0.00	9.67	0.00	0.00
9L19	7.66	4.14	8.67	263.37	9.95	263.37	0.00	15.34	13.93	9.23	0.00	9.29	0.00	0.00

0, 200-300 values=missing data

SUMMARY SMU 69002 Upper dentition

Medial

N=12

Minimum	0.93	0.23	8.09	2.64	8.20	3.00	5.18	4.78	8.17	6.44	2.71	3.94	3.56	0.00
Maximum	3.56	1.87	10.79	4.54	11.11	4.31	7.25	17.67	17.31	18.32	4.94	17.01	4.80	0.00
Arithmetic Mean	1.94	0.933	9.51	3.74	9.98	3.65	6.12	12.37	14.17	11.56	3.70	9.43	4.03	0.00
Standard Deviation	0.953	0.641	0.79	0.62	0.76	0.43	0.71	3.59	2.95	3.36	0.70	4.17	0.34	

RPM

N=9

Minimum	1.04	0.37	20.38	12.44	13.73	9.71	18.57	25.47	30.05	20.96	10.18	16.31	11.59	4.00
Maximum	10.84	5.65	28.69	15.70	27.59	16.59	23.11	31.29	42.83	29.14	14.14	28.88	18.25	4.00
Arithmetic Mean	4.55	2.307	23.78	14.36	22.97	14.24	20.58	29.05	36.61	26.57	12.16	25.23	14.71	4.00
Standard Deviation	3.899	2.144	2.37	1.23	4.35	2.22	1.32	2.12	3.76	2.58	1.38	3.97	2.09	0.00

R2

N=18

Minimum	8.43	1.59	18.48	9.94	17.92	9.95	14.31	23.10	14.65	14.19	7.44	14.97	10.70	4.00
Maximum	12.16	7.55	21.98	13.33	21.88	12.53	17.93	28.13	36.04	27.69	11.32	23.77	14.09	4.00
Arithmetic Mean	10.009	4.922	19.89	11.61	19.78	11.35	16.10	25.04	29.14	20.37	9.68	20.91	12.32	4.00
Standard Deviation	1.15	1.617	0.84	0.88	1.28	0.91	1.03	1.34	6.82	3.44	1.14	2.38	0.84	0.00

R3

N=19

Minimum	6.47	2.43	13.59	9.82	13.57	8.57	13.69	13.69	19.08	13.45	8.57	14.13	10.01	4.00
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Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Maximum	10.43	7.12	20.80	12.84	18.60	13.13	18.61	18.61	29.61	17.88	11.32	19.73	14.81	4.00
Arithmetic Mean	8.307	5.587	17.50	11.14	16.03	10.89	15.75	15.75	25.24	16.17	9.92	17.15	12.35	4.00
Standard Deviation	0.961	0.953	2.07	0.84	1.42	1.20	1.20	1.20	2.86	1.13	0.93	1.58	1.34	0.00
Mean TH-CH	8.31	5.59	0.64											
R4														
N=23														
Minimum	6.07	3.33	12.33	7.57	12.94	7.21	13.02	18.77	19.14	7.16	5.63	10.89	7.64	3.00
Maximum	8.52	5.67	16.96	11.22	18.24	11.41	15.19	23.62	29.12	19.00	10.31	17.70	10.87	3.00
Arithmetic Mean	7.425	4.099	15.03	9.64	15.66	9.06	14.18	21.38	24.65	13.55	8.13	15.30	9.08	3.00
Standard Deviation	0.608	0.612	1.19	0.95	1.16	1.16	0.64	1.43	2.09	3.52	1.22	1.67	1.00	0.00
R5														
N=18														
Minimum	5.47	2.58	10.75	6.64	11.62	6.47	10.28	15.17	14.75	10.40	6.13	10.18	5.68	3.00
Maximum	7.59	4.45	14.32	9.10	15.71	17.65	14.55	21.38	23.39	18.82	19.37	17.31	12.13	3.00
Arithmetic Mean	6.538	3.344	12.51	7.93	13.66	8.39	12.60	18.47	20.04	14.43	7.59	14.39	7.83	3.00
Standard Deviation	0.61	0.5	0.87	0.59	1.15	2.41	1.12	1.44	2.81	2.66	3.03	1.80	1.38	0.00
R6														
N=27														
Minimum	2.19	0.97	8.57	4.27	7.73	3.27	5.57	12.31	9.25	6.66	3.76	7.05	3.57	3.00
Maximum	6.07	3.52	14.37	8.64	13.50	8.43	13.35	19.78	23.54	16.34	10.29	25.12	11.54	3.00
Arithmetic Mean	4.018	2.344	11.05	6.77	11.07	6.19	10.89	16.66	14.64	12.57	5.85	12.92	5.98	3.00
Standard Deviation	0.911	0.718	1.21	0.99	1.82	1.30	1.64	2.09	3.35	2.39	1.29	4.55	1.49	0.00
R7														
N=21														
Minimum	1.47	0.62	6.35	343.48	7.97	343.48	0.00	12.30	7.49	5.26	0.00	5.52	0.00	3.00
Maximum	4.07	4.06	12.53	371.83	12.79	371.83	0.00	18.70	17.15	11.99	0.00	20.52	0.00	3.00
Arithmetic Mean	2.981	1.676	9.29	354.81	9.82	354.81	0.00	14.82	13.68	9.59	0.00	11.62	0.00	3.00
Standard Deviation	0.724	0.743	1.37	8.47	1.06	8.47	0.00	1.88	2.74	2.07	0.00	4.19	0.00	0.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
R8														
N=21														
Minimum	1.17	0.32	4.60	362.02	6.92	362.02	0.00	9.14	7.88	6.64	0.00	7.81	0.00	0.00
Maximum	3.68	1.94	10.63	413.69	11.03	413.69	0.00	16.01	362.87	11.59	0.00	376.88	0.00	0.00
Arithmetic Mean	2.345	1.07	7.39	376.90	8.63	376.90	0.00	12.84	78.59	9.69	0.00	79.27	0.00	0.00
Standard Deviation	0.697	0.484	1.73	16.23	1.08	16.23	0.00	2.04	139.35	1.39	0.00	146.61	0.00	0.00
R9														
N=16														
Minimum	1.15	0.1	5.02	380.18	4.96	380.18	0.00	8.49	9.53	6.73	0.00	6.00	0.00	0.00
Maximum	3.14	1.58	8.58	393.94	10.19	393.94	0.00	13.96	15.09	11.79	0.00	11.39	0.00	0.00
Arithmetic Mean	2.019	0.82	6.91	384.76	8.10	384.76	0.00	11.58	12.36	9.09	0.00	8.52	0.00	0.00
Standard Deviation	0.593	0.498	1.18	3.98	1.17	3.98	0.00	1.59	1.50	1.42	0.00	1.33	0.00	0.00
LPM														
N=13														
Minimum	10.88	5.32	14.16	10.66	22.44	12.29	17.48	23.07	34.79	22.56	9.30	25.97	9.98	4.00
Maximum	15.53	8.6	26.86	17.34	330.20	15.48	23.20	32.02	42.19	29.45	15.55	29.12	17.30	4.00
Arithmetic Mean	13.142	7.133	21.96	14.42	51.05	14.07	20.60	28.56	37.91	25.94	13.67	27.12	13.85	4.00
Standard Deviation	1.323	0.844	3.28	1.61	84.40	0.98	1.52	2.60	2.15	2.10	1.52	1.10	2.07	0.00
L2														
N=21														
Minimum	8.1	2.16	17.47	8.59	17.66	8.51	13.17	23.38	22.06	5.87	7.40	16.74	7.15	4.00
Maximum	14.07	6.6	21.95	14.00	25.04	13.47	19.93	31.20	38.12	25.10	13.42	24.87	12.20	4.00
Arithmetic Mean	10.548	5.156	19.56	11.11	20.33	10.85	16.43	26.24	31.91	19.13	11.04	20.06	10.04	4.00
Standard Deviation	1.319	1.173	1.44	1.55	1.92	1.07	1.71	2.19	3.58	4.11	1.43	1.97	1.17	0.00
L3														
N=9														
Minimum	5.81	3.14	13.24	8.12	15.60	7.82	12.90	21.92	24.73	8.15	7.50	15.88	6.37	3.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Maximum	9.51	5.59	19.02	10.46	21.48	11.58	17.22	27.01	31.58	20.02	10.16	20.88	8.90	3.00
Arithmetic Mean	7.997	4.024	16.59	9.54	18.01	9.34	14.47	23.57	28.86	15.82	9.09	17.57	8.17	3.00
Standard Deviation	1.257	0.74	1.88	0.86	1.70	1.32	1.41	1.58	1.94	4.19	0.80	1.67	0.77	0.00
L4														
N=20														
Minimum	3.22	0.99	14.53	6.44	15.30	5.89	11.49	19.33	13.58	7.53	6.11	6.83	6.25	3.00
Maximum	9.35	4.41	17.48	10.51	19.36	10.11	15.47	27.05	33.48	26.29	15.54	19.26	9.97	3.00
Arithmetic Mean	7.006	3.286	16.26	8.80	17.02	8.49	13.52	23.03	25.81	13.86	8.79	16.11	7.64	3.00
Standard Deviation	1.538	0.899	0.82	1.00	1.17	0.92	0.99	1.80	6.43	4.37	1.90	2.75	0.93	0.00
L5														
N=19														
Minimum	3.6	1.85	11.84	6.52	11.40	6.10	10.65	16.31	15.67	4.84	4.14	5.63	5.10	3.00
Maximum	9.11	3.55	17.53	9.53	16.07	9.30	13.33	22.69	27.56	16.65	8.33	18.61	8.14	3.00
Arithmetic Mean	6.432	2.69	15.11	7.89	13.60	7.82	12.28	20.15	21.64	11.86	6.73	13.84	6.64	3.00
Standard Deviation	1.427	0.464	1.39	0.74	1.31	0.93	0.74	1.71	2.95	3.97	0.95	2.86	0.85	0.00
L6														
N=18														
Minimum	3.33	0.59	10.23	4.33	8.24	4.63	8.20	16.02	6.96	5.63	4.31	8.64	4.25	2.00
Maximum	6.54	3.81	14.88	11.78	14.67	8.03	12.88	21.72	24.28	22.06	17.17	14.54	10.81	2.00
Arithmetic Mean	4.719	1.805	12.79	6.91	11.60	6.31	10.12	18.10	17.26	11.69	7.05	11.53	6.38	2.00
Standard Deviation	0.961	0.826	1.24	1.76	1.51	0.85	1.18	1.46	4.00	3.14	3.19	1.48	1.69	0.00
L7														
N=19														
Minimum	3.22	0.99	10.45	5.77	7.72	5.05	0.00	14.59	14.66	3.50	0.00	4.74	0.00	1.00
Maximum	9.51	5.59	14.21	12.63	13.81	13.91	11.04	19.18	26.76	14.68	7.54	13.45	7.20	1.00
Arithmetic Mean	7.163	3.444	12.45	7.47	10.87	7.47	7.00	17.13	18.62	11.04	4.30	11.16	4.07	1.00
Standard Deviation	1.516	0.99	1.07	1.71	1.36	2.39	4.91	1.21	3.19	2.67	3.05	2.34	2.90	0.00

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown	Posterior Tooth	Anterior Tooth	Labial Tooth	Labial Crown	Lingual Tooth	Lingual Crown	# of Ridges
			r tooth edge	r crown edge	r tooth edge	r crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
L8														
N=23														
Minimum	2.98	0.59	8.11	45.05	5.84	263.22	0.00	11.81	4.44	4.23	0.00	5.81	0.00	0.00
Maximum	9.11	3.55	11.44	294.62	11.87	294.62	263.04	18.40	53.77	44.25	263.04	12.09	0.00	0.00
Arithmetic Mean	6.026	2.478	9.88	216.08	9.19	273.76	78.95	14.43	16.31	12.08	78.95	9.51	0.00	0.00
Standard Deviation	1.63	0.669	0.87	89.10	1.28	8.93	122.05	1.79	9.96	8.54	122.05	1.61	0.00	0.00
L9														
N=19														
Minimum	3.33	0.69	7.71	129.33	4.75	246.31	0.00	9.37	10.75	4.46	0.00	5.35	0.00	0.00
Maximum	9.51	5.59	10.61	266.04	10.18	270.62	261.23	16.79	15.85	11.04	261.23	10.64	0.00	0.00
Arithmetic Mean	5.354	2.505	9.02	247.80	7.39	255.23	13.75	12.60	12.82	8.96	13.75	8.79	0.00	0.00
Standard Deviation	1.631	1.335	0.88	29.23	1.70	6.71	59.93	1.89	1.51	1.52	59.93	1.23	0.00	0.00

0, 200-300 values=missing data

Tooth Files	SMU 69001 <i>P. rugosus</i> Lower dentition													
M1	13.23	7.44	25.34	17.31	27.21	16.76	26.20	30.97	40.05	31.72	17.16	18.05	16.44	2.00
M2	16.52	8.89	28.18	16.74	27.69	18.10	26.33	35.67	34.58	27.38	14.36	29.75	15.79	2.00
M3	17.32	9.53	29.68	18.78	28.58	20.68	31.29	32.18	38.87	31.66	13.34	31.58	17.02	3.00
M4	13.82	6.51	26.91	17.24	26.73	14.40	24.90	29.56	32.45	33.83	14.97	33.17	14.28	3.00
M5	15.21	7.53	26.70	15.69	28.30	17.26	25.21	31.68	34.31	27.49	13.72	29.90	16.02	3.00
M6	15.34	7.43	27.61	16.31	30.45	20.37	28.08	34.09	39.73	27.17	15.88	30.01	18.41	3.00
M7	15.63	8.79	25.33	16.77	27.66	16.46	26.00	32.06	36.29	29.01	16.63	30.79	15.86	3.00
M8	13.76	7.23	24.55	15.55	25.13	17.07	25.49	28.21	32.79	33.94	15.35	30.81	17.17	3.00
M9	15.12	8.68	26.06	17.32	29.33	19.08	28.76	34.92	37.97	31.01	13.65	27.51	15.66	3.00
M10	14.20	7.70	25.64	19.91	28.40	19.36	31.55	29.90	33.07	33.61	18.56	33.22	18.86	3.00
RPM1	12.14	6.87	21.87	13.10	21.92	13.89	21.10	29.43	34.38	24.09	11.11	24.38	13.74	3.00
RPM2	10.98	6.41	19.65	14.33	20.28	13.45	21.11	24.85	35.87	27.48	10.73	22.02	13.91	3.00
RPM3	11.29	7.31	23.52	14.21	19.53	12.05	18.75	28.47	33.15	23.66	10.92	22.89	11.69	3.00
RPM4	11.68	7.00	22.26	13.20	21.23	12.71	19.10	27.84	36.13	22.88	11.61	24.04	12.15	3.00
RPM5	11.85	7.26	23.04	14.49	19.52	13.19	20.81	27.20	34.02	22.59	12.43	23.82	13.97	3.00
RPM6	11.04	6.81	21.29	14.69	22.21	12.51	19.95	30.53	38.83	24.09	14.11	15.70	12.45	3.00



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges	
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Crown	Tooth	Crown	Tooth		Crown
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
RPM7	12.94	7.63	21.65	13.72	21.41	13.98	21.64	28.12	20.90	27.32	11.59	23.65	12.50	3.00	
RPM8	11.70	6.59	22.35	14.74	21.84	13.28	21.44	29.00	34.37	24.59	10.90	23.37	14.03	3.00	
RPM9	10.40	6.97	19.13	12.84	19.24	12.38	19.42	27.38	31.90	19.83	11.90	23.95	13.09	3.00	
RPM10	9.99	9.03	19.20	14.10	20.60	12.29	18.73	25.42	33.30	23.55	13.54	25.83	14.19	3.00	
RPM11	10.55	6.16	19.77	14.08	20.96	12.97	20.20	25.63	33.35	24.00	13.25	25.84	13.17	3.00	
RPM12	10.80	7.04	19.94	12.71	19.30	14.37	20.06	26.46	33.25	23.56	12.52	23.09	14.42	3.00	
RPM13	11.61	6.95	21.50	13.77	21.65	13.07	20.17	26.94	33.37	23.85	10.82	25.93	13.50	3.00	
RPM14	12.16	7.01	23.77	15.16	20.81	15.44	20.02	28.04	38.14	17.35	12.81	21.95	19.38	3.00	
RPM15	11.45	7.14	20.25	12.83	22.35	13.64	20.13	29.48	35.98	23.10	10.74	20.43	13.55	3.00	
2R1	9.30	5.77	19.11	12.40	17.57	10.44	16.75	23.12	28.75	19.09	8.89	18.26	10.90	3.00	
2R2	9.16	4.15	17.84	11.71	17.43	8.45	15.30	21.98	29.51	20.16	12.01	18.88	8.53	3.00	
2R3	9.81	4.09	18.37	11.99	18.29	8.32	14.94	22.56	28.65	22.38	10.85	20.26	9.96	3.00	
2R4	11.09	2.29	21.79	13.16	19.77	8.96	14.81	25.53	30.22	18.89	9.78	21.22	11.92	3.00	
2R5	11.64	7.55	18.83	14.02	19.99	12.43	16.83	19.41	30.01	22.75	12.56	19.46	11.51	3.00	
2R6	10.04	4.82	17.82	9.72	18.96	9.89	16.45	22.99	27.82	18.20	8.24	20.05	9.11	3.00	
2R7	9.85	1.59	17.95	11.09	17.48	9.35	15.50	22.57	28.57	19.97	10.19	19.95	15.16	3.00	
2R8	9.34	4.33	19.30	12.01	18.65	12.64	15.80	23.21	29.08	20.21	10.36	19.73	11.20	3.00	
2R9	10.11	4.72	19.77	11.40	18.10	9.56	15.71	24.43	27.32	21.32	9.87	20.44	9.16	3.00	
2R10	8.81	5.54	17.41	11.37	18.62	11.39	14.79	23.69	29.46	17.43	11.23	20.28	13.45	3.00	
2R11	9.13	4.42	18.39	11.24	13.57	8.99	12.81	20.17	28.86	19.98	8.83	19.08	12.08	3.00	
2R12	9.04	5.90	15.80	11.01	18.81	10.63	16.04	23.27	28.52	19.52	11.29	20.23	14.32	3.00	
3R1	8.43	4.38	17.43	9.17	15.10	8.46	14.11	21.54	25.38	16.50	7.11	17.95	9.79	3.00	
3R2	8.67	4.10	15.35	9.40	14.17	7.55	12.97	22.79	26.80	16.98	7.75	10.29	6.63	3.00	
3R3	8.39	2.76	14.41	8.75	15.78	6.01	11.35	20.10	25.14	17.77	7.75	18.06	7.89	3.00	
3R4	7.74	3.04	14.71	9.58	14.27	6.83	12.86	18.82	24.51	19.92	7.98	17.38	8.36	3.00	
3R5	7.69	4.06	13.24	9.14	15.16	7.58	12.75	18.30	23.29	15.38	8.55	16.82	6.53	3.00	
3R6	7.69	2.49	14.58	8.94	16.64	7.03	10.75	19.73	26.07	15.85	8.92	18.65	6.58	3.00	
3R7	8.07	3.04	16.63	9.91	16.76	6.15	11.46	21.35	27.42	17.30	9.02	18.28	8.13	3.00	
3R8	7.97	3.18	16.01	8.87	15.38	8.24	13.53	21.16	23.31	16.38	8.24	17.19	10.40	3.00	
3R9	7.92	4.32	14.25	9.28	16.18	7.98	11.30	19.44	22.58	15.95	9.74	17.48	9.53	3.00	
3R10	7.79	3.13	15.56	10.16	13.96	7.50	12.94	19.82	25.29	15.14	8.16	15.97	8.92	3.00	
3R11	8.19	3.89	15.76	9.73	17.29	9.56	12.38	21.29	24.84	16.16	9.88	17.33	9.34	3.00	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
3R12	8.19	3.89	15.64	9.59	15.91	7.53	12.32	20.61	15.07	16.19	9.01	12.12	9.34	3.00
4R1	7.84	2.99	13.55	8.60	14.30	6.79	11.91	18.47	21.78	12.79	7.17	12.75	7.21	3.00
4R2	7.14	3.73	12.43	7.61	14.18	6.67	11.21	19.02	21.65	12.82	6.98	12.79	6.42	3.00
4R3	7.75	4.46	13.89	9.59	14.28	8.03	12.60	17.02	20.75	15.73	6.54	14.72	6.82	3.00
4R4	2.12	1.91	13.29	8.60	14.25	7.16	11.90	18.17	21.39	13.78	6.89	13.42	6.82	3.00
4R5	8.51	7.11	13.68	8.40	14.19	8.25	13.44	19.13	19.12	14.06	6.79	14.47	7.06	3.00
4R6	6.93	4.17	11.66	8.64	12.71	6.06	11.11	17.19	24.00	13.14	7.34	11.03	6.55	3.00
4R7	6.90	4.99	13.28	8.53	14.92	7.34	10.88	18.16	18.44	15.87	7.37	15.17	6.85	3.00
4R8	6.73	3.97	13.95	9.65	13.27	7.75	12.23	18.74	20.93	15.20	9.27	15.01	9.37	3.00
4R9	9.11	5.71	13.22	8.70	14.01	7.26	11.91	18.24	21.01	14.17	7.29	13.67	7.14	3.00
4R10	7.50	4.30	13.03	8.88	13.73	7.46	11.53	18.08	20.32	14.60	7.82	13.57	6.15	3.00
4R11	6.81	3.50	12.67	8.72	13.98	7.28	11.87	18.22	20.94	14.22	7.34	13.66	7.04	3.00
4R12	7.62	4.84	11.62	6.99	11.92	7.87	12.12	15.10	20.14	13.35	5.65	11.23	6.64	3.00
5R1	8.89	5.33	14.17	6.87	15.68	7.53	10.96	18.91	20.03	11.25	5.97	15.51	5.75	2.00
5R2	8.58	4.26	10.49	4.18	10.81	6.23	8.66	16.67	17.27	9.90	4.00	12.19	3.17	2.00
5R3	5.38	3.38	11.27	5.92	11.56	5.62	10.28	16.31	19.67	9.62	4.09	12.75	4.69	2.00
5R4	9.65	6.09	10.22	5.65	12.15	6.25	9.98	13.41	19.88	11.82	5.37	11.47	5.79	2.00
6R1	5.08	2.50	9.97	6.64	9.89	6.97	12.02	14.15	16.53	14.44	6.64	10.65	7.34	2.00
6R2	5.77	3.20	9.29	4.69	9.23	7.57	11.38	16.39	15.54	10.77	5.05	9.19	5.95	2.00
6R3	9.28	4.00	11.69	9.10	12.12	9.55	15.27	16.89	18.36	13.22	8.17	10.01	8.22	2.00
6R4	4.97	2.90	11.66	6.56	11.41	8.97	13.18	17.88	17.54	10.97	4.86	10.99	8.23	2.00
6R5	3.70	3.51	11.18	5.87	11.71	8.94	12.18	16.78	19.10	11.25	5.95	11.07	7.70	2.00
6R6	4.55	3.00	13.18	6.31	9.27	8.12	11.86	18.59	18.74	8.48	6.66	7.59	6.31	2.00
6R7	4.92	2.12	11.57	6.98	10.52	7.93	12.31	17.49	17.09	9.34	5.72	10.54	6.89	2.00
6R8	3.33	2.19	12.88	5.11	10.69	7.70	10.76	17.52	16.88	11.82	6.00	10.30	5.15	2.00
6R9	4.49	1.37	11.53	8.16	12.35	9.27	13.95	16.41	16.78	12.40	7.85	10.36	5.82	2.00
6R10	1.71	1.94	14.04	9.10	10.20	7.81	12.98	19.12	18.58	11.63	7.27	11.40	6.45	2.00
7R1	2.81	1.74	9.64	7.54	7.16	4.92	11.36	11.36	313.34	306.45	4.83	8.82	5.27	0.00
7R2	3.56	1.87	10.61	6.38	9.33	7.01	10.70	10.70	13.05	8.69	6.26	10.86	6.99	0.00
7R3	2.49	1.76	9.05	6.73	8.93	6.01	10.73	10.73	174.79	174.63	5.85	7.30	4.70	0.00
7R4	1.73	0.23	9.44	7.36	9.30	6.52	11.38	11.38	166.64	165.97	6.40	8.95	4.14	0.00
8R1	1.18	0.33	6.47	3.87	7.06	4.68	7.65	7.65	127.81	129.64	3.68	6.76	4.31	0.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	Width F-G	Width B-C	Width E-D	Length B-E	Length F-I	Length C-D	Length G-H	
8R2	1.03	0.34	6.04	4.51	7.41	4.68	7.80	7.80	116.46	119.58	3.83	7.47	3.67	0.00
8R3	0.93	0.58	6.19	3.97	6.85	4.48	7.51	7.51	9.00	8.66	3.80	7.74	4.85	0.00
8R4	0.93	0.36	7.56	5.95	6.95	4.70	9.00	9.00	10.43	6.98	4.74	6.79	4.98	0.00
8R5	2.42	1.38	7.21	5.43	7.17	4.46	7.51	7.51	10.55	7.50	4.15	7.34	3.46	0.00
8R6	1.32	0.66	8.04	6.28	8.43	5.41	10.09	10.09	11.77	7.94	4.39	7.88	4.30	0.00
8R7	1.52	0.55	7.80	5.12	6.59	4.11	7.84	7.84	9.60	8.78	4.45	9.18	5.07	0.00
8R8	1.04	0.37	6.84	4.49	7.85	5.17	7.34	7.34	10.70	9.87	6.77	8.58	5.31	0.00
8R9	1.22	0.37	7.33	4.90	7.34	4.72	7.61	7.61	10.49	7.83	4.57	9.14	4.52	0.00
8R10	1.82	0.98	6.62	3.97	6.98	5.77	8.00	8.00	9.68	7.72	4.63	7.86	5.62	0.00
8R11	11.73	5.65	7.49	4.24	8.56	6.18	8.39	8.39	10.42	8.42	4.89	8.47	6.04	0.00
LPM1	12.54	6.89	20.99	11.71	25.08	12.82	17.67	31.79	10.68	24.23	13.25	8.68	11.71	0.00
LPM2	10.09	7.67	21.79	14.02	22.82	13.45	19.80	32.12	28.27	16.12	11.06	24.92	12.76	4.00
LPM3	10.30	4.93	21.73	14.12	19.31	12.66	21.09	31.96	28.29	24.73	10.51	23.73	10.87	4.00
LPM4	11.03	5.39	21.70	12.11	22.55	13.56	18.38	26.80	16.40	24.80	10.45	27.17	12.46	4.00
LPM5	10.22	5.85	21.77	12.94	21.69	11.86	18.30	25.90	32.26	24.48	11.54	25.31	9.72	4.00
LPM6	12.62	7.25	21.06	13.76	23.12	12.65	19.82	27.16	36.15	25.01	12.43	23.47	12.74	4.00
LPM7	11.94	5.72	21.85	13.41	19.68	12.97	18.95	26.98	31.34	34.78	27.06	24.11	10.92	4.00
LPM8	12.37	6.36	21.49	12.54	24.50	12.37	19.21	27.38	16.95	25.41	12.65	22.49	20.36	4.00
LPM9	8.81	3.68	20.68	12.96	20.82	13.65	17.51	25.12	33.23	22.85	12.66	23.73	14.89	4.00
LPM10	6.18	3.36	20.76	10.85	11.68	12.20	14.86	20.94	31.68	26.80	9.78	19.83	10.59	4.00
2L1	10.40	4.96	16.74	7.65	20.32	8.08	14.82	23.60	20.57	20.50	7.81	22.06	10.63	4.00
2L2	9.17	2.82	18.96	12.36	19.68	10.36	16.78	24.76	30.96	21.66	9.53	11.07	7.68	4.00
2L3	6.85	3.82	19.55	7.99	17.82	10.16	14.90	24.68	30.06	21.12	7.28	19.65	10.64	4.00
2L4	7.43	1.11	19.01	10.02	18.70	10.62	16.04	24.78	28.60	21.01	10.00	21.38	8.60	4.00
2L5	11.90	4.64	19.17	9.50	19.13	9.80	15.64	24.46	27.54	21.07	8.65	18.54	9.39	4.00
2L6	11.03	3.79	20.54	10.30	19.43	8.67	16.48	26.20	30.49	20.02	10.92	15.83	13.96	4.00
2L7	6.77	3.94	19.40	8.98	16.93	10.89	13.85	22.44	30.21	21.50	10.09	18.50	10.23	4.00
2L8	7.45	3.86	17.32	11.15	21.91	8.99	16.96	26.75	29.29	21.33	11.53	19.47	8.91	4.00
2L9	8.88	5.65	16.98	8.32	19.95	11.90	14.45	24.99	31.53	19.31	7.43	16.24	9.84	4.00
2L10	10.84	4.53	17.97	10.02	18.69	9.86	14.27	23.24	28.42	20.82	9.25	15.92	8.30	4.00
2L11	10.56	3.85	18.94	9.99	18.63	9.90	15.30	21.88	31.22	19.87	8.84	19.86	10.10	4.00
2L12	11.58	6.95	19.23	9.85	19.97	10.86	13.65	28.51	29.16	17.79	9.24	19.50	10.71	4.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
2L13	12.16	7.01	17.67	10.22	18.97	8.60	15.14	24.81	31.17	18.58	8.81	12.13	10.54	4.00
2L14	11.45	7.14	19.73	11.93	19.33	9.90	16.56	25.04	27.81	18.63	9.84	24.86	9.91	4.00
2L15	9.30	5.77	18.53	9.47	16.63	10.79	14.41	23.36	32.13	20.24	9.75	17.64	10.53	4.00
2L16	9.16	4.15	18.36	9.28	19.79	10.11	14.45	26.03	28.09	16.86	6.84	18.36	9.68	4.00
3L1	9.81	4.09	19.01	9.93	19.06	9.00	14.45	22.97	27.10	22.38	11.96	15.38	6.22	4.00
3L2	11.09	2.29	15.96	8.11	19.09	11.18	13.07	26.00	31.83	19.08	7.56	17.80	10.43	4.00
3L3	11.64	7.55	16.81	9.55	18.91	8.45	14.58	24.39	26.77	18.74	7.62	13.03	8.17	4.00
3L4	10.04	4.82	17.89	17.10	15.87	9.74	20.56	20.36	29.26	16.37	9.28	15.19	8.38	4.00
3L5	9.85	1.59	16.29	7.01	17.28	9.50	12.67	24.80	29.04	18.18	8.74	16.98	10.09	4.00
3L6	9.34	4.33	15.81	9.03	17.71	8.43	14.49	22.67	22.69	18.58	9.07	15.11	8.35	4.00
3L7	10.11	4.72	16.09	9.06	14.39	10.42	14.01	19.97	26.21	15.97	8.46	15.57	9.69	4.00
3L8	8.81	5.54	17.42	8.19	15.70	10.39	13.27	21.77	24.72	26.51	8.58	17.02	8.92	4.00
3L9	9.13	4.42	16.46	9.39	18.02	9.59	14.52	24.67	11.93	17.69	9.39	16.85	9.79	4.00
3L10	9.04	5.90	15.65	8.17	18.76	10.32	14.23	25.33	24.45	18.60	8.67	14.20	8.28	4.00
3L11	8.43	4.38	16.61	8.61	16.71	9.75	12.75	21.00	27.05	10.48	8.33	11.08	9.45	4.00
3L12	8.67	4.10	16.78	8.02	17.48	8.57	13.64	22.74	28.08	17.77	7.50	10.00	8.16	4.00
3L13	8.39	2.76	16.18	8.17	15.50	9.46	12.70	20.28	26.57	18.16	8.71	5.45	7.41	4.00
3L14	7.74	3.04	15.66	7.31	13.43	7.68	14.49	18.86	26.97	13.47	6.62	16.06	8.26	4.00
3L15	7.69	4.06	17.30	8.23	15.69	9.54	11.99	21.96	24.36	17.86	8.65	16.64	8.63	4.00
3L16	7.69	2.49	13.67	9.21	15.09	7.47	12.54	19.28	26.01	15.95	9.06	11.55	7.94	4.00
3L17	8.07	3.04	18.15	9.60	18.12	7.78	13.78	23.12	28.79	15.06	8.69	17.24	8.83	4.00
3L18	7.97	3.18	14.38	8.05	16.31	9.26	11.67	19.67	31.95	15.44	9.38	10.84	7.43	4.00
3L19	7.92	4.32	14.52	8.61	18.36	7.92	14.16	21.63	24.75	16.22	8.25	18.29	7.83	4.00
4L1	7.79	3.13	16.09	8.36	15.66	10.47	12.64	21.81	27.42	15.95	8.35	11.93	8.62	4.00
4L2	8.19	3.89	14.98	8.64	15.73	8.34	13.62	21.14	26.63	14.51	6.84	9.92	7.14	4.00
4L3	8.19	3.89	14.99	8.26	14.91	8.66	12.07	21.68	23.33	16.35	8.59	9.56	6.37	4.00
4L4	7.84	2.99	12.40	7.87	14.24	7.32	11.74	17.30	21.73	23.72	7.43	12.43	7.44	4.00
4L5	7.14	3.73	13.93	8.30	12.43	8.42	14.29	18.70	13.29	13.69	7.58	11.30	6.39	4.00
4L6	7.75	4.46	14.15	6.81	12.23	9.04	13.02	20.21	21.80	15.91	6.88	12.87	6.16	4.00
4L7	2.12	1.91	15.08	8.73	11.87	8.86	12.58	18.09	18.58	15.83	8.19	12.73	6.99	4.00
4L8	8.51	7.11	12.81	12.46	12.46	7.24	12.46	18.61	19.04	14.09	6.24	14.15	6.59	4.00
4L9	6.93	4.17	14.31	8.68	13.69	8.55	12.80	19.69	12.81	14.49	6.73	12.46	6.96	4.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
4L10	6.90	4.99	12.14	5.56	10.67	8.55	10.11	17.58	18.88	10.16	4.20	11.03	6.60	4.00
4L11	6.73	3.97	10.81	5.49	11.23	5.39	10.03	17.57	22.23	17.87	4.56	13.19	3.94	4.00
4L12	9.11	5.71	12.11	5.45	10.90	6.72	9.54	15.99	5.77	12.33	5.88	12.39	5.13	4.00
4L13	7.50	4.30	11.06	7.04	12.88	6.13	10.15	16.96	20.58	14.68	7.96	8.04	6.24	4.00
4L14	6.81	3.50	14.89	6.57	14.08	6.31	9.46	22.22	20.40	13.50	6.50	7.57	5.23	4.00
4L15	7.62	4.84	13.81	7.30	16.13	5.94	13.77	24.00	20.96	13.19	6.60	11.45	4.77	4.00
4L16	8.89	5.33	15.88	8.53	15.35	8.55	13.03	22.85	23.79	16.47	7.46	8.75	5.28	4.00
5L1	8.58	4.26	11.89	6.22	12.27	7.59	10.61	18.22	24.09	12.51	6.35	14.19	5.23	2.00
5L2	5.38	3.38	10.89	6.27	9.78	6.82	10.01	15.05	19.80	12.78	4.87	11.66	5.42	2.00
5L3	9.65	6.09	12.22	7.02	12.83	4.99	12.09	19.70	16.66	12.50	5.86	12.77	4.16	2.00
5L4	5.08	2.50	14.64	6.73	10.60	6.88	10.11	17.02	19.92	13.72	5.63	8.12	5.27	2.00
5L5	5.77	3.20	11.18	4.70	11.22	5.90	9.37	16.49	17.10	9.73	5.43	11.63	5.06	2.00
5L6	9.28	4.00	12.65	5.54	12.41	6.34	8.95	20.67	20.34	11.87	6.02	8.72	4.86	2.00
5L7	4.97	2.90	11.94	6.01	11.72	5.02	10.84	17.02	19.71	12.25	4.17	7.50	4.94	2.00
5L8	3.70	3.51	11.64	5.98	11.44	6.33	10.47	17.29	20.45	12.24	4.95	7.95	4.26	2.00
5L9	4.55	3.00	10.11	4.14	11.85	5.97	9.57	15.96	19.79	12.32	5.09	10.25	3.88	2.00
5L10	4.92	2.12	10.61	6.06	11.54	6.76	8.79	16.59	18.21	11.40	4.99	10.40	5.23	2.00
5L11	3.33	2.19	11.02	5.39	11.70	4.43	9.64	15.87	19.48	12.35	4.25	6.96	4.26	2.00
5L12	4.49	1.37	10.06	5.45	9.62	6.17	8.71	14.96	18.25	12.58	5.00	11.08	2.74	2.00
5L13	1.71	1.94	10.00	4.66	12.28	4.85	8.80	17.98	17.39	10.46	3.94	6.00	4.94	2.00
5L14	5.56	3.15	10.23	5.68	11.46	5.52	9.62	14.72	19.64	12.92	5.20	8.51	4.37	2.00
6L1	4.73	2.54	10.54	5.50	12.45	5.78	7.49	17.34	17.47	11.76	5.17	8.67	4.12	2.00
6L2	2.00	1.39	8.10	5.15	10.68	4.25	8.92	11.77	15.03	10.88	4.60	10.13	3.74	2.00
6L3	3.39	1.46	10.99	4.51	10.73	6.51	8.47	16.02	16.56	12.67	5.12	8.99	5.89	2.00
6L4	3.06	0.84	9.93	5.78	13.21	5.12	8.26	16.36	15.74	13.65	5.47	9.98	4.60	2.00
6L5	3.37	0.28	7.02	5.63	7.79	4.49	7.64	10.12	17.70	9.29	4.24	7.78	3.89	2.00
6L6	2.31	0.74	9.74	5.18	10.29	3.51	8.58	15.24	15.67	8.39	4.52	7.75	3.31	2.00
6L7	6.86	0.62	9.81	5.86	10.21	5.25	9.99	15.75	15.43	9.82	5.67	7.49	2.98	2.00
6L8	7.25	1.78	9.48	4.31	9.67	6.04	7.68	15.06	17.79	8.38	4.30	6.42	7.44	2.00
6L9	7.75	2.58	8.37	5.09	8.12	4.81	7.70	12.86	17.90	9.76	3.40	7.53	4.07	2.00
6L10	7.72	2.10	7.66	4.71	6.66	4.05	6.17	10.54	14.64	9.55	4.02	9.64	4.15	2.00
6L11	7.56	2.83	10.97	5.81	9.88	2.87	9.57	15.30	10.79	10.07	5.12	8.31	4.11	2.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
6L12	2.01	0.66	8.60	5.06	11.07	5.42	7.86	14.56	17.45	11.54	6.43	10.00	4.33	2.00
7L1	1.41	0.28	8.35	5.74	7.16	4.86	9.76	9.76	14.76	8.06	4.60	9.05	4.50	2.00
7L2	1.27	0.44	8.63	5.44	8.52	6.15	10.45	10.45	13.04	9.83	4.86	8.45	5.35	2.00
7L3	2.05	0.81	8.01	5.10	5.56	3.65	7.96	7.96	11.64	8.75	4.31	9.89	4.46	2.00
7L4	1.32	0.64	8.20	6.31	7.01	4.65	9.99	9.99	13.18	6.44	4.22	9.16	4.98	2.00
7L5	1.79	0.61	8.91	7.04	7.84	4.63	8.83	8.83	14.64	6.88	5.90	9.53	5.47	2.00
7L6	1.06	0.41	9.66	6.41	7.40	5.46	9.85	9.85	13.10	7.70	4.35	8.72	5.70	2.00
7L7	2.35	0.63	7.70	6.82	6.47	4.66	9.01	9.01	13.25	6.43	3.26	9.76	6.11	2.00
7L8	1.69	0.81	10.22	8.36	9.83	7.02	12.26	12.26	16.79	7.21	5.03	8.42	5.83	2.00
7L9	1.00	0.41	8.77	6.55	8.09	5.49	10.11	10.11	12.45	8.28	4.05	7.90	4.44	2.00
7L10	2.14	0.98	9.11	6.62	5.73	4.17	9.12	9.12	12.53	9.31	5.18	9.60	6.77	2.00
7L11	1.62	0.51	9.47	7.31	8.01	5.68	11.00	11.00	11.71	9.58	6.25	9.55	5.23	2.00
7L12	1.29	0.63	8.40	5.04	5.24	4.12	7.45	7.45	11.38	9.29	4.68	9.31	6.37	2.00
7L13	1.97	0.82	8.01	5.78	7.76	5.25	9.40	9.40	12.77	7.21	4.54	6.29	5.23	2.00
8L1	1.06	0.35	7.72	4.80	6.40	4.69	7.84	7.84	10.84	6.28	3.51	8.27	4.24	0.00
8L2	1.29	0.48	7.46	5.09	7.23	5.13	8.55	8.55	12.61	5.09	4.00	7.76	4.26	0.00
8L3	1.64	0.58	8.15	4.17	7.31	5.49	8.42	8.42	10.13	7.94	3.68	6.34	4.25	0.00

**SUMMARY SMU 69001 Lower dentition**

Medial														
N=10														
Minimum	13.23	6.51	24.55	15.55	25.13	14.40	24.90	28.21	32.45	27.17	13.34	18.05	14.28	3.00
Maximum	17.32	9.53	29.68	19.91	30.45	20.68	31.55	35.67	40.05	33.94	18.56	33.22	18.86	3.00
Arithmetic Mean	15.015	7.973	26.60	17.16	27.95	17.96	27.38	31.92	36.01	30.68	15.36	29.48	16.55	3.00
Standard Deviation	1.289	0.941	1.56	1.34	1.45	1.95	2.45	2.41	2.96	2.74	1.71	4.36	1.36	0.00
RPM														
N=15														
Minimum	9.99	6.16	19.13	12.71	19.24	12.05	18.73	24.85	20.90	17.35	10.73	15.70	11.69	3.00
Maximum	12.94	9.03	23.77	15.16	22.35	15.44	21.64	30.53	38.83	27.48	14.11	25.93	19.38	3.00
Arithmetic Mean	11.372	7.079	21.28	13.86	20.86	13.28	20.18	27.65	33.80	23.46	11.93	23.13	13.72	3.00
Standard Deviation	0.77	0.649	1.55	0.78	1.08	0.90	0.92	1.62	4.06	2.47	1.12	2.56	1.76	0.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
R2														
N=12														
Minimum	8.81	1.59	15.80	9.72	13.57	8.32	12.81	19.41	27.32	17.43	8.24	18.26	8.53	3.00
Maximum	11.64	7.55	21.79	14.02	19.99	12.64	16.83	25.53	30.22	22.75	12.56	21.22	15.16	3.00
Arithmetic Mean	9.777	4.598	18.53	11.76	18.10	10.09	15.48	22.75	28.90	19.99	10.34	19.82	11.44	3.00
Standard Deviation	0.857	1.586	1.46	1.10	1.65	1.45	1.10	1.67	0.84	1.57	1.32	0.80	2.10	0.00
R3														
N=12														
Minimum	7.69	2.49	13.24	8.75	13.96	6.01	10.75	18.30	15.07	15.14	7.11	10.29	6.53	3.00
Maximum	8.67	4.38	17.43	10.16	17.29	9.56	14.11	22.79	27.42	19.92	9.88	18.65	10.40	3.00
Arithmetic Mean	8.062	3.523	15.30	9.38	15.55	7.53	12.39	20.41	24.14	16.63	8.51	16.46	8.45	3.00
Standard Deviation	0.32	0.65	1.14	0.43	1.08	0.98	1.00	1.28	3.19	1.28	0.84	2.58	1.33	0.00
R4														
N=12														
Minimum	2.12	1.91	11.62	6.99	11.92	6.06	10.88	15.10	18.44	12.79	5.65	11.03	6.15	3.00
Maximum	9.11	7.11	13.95	9.65	14.92	8.25	13.44	19.13	24.00	15.87	9.27	15.17	9.37	3.00
Arithmetic Mean	7.08	4.307	13.02	8.58	13.81	7.33	11.89	17.96	20.87	14.14	7.20	13.46	7.00	3.00
Standard Deviation	1.719	1.321	0.79	0.73	0.82	0.62	0.70	1.10	1.39	1.05	0.85	1.34	0.81	0.00
R5														
N=4														
Minimum	5.38	3.38	10.22	4.18	10.81	5.62	8.66	13.41	17.27	9.62	4.01	11.47	3.17	3.00
Maximum	9.65	6.09	14.17	6.87	15.68	7.53	10.96	18.91	20.03	11.82	5.97	15.51	5.79	3.00
Arithmetic Mean	8.125	4.765	11.54	5.66	12.55	6.41	9.97	16.33	19.21	10.65	4.86	12.98	4.85	3.00
Standard Deviation	1.884	1.19	1.81	1.12	2.16	0.80	0.96	2.26	1.30	1.06	0.97	1.77	1.23	0.00
R6														
N=10														
Minimum	1.71	1.37	9.29	4.69	9.23	6.97	10.76	14.15	15.54	8.49	4.86	7.59	5.15	2.00

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown	Posterior Tooth	Anterior Tooth	Labial Tooth	Labial Crown	Lingual Tooth	Lingual Crown	# of Ridges
			r tooth edge	r crown edge	r tooth edge	r crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Maximum	9.28	4	14.04	9.10	12.35	9.55	15.27	19.12	19.10	14.44	8.17	11.40	8.23	2.00
Arithmetic Mean	4.78	2.673	11.70	6.85	10.74	8.28	12.59	17.12	17.51	11.43	6.42	10.21	6.81	2.00
Standard Deviation	1.95	0.796	1.42	1.53	1.13	0.85	1.31	1.38	1.15	1.74	1.11	1.11	1.05	0.00
R7														
N=4														
Minimum	1.73	0.23	8.59	6.19	9.07	7.11	11.29	13.56	12.84	8.21	5.04	7.55	4.41	0.00
Maximum	3.56	1.87	11.30	7.66	11.08	7.91	12.60	16.63	15.60	10.97	6.33	10.23	7.59	0.00
Arithmetic Mean	2.648	1.4	10.11	6.60	9.99	7.48	11.77	15.69	14.40	9.45	5.69	9.31	5.87	0.00
Standard Deviation	0.758	0.78	1.14	0.71	0.83	0.34	0.57	1.45	1.17	1.27	0.53	1.22	1.32	0.00
R8														
N=11														
Minimum	0.93	0.33	6.15	3.81	5.95	4.55	7.49	8.93	9.41	7.03	3.60	6.74	4.19	0.00
Maximum	11.73	5.65	9.58	6.50	7.79	5.79	9.19	11.40	12.02	8.22	4.51	8.91	5.49	0.00
Arithmetic Mean	2.285	1.052	7.44	4.87	7.17	5.15	8.36	10.58	10.52	7.55	3.95	7.49	4.81	0.00
Standard Deviation	3.164	1.559	0.93	0.81	0.62	0.42	0.51	0.80	0.88	0.29	0.27	0.62	0.38	0.00
LPM														
N=10														
Minimum	6.18	3.36	20.68	10.85	11.68	11.86	14.86	20.94	10.68	16.12	9.78	8.68	9.72	4.00
Maximum	12.62	7.67	21.85	14.12	25.08	13.65	21.09	32.12	36.15	34.78	27.06	27.17	20.36	4.00
Arithmetic Mean	10.61	5.71	21.38	12.84	21.12	12.82	18.56	27.62	26.52	24.92	13.14	22.34	12.70	4.00
Standard Deviation	2.005	1.43	0.46	1.06	3.81	0.60	1.69	3.52	8.64	4.51	5.02	5.16	3.06	0.00
L2														
N=16														
Minimum	6.77	1.11	16.74	7.65	16.63	8.08	13.65	21.88	20.57	16.86	6.84	11.07	7.68	4.00
Maximum	12.16	7.14	20.54	12.36	21.91	11.90	16.96	28.51	32.13	21.66	11.53	24.86	13.96	4.00
Arithmetic Mean	9.683	4.624	18.63	9.81	19.12	9.97	15.23	24.72	29.20	20.02	9.11	18.19	9.98	4.00
Standard Deviation	1.828	1.607	1.06	1.28	1.29	0.99	1.07	1.66	2.71	1.42	1.30	3.47	1.40	0.00



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge A-B	posterior crown edge A-F	posterior tooth edge A-C	posterior crown edge A-G	r Crown Width F-G	r Tooth Width B-C	Tooth Width E-D	Tooth Length B-E	Crown Length F-I	Tooth Length C-D	Crown Length G-H	
L3														
N=19														
Minimum	7.69	1.59	13.67	7.01	13.43	7.47	11.67	18.86	11.93	10.48	6.62	5.46	6.22	4.00
Maximum	11.64	7.55	19.01	17.10	19.09	11.18	20.56	26.00	31.95	26.51	11.96	18.29	10.43	4.00
Arithmetic Mean	9.023	4.033	16.35	9.02	16.92	9.18	13.87	22.18	26.24	17.50	8.66	14.44	8.54	4.00
Standard Deviation	1.157	1.402	1.32	2.11	1.68	1.04	1.86	2.16	4.23	3.30	1.07	3.32	1.03	0.00
L4														
N=16														
Minimum	2.12	1.91	10.81	5.45	10.67	5.39	9.46	15.99	5.77	10.16	4.20	7.57	3.94	4.00
Maximum	9.11	7.11	16.09	12.46	16.13	10.47	14.29	24.00	27.42	23.72	8.59	14.15	8.62	4.00
Arithmetic Mean	7.376	4.245	13.72	7.75	13.40	7.78	11.96	19.65	19.83	15.17	6.88	11.24	6.24	4.00
Standard Deviation	1.578	1.209	1.64	1.72	1.82	1.39	1.59	2.40	5.42	2.94	1.25	1.94	1.15	0.00
L5														
N=14														
Minimum	1.71	1.37	10.00	4.14	9.62	4.43	8.71	14.72	16.66	9.73	3.94	6.00	2.74	4.00
Maximum	9.65	6.09	14.64	7.03	12.83	7.59	12.09	20.67	24.09	13.72	6.35	14.19	5.42	4.00
Arithmetic Mean	5.498	3.115	11.36	5.70	11.48	5.97	9.83	16.97	19.34	12.12	5.12	9.69	4.61	4.00
Standard Deviation	2.255	1.173	1.28	0.80	0.94	0.91	0.95	1.74	1.85	1.01	0.70	2.38	0.73	0.00
L6														
N=12														
Minimum	2	0.28	7.02	4.31	6.66	2.87	6.17	10.12	10.79	8.38	3.40	6.42	2.98	2.00
Maximum	7.75	2.83	10.99	5.86	13.21	6.51	9.99	17.34	17.90	13.65	6.43	10.13	7.45	2.00
Arithmetic Mean	4.834	1.485	9.27	5.22	10.06	4.84	8.20	14.24	16.01	10.48	4.84	8.56	4.39	2.00
Standard Deviation	2.411	0.876	1.31	0.52	1.86	1.06	1.02	2.36	2.02	1.65	0.82	1.21	1.20	0.00
L7														
N=13														
Minimum	1	0.28	7.7	5.04	5.24	3.65	7.45	7.45	11.38	6.43	3.26	6.29	4.44	2
Maximum	2.35	0.98	10.22	8.36	9.83	7.02	12.26	12.26	16.79	9.83	6.25	9.89	6.77	2

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			r tooth edge	r crown edge	r tooth edge	r crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Arithmetic Mean	1.612	0.614	8.726	6.348	7.278	5.061	9.63	9.63	13.172	8.075	4.71	8.895	5.418	2
Standard Deviation	0.429	0.202	0.733	0.939	1.293	0.913	1.251	1.251	1.488	1.2	0.777	0.982	0.733	0
L8														
N=3														
Minimum	1.06	0.35	7.46	4.17	6.4	4.69	7.84	7.84	10.13	5.09	3.51	6.34	4.24	0
Maximum	1.64	0.58	8.15	5.09	7.31	5.49	8.55	8.55	12.61	7.94	4	8.27	4.26	0
Arithmetic Mean	1.33	0.47	7.777	4.687	6.98	5.103	8.27	8.27	11.193	6.437	3.73	7.457	4.25	0
Standard Deviation	0.292	0.115	0.348	0.47	0.504	0.401	0.378	0.378	1.277	1.431	0.249	1	0.01	0

*Ptychodus marginalis*

Texas specimens

SMU 76430 47 teeth

Right Series	8.75	4.75	14.48	11.42	14.87	10.47	15.25	18.83	16.45	18.87	10.35	17.77	10.87	9.00
	10.60	3.70	17.03	7.85	15.82	10.35	13.08	21.41	21.00	20.14	9.65	13.71	9.32	11.00
	4.81	2.28	10.04	5.03	9.36	5.42	7.82	12.49	10.05	10.54	5.45	10.41	4.94	7.00
	3.87	1.95	8.65	5.06	7.59	4.71	7.03	10.01	10.78	7.72	4.03	8.01	4.80	6.00
	5.48	2.56	12.22	6.90	8.68	4.98	8.56	12.25	11.20	11.85	6.14	11.44	5.63	8.00
	4.93	1.88	9.82	6.56	9.64	6.30	10.88	11.12	14.46	13.03	6.19	9.95	5.76	7.00
	4.27	1.77	9.96	5.17	9.09	5.11	8.04	13.05	12.21	9.74	4.44	10.31	4.53	7.00
	5.43	2.88	11.61	6.57	8.35	4.68	8.17	12.80	10.22	9.59	3.68	8.31	4.14	8.00
	3.57	1.26	8.33	5.75	7.79	5.30	9.80	13.14	14.55	7.90	4.07	5.89	4.57	7.00
	2.44	0.74	8.84	3.24	8.58	5.83	8.28	13.56	14.24	8.14	3.40	7.70	3.99	7.00
	4.41	2.14	9.84	4.77	7.46	4.16	6.90	11.83	11.75	8.46	4.53	9.34	4.89	7.00
	3.51	1.18	9.67	5.01	8.23	4.61	8.34	12.54	12.92	7.05	3.53	7.50	4.61	7.00
	2.17	1.38	6.23	8.00	6.98	3.75	4.89	10.20	11.40	7.15	10.82	5.80	6.55	6.00
	2.46	1.33	6.04	3.13	4.21	3.35	5.06	7.79	8.09	5.97	2.85	5.11	3.34	6.00
	3.09	1.40	6.73	9.05	8.43	3.26	6.33	10.78	6.13	8.33	5.89	6.08	5.65	6.00
	2.61	1.19	7.28	4.02	6.68	4.53	6.36	8.85	9.88	8.11	4.22	7.00	4.63	7.00
	1.97	1.18	6.16	4.68	5.71	2.67	6.48	8.45	7.64	8.19	4.75	7.46	3.67	6.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
	2.99	1.85	6.82	4.64	6.27	4.42	7.06	7.87	7.41	8.25	3.69	7.16	2.94	6.00
	2.93	1.41	8.53	5.06	5.71	4.04	7.24	10.93	7.86	6.63	3.75	6.90	4.37	7.00
	3.73	1.07	7.22	5.10	5.52	2.67	6.40	8.79	7.60	7.18	4.43	7.06	3.93	7.00
	2.10	0.06	6.67	3.54	6.09	2.42	5.17	8.82	11.09	6.60	2.26	2.38	3.31	7.00
	0.51	0.58	5.42	3.19	5.33	4.08	5.10	6.98	8.46	6.41	4.05	3.26	3.68	5.00
	1.22	0.18	4.69	2.33	3.69	2.48	3.75	6.31	5.88	4.01	1.94	5.06	2.16	5.00
	10.08	4.26	4.86	3.31	3.83	2.41	5.16	7.18	6.65	4.21	2.12	2.93	2.36	5.00
LEFT SERIES	7.39	4.39	17.70	10.38	15.91	8.67	13.21	19.09	21.80	18.41	9.58	18.52	10.59	11.00
	5.04	2.47	12.69	8.41	13.98	7.12	9.69	15.86	15.05	13.45	6.14	13.62	7.20	8.00
	6.69	1.51	10.89	6.09	11.31	6.28	10.38	13.04	10.84	12.23	3.76	10.29	5.94	8.00
	4.83	2.04	9.19	3.37	11.32	4.03	5.03	11.15	7.29	16.50	5.12	5.36	3.92	7.00
	4.28	1.55	9.00	4.61	10.10	3.84	6.06	12.60	9.82	9.82	3.95	8.09	4.44	7.00
	8.64	3.66	8.29	4.14	9.65	3.66	6.31	10.16	10.96	8.27	4.03	9.81	3.93	7.00
	5.47	3.04	12.64	7.87	16.04	9.22	13.21	15.54	17.56	17.46	8.24	17.14	10.00	8.00
	6.49	3.05	10.26	5.64	13.49	5.35	7.56	15.50	18.31	11.87	6.76	10.51	7.07	7.00
	5.25	1.90	11.14	9.25	12.23	5.81	4.22	14.00	6.61	19.78	13.27	4.95	8.25	7.00
	0.45	1.41	9.11	3.92	9.60	3.52	6.15	13.85	13.99	8.81	3.17	5.63	3.78	6.00
	0.54	0.47	13.39	5.31	17.14	11.36	9.45	9.37	6.17	15.95	3.95	12.55	5.98	8.00
	5.72	1.65	8.61	5.09	8.90	4.34	7.99	12.53	10.16	8.98	4.13	10.03	3.51	6.00
	2.45	1.29	8.21	4.20	7.60	4.51	6.68	10.52	11.61	8.07	4.96	5.94	3.42	6.00
	3.63	1.01	7.02	6.70	6.14	7.13	5.81	8.64	4.59	13.85	8.21	7.00	9.82	6.00
	1.77	0.90	6.95	3.01	7.38	4.61	7.01	10.44	10.22	7.62	2.24	6.00	1.95	5.00
	1.34	0.06	5.89	4.12	6.63	2.87	5.90	8.23	9.29	7.49	3.21	6.83	4.60	5.00
	3.55	1.13	4.56	2.28	6.55	3.23	4.22	7.33	3.71	10.73	3.47	4.28	3.81	5.00
	2.72	0.65	7.13	3.66	6.75	3.08	6.16	9.40	8.67	7.41	2.64	7.09	2.35	6.00
	1.73	1.79	6.17	4.25	6.78	4.20	6.99	10.67	8.35	5.65	2.86	4.91	2.96	6.00
	1.26	1.31	8.40	4.92	8.42	3.72	6.73	7.77	10.65	8.70	2.89	8.68	3.64	7.00
	7.53	3.90	5.32	3.96	5.04	3.05	5.06	6.54	7.13	5.06	3.62	4.85	2.83	7.00
	3.47	0.71	11.43	7.86	11.64	6.45	9.76	11.74	6.80	16.39	5.27	8.01	6.40	8.00
	1.49	1.17	8.22	5.34	8.50	6.26	10.13	11.08	8.84	12.86	5.20	9.72	6.05	6.00
	3.20	1.01	6.88	4.19	5.35	3.71	6.10	9.58	7.67	8.99	3.46	6.71	4.50	7.00
														6.83

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
<b>Kansas specimens</b>														
KUVP 55255 A	8.02	5.60	16.28	13.83	18.93	13.12	22.33	25.73	27.22	20.34	14.35	23.47	21.04	10.00
KUVP 55255 B	7.91	3.60	18.21	14.72	19.67	14.36	24.05	24.33	23.27	26.44	15.64	26.45	18.15	10.00
KUVP 55255 C	7.93	4.97	19.76	14.61	14.76	12.76	22.07	24.18	22.90	23.11	14.71	25.42	15.70	8.00
KUVP 55255 D	7.79	4.56	17.16	14.20	16.37	12.05	21.60	23.85	23.77	23.46	12.99	22.98	14.35	8.00
KUVP 55263 2 teeth	3.53	1.59	14.38	11.78	13.71	12.38	19.56	20.41	20.07	18.54	13.02	20.55	14.48	9.00
	3.48	1.92	16.93	13.02	16.11	12.02	19.44	25.83	26.25	17.54	12.77	18.70	13.32	9.00
KUVP 13525 3 teeth	12.01	6.43	21.336	16.673	21.779	15.33	23.717	22.462	30.633	19.548	29.836	25.473	17.229	12.00
<b>0, 200-300 values=missi</b>	8.25	1.59	15.984	353.25	19.206	353.25	0	20.441	26.713	0	29.952	28.975	0	12.00
<b>0, 200-300 values=missi</b>	3.48	1.92	13.385	392.75	19.544	392.75	0	18.618	24.335	0	27.692	28.831	0	12.00

<b>TYPE SPECIMEN <i>Ptychodus martini</i> KUVP 55277</b>														
Tooth Files labeled as positioned in mount														
M1	3.30	1.55	18.72	15.61	16.90	15.96	29.36	32.00	36.46	17.83	11.33	16.49	12.46	10.00
M2	3.80	2.25	19.03	17.51	19.70	16.49	30.19	32.79	34.45	18.54	14.01	17.92	14.33	10.00
M3	3.87	2.38	19.14	16.78	21.61	19.23	32.57	35.04	35.19	18.88	14.64	19.51	16.03	10.00
M4	4.98	2.51	20.41	18.24	20.78	18.98	33.24	34.26	36.40	20.05	15.27	21.00	15.72	10.00
M5	2.52	1.38	19.00	16.08	18.14	17.15	30.77	33.38	36.21	14.68	12.66	16.46	13.61	10.00
M6	5.11	3.06	23.34	18.74	19.68	16.84	33.14	38.58	36.86	18.09	13.78	17.90	14.28	10.00
M7	5.23	3.03	24.92	21.06	20.66	18.56	37.08	41.00	39.66	17.66	14.03	20.11	14.77	10.00
M8	4.57	2.54	24.82	20.96	22.46	20.71	37.59	40.85	40.88	19.36	15.81	19.37	13.83	10.00
M9	7.00	4.78	22.53	16.42	14.39	12.35	22.25	26.28	28.95	24.67	15.29	20.89	14.97	10.00
RPM1	6.02	4.93	13.68	13.84	20.22	12.90	22.13	26.39	28.13	20.32	14.40	20.15	13.53	10.00
RPM2	7.87	4.68	24.67	16.06	18.26	13.76	24.58	30.23	25.16	25.39	15.85	21.99	14.81	10.00
RPM3	7.57	4.17	21.06	15.47	19.26	12.94	21.89	28.88	25.36	23.25	16.07	21.11	14.80	10.00
RPM4	8.63	4.06	21.44	15.06	19.48	13.27	23.36	29.24	29.00	22.93	16.67	20.80	15.48	10.00
RPM5	7.47	4.72	20.10	15.66	18.63	14.37	23.81	28.00	30.65	19.48	16.23	20.31	15.37	10.00
RPM6	7.88	3.70	20.02	13.54	19.05	14.54	21.54	27.14	27.14	21.73	17.20	20.79	14.60	10.00
RPM7	7.62	3.63	21.67	15.13	18.47	13.48	21.85	28.78	25.75	24.67	18.04	21.73	15.35	10.00
RPM8	5.98	3.30	15.54	13.71	19.21	12.97	20.01	24.00	28.37	21.23	15.22	19.28	12.44	10.00
2R1	2.59	1.25	9.51	7.48	11.20	9.69	14.90	16.68	19.81	12.26	7.45	11.20	7.03	7.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
2R2	3.50	1.73	12.66	9.91	12.75	10.01	17.16	19.80	20.45	15.15	9.06	13.80	8.94	7.00
2R3	3.13	1.02	10.76	8.57	13.92	10.20	13.85	16.54	18.83	15.02	10.38	15.37	7.68	7.00
2R4	1.72	0.79	11.11	8.25	12.23	9.86	15.78	18.51	19.24	15.40	10.57	13.87	8.90	7.00
2R5	3.52	2.00	10.87	8.66	11.55	8.91	14.05	18.27	17.17	10.44	10.04	12.71	8.21	7.00
2R6	3.35	1.77	12.10	9.44	13.16	10.58	16.78	20.55	22.07	12.83	9.75	13.88	10.07	7.00
2R7	3.53	2.10	12.29	9.51	11.65	9.04	14.40	18.86	18.63	13.55	9.70	12.89	9.24	7.00
2R8	2.05	0.76	13.15	10.29	13.08	10.18	17.70	22.47	18.17	14.24	10.60	13.64	9.36	7.00
2R9	2.34	0.95	11.33	8.93	11.51	9.16	16.51	18.95	19.78	14.21	8.59	14.65	7.58	7.00
2R10	2.58	1.34	10.68	8.89	11.14	9.29	16.19	17.68	20.11	14.11	9.63	13.68	8.76	7.00
2R11	3.60	1.64	11.69	9.86	13.72	9.75	13.63	18.05	15.38	12.94	9.87	13.21	7.66	7.00
2R12	3.97	1.82	13.01	9.78	11.00	9.54	15.14	18.74	17.13	13.82	10.23	12.69	9.05	7.00
2R13	4.04	2.63	13.47	9.96	11.04	8.44	15.37	19.56	19.56	12.86	9.74	12.83	9.36	7.00
2R14	5.01	1.59	13.91	8.94	10.63	8.33	13.89	18.94	20.60	14.24	9.73	12.57	7.63	7.00
3R1	2.07	1.25	8.52	5.93	9.91	7.81	12.49	15.33	16.68	11.19	5.80	8.61	5.83	6.00
3R2	1.99	0.63	8.69	6.63	8.45	7.41	12.23	13.11	15.12	11.45	4.79	10.06	5.93	6.00
3R3	1.97	0.84	8.43	5.73	9.26	6.13	10.73	14.87	14.52	7.98	4.80	9.22	5.53	6.00
3R4	2.29	1.01	8.20	6.56	10.16	8.06	13.14	15.44	15.38	10.91	6.92	9.79	5.83	6.00
3R5	2.05	0.78	7.83	6.10	9.34	7.90	12.65	14.10	16.86	12.41	7.55	10.12	7.68	6.00
3R6	2.31	1.20	9.36	6.84	9.24	6.97	11.65	15.81	14.30	9.31	6.53	10.34	7.10	6.00
3R7	3.30	1.19	11.07	7.34	10.77	7.58	12.99	18.32	15.36	12.40	8.45	12.16	8.68	6.00
3R8	2.62	1.28	8.60	7.36	10.84	8.21	13.96	16.72	15.71	11.26	7.95	12.61	8.35	6.00
3R9	2.07	1.09	11.15	8.23	10.47	7.50	13.77	18.26	14.85	10.92	7.12	12.01	7.64	6.00
3R10	1.91	0.57	10.84	8.87	10.45	8.83	15.49	17.77	16.97	11.42	8.46	12.44	7.28	6.00
3R11	1.93	0.69	8.35	7.00	9.22	6.88	12.73	14.76	15.26	12.03	7.86	12.48	6.55	6.00
3R12	1.72	0.58	8.57	6.98	10.05	7.24	11.93	14.93	16.04	12.21	7.14	10.92	7.21	6.00
4R1	1.74	0.84	7.81	5.86	7.17	6.58	12.00	13.38	12.07	6.66	4.65	7.57	4.48	5.00
4R2	1.34	0.61	7.42	6.38	8.32	4.94	10.02	13.96	11.46	7.62	4.87	7.66	5.96	5.00
4R3	1.93	0.78	7.87	5.67	7.43	5.36	10.34	14.00	11.66	6.91	4.08	7.76	4.96	5.00
4R4	0.99	0.15	7.34	6.17	8.63	5.21	9.94	14.36	11.86	7.52	4.59	6.38	4.34	5.00
4R5	0.82	0.16	7.37	6.94	7.87	6.51	11.99	13.96	14.53	7.12	5.51	6.86	5.69	5.00
4R6	1.07	0.50	7.29	5.63	7.71	5.99	10.44	13.57	13.68	6.67	5.18	6.80	4.57	5.00
4R7	1.27	0.53	7.52	5.75	8.01	6.13	10.89	13.92	13.53	7.57	4.45	7.39	4.55	5.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
4R8	1.29	0.85	6.05	5.25	7.54	6.18	10.49	12.14	11.27	7.48	4.62	7.89	4.86	5.00
4R9	1.79	0.66	7.48	5.85	7.48	6.69	11.41	12.77	12.56	8.31	4.84	8.05	4.93	5.00
4R10	1.11	0.22	6.96	4.89	8.96	7.35	10.69	13.76	13.40	7.39	5.34	7.12	5.57	5.00
4R11	1.02	0.19	8.14	5.75	7.74	5.77	10.47	14.15	14.64	8.87	5.15	8.28	4.74	5.00
4R12	1.49	0.59	8.58	6.90	8.22	6.86	11.36	13.72	14.55	8.83	5.08	10.64	5.91	5.00
4R13	1.13	0.62	7.11	6.32	9.02	7.09	11.90	13.79	14.74	10.27	6.47	10.57	6.37	5.00
LPM1	3.65	1.35	14.36	11.59	14.88	13.26	20.75	23.01	22.61	18.25	13.98	18.35	13.55	9.00
LPM2	3.21	1.89	15.94	14.31	16.22	13.54	23.14	25.85	25.86	17.39	14.35	20.25	15.25	9.00
LPM3	3.33	1.62	14.50	11.94	15.94	14.91	23.06	24.43	24.03	18.67	13.87	19.34	14.75	9.00
LPM4	2.97	1.47	16.42	14.67	16.96	13.85	24.06	26.29	27.56	19.83	15.21	19.89	14.05	9.00
LPM5	2.94	0.17	17.22	14.83	16.33	12.82	21.72	25.45	27.25	17.94	13.79	19.40	13.44	9.00
LPM6	3.77	1.10	15.71	12.48	14.93	13.38	21.60	24.58	24.63	19.72	14.89	18.75	15.51	9.00
LPM7	3.74	1.27	16.17	12.82	15.65	13.19	21.08	24.55	24.27	20.41	13.72	20.25	14.80	9.00
LPM8	2.55	1.22	14.52	12.69	15.10	14.39	22.71	23.53	25.04	19.28	16.23	20.50	15.84	9.00
LPM9	2.50	1.29	12.21	9.93	10.41	9.27	16.97	18.06	20.63	13.68	9.55	14.58	10.03	9.00
2L1	2.45	1.10	11.43	8.92	12.82	10.53	16.23	19.49	18.84	13.58	9.37	13.77	11.54	8.00
2L2	2.32	0.80	12.05	9.95	10.63	9.28	16.12	17.77	19.81	14.46	10.82	15.59	9.52	8.00
2L3	1.71	0.54	12.17	9.88	13.01	9.97	17.26	20.85	19.84	13.63	8.49	12.71	9.94	8.00
2L4	1.85	0.60	12.63	9.92	12.52	10.30	17.61	20.78	18.71	12.88	7.46	13.40	8.20	8.00
2L5	2.61	0.73	11.35	8.77	12.80	9.89	16.74	20.60	21.15	13.93	9.09	12.63	9.48	8.00
2L6	3.09	1.44	12.99	9.67	12.07	10.26	16.35	19.60	19.92	13.71	9.45	14.50	11.02	8.00
2L7	2.98	1.25	11.77	8.81	10.84	9.88	16.39	18.17	17.83	14.65	10.05	15.70	9.90	8.00
2L8	3.64	2.00	14.01	8.65	10.74	7.86	13.35	16.78	19.28	17.40	9.56	14.77	9.90	8.00
2L9	2.89	1.65	12.14	8.66	10.52	9.76	16.21	17.82	16.32	15.23	9.22	15.19	10.33	8.00
2L10	3.08	1.59	14.46	9.40	9.52	8.03	13.45	16.66	16.49	13.87	8.73	15.73	8.54	8.00
3L1	2.34	0.58	11.17	8.03	10.24	8.17	15.31	19.20	19.35	10.66	6.24	10.88	7.04	6.00
3L2	2.88	1.03	11.21	8.24	11.04	8.64	14.61	18.82	18.63	11.93	7.47	11.22	7.44	6.00
3L3	1.29	0.18	10.10	7.75	11.64	8.09	14.48	19.70	17.41	10.79	7.45	11.63	7.02	6.00
3L4	2.36	0.60	10.89	8.56	11.06	8.69	15.19	18.66	20.79	11.41	7.84	10.91	7.39	6.00
3L5	1.99	0.43	10.74	7.71	10.30	8.50	14.89	18.15	17.71	11.76	6.04	11.34	6.77	6.00
3L6	2.27	0.70	10.57	6.96	10.64	7.83	13.07	17.19	17.70	12.76	7.32	11.92	6.74	6.00
3L7	2.49	0.85	11.16	8.46	10.36	8.78	14.84	17.52	17.09	12.18	7.18	12.37	7.95	6.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges	
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Crown	Tooth	Crown	Tooth		Crown
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length		
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H			
3L8	0.49	0.42	10.84	8.68	11.95	9.57	15.92	18.39	18.77	13.32	8.56	12.16	8.41	6.00	
3L9	2.12	0.54	11.44	8.23	12.25	7.69	14.09	19.71	18.26	11.60	7.32	12.88	8.48	6.00	
3L10	1.02	0.47	9.80	8.02	10.91	9.14	14.67	17.21	17.37	11.49	7.24	12.69	7.99	6.00	
3L11	2.76	0.74	11.45	7.94	10.72	9.99	14.50	17.00	18.69	13.44	8.58	14.52	9.87	6.00	
3L12	1.46	0.50	7.72	4.61	7.65	5.54	9.31	13.83	11.93	6.23	4.40	7.63	4.14	6.00	
4L1	1.57	0.52	7.23	4.86	8.26	4.73	8.65	13.61	12.15	7.40	4.63	8.19	4.50	5.00	
4L2	1.51	0.30	8.28	6.32	9.10	5.65	10.35	15.10	13.96	8.20	4.79	8.33	6.53	5.00	
4L3	2.02	0.62	7.06	4.53	7.76	5.83	9.25	12.19	15.72	7.92	4.57	7.11	4.33	5.00	
4L4	1.30	0.38	7.67	5.52	8.26	6.02	10.17	13.96	12.14	8.36	5.20	8.71	4.99	5.00	
4L5	1.05	0.16	8.98	6.47	8.70	4.93	9.60	14.85	14.00	9.33	7.30	9.49	6.09	5.00	
4L6	1.72	0.32	8.76	6.85	8.38	5.86	10.96	14.41	13.30	9.52	6.20	8.92	5.71	5.00	
4L7	1.28	0.32	9.65	6.64	7.85	6.08	11.79	15.54	14.87	9.41	5.89	9.51	6.45	5.00	
4L8	2.38	0.55	10.65	7.55	8.73	6.06	12.45	17.55	14.65	9.08	6.19	8.82	5.70	5.00	
4L9	1.68	0.01	10.42	7.63	9.86	7.00	12.45	17.75	16.00	8.39	5.82	8.79	5.80	5.00	
4L10	1.14	0.35	9.36	7.37	8.11	5.91	11.84	15.66	16.39	8.03	10.32	9.16	12.53	5.00	
4L11	0.26	0.58	9.57	7.37	8.47	7.01	12.65	15.98	15.13	9.70	6.67	9.42	7.86	5.00	
4L12	1.65	0.54	9.16	6.59	8.61	7.11	12.09	15.10	15.36	11.40	6.34	10.88	7.38	5.00	
4L13	1.82	0.76	9.06	5.87	8.50	7.02	12.22	15.82	14.35	10.18	7.60	8.95	5.60	5.00	
4L14	0.60	0.22	7.00	5.39	7.06	5.86	9.36	9.70	17.76	10.53	6.48	9.47	7.05	5.00	
4L15	1.61	0.42	10.43	7.69	10.36	8.38	14.32	18.29	16.04	11.04	6.74	11.20	7.32	5.00	

**SUMMARY KUVP 55271 *P. martini***

Medial														
N=9														
Minimum	2.52	1.38	18.72	15.61	14.39	12.35	22.25	26.28	28.95	14.68	11.33	16.46	12.46	10.00
Maximum	7	4.78	24.92	21.06	22.46	20.71	37.59	41.00	40.88	24.67	15.81	21.00	16.03	10.00
Arithmetic Mean	4.487	2.609	21.32	17.93	19.37	17.36	31.80	34.91	36.12	18.86	14.09	18.85	14.44	10.00
Standard Deviation	1.306	0.995	2.59	2.01	2.52	2.42	4.56	4.69	3.37	2.65	1.41	1.74	1.09	0.00
RPM														
N=8														
Minimum	5.98	3.3	13.68	13.54	18.26	12.90	20.01	24.00	25.16	19.48	14.40	19.28	12.44	10.00

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown	Posterior Tooth	Anterior Tooth	Labial Tooth	Labial Crown	Lingual Tooth	Lingual Crown	# of Ridges
			r tooth edge	r crown edge	r tooth edge	r crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Maximum	8.63	4.93	24.67	16.06	20.22	14.54	24.58	30.23	30.65	25.39	18.04	21.99	15.48	10.00
Arithmetic Mean	7.38	4.149	19.77	14.81	19.07	13.53	22.40	27.83	27.44	22.38	16.21	20.77	14.55	10.00
Standard Deviation	0.923	0.588	3.53	0.97	0.63	0.64	1.45	1.96	1.95	2.06	1.13	0.88	1.06	0.00
R2														
N=14														
Minimum	1.72	0.76	9.51	7.48	10.63	8.33	13.63	16.54	15.38	10.44	7.45	11.20	7.03	7.00
Maximum	5.01	2.63	13.91	10.29	13.92	10.58	17.70	22.47	22.07	15.40	10.60	15.37	10.07	7.00
Arithmetic Mean	3.209	1.528	11.90	9.18	12.04	9.50	15.38	18.83	19.07	13.65	9.67	13.36	8.53	7.00
Standard Deviation	0.88	0.541	1.26	0.78	1.09	0.67	1.34	1.52	1.70	1.32	0.84	1.01	0.90	0.00
R3														
N=12														
Minimum	1.72	0.57	7.83	5.73	8.45	6.13	10.73	13.11	14.30	7.98	4.79	8.61	5.53	6.00
Maximum	3.3	1.28	11.15	8.87	10.84	8.83	15.49	18.32	16.97	12.41	8.46	12.61	8.68	6.00
Arithmetic Mean	2.186	0.926	9.13	6.96	9.85	7.54	12.81	15.79	15.59	11.12	6.95	10.90	6.97	6.00
Standard Deviation	0.42	0.274	1.19	0.91	0.74	0.70	1.23	1.66	0.89	1.31	1.26	1.40	1.04	0.00
R4														
N=13														
Minimum	0.82	0.15	6.05	4.90	7.17	4.94	9.94	12.14	11.27	6.66	4.08	6.38	4.34	5.00
Maximum	1.93	0.85	8.59	6.94	9.02	7.35	12.00	14.36	14.74	10.27	6.47	10.64	6.37	5.00
Arithmetic Mean	1.307	0.515	7.46	5.95	8.01	6.20	10.92	13.65	13.07	7.79	4.99	7.92	5.15	5.00
Standard Deviation	0.341	0.256	0.61	0.59	0.59	0.74	0.73	0.60	1.32	1.03	0.59	1.31	0.67	0.00
LPM														
N=9														
Minimum	2.5	0.17	12.21	9.93	10.41	9.28	16.97	18.06	20.63	13.68	9.55	14.58	10.03	9.00
Maximum	3.77	1.89	17.22	14.83	16.96	14.91	24.06	26.29	27.56	20.41	16.23	20.50	15.84	9.00
Arithmetic Mean	3.184	1.264	15.23	12.81	15.16	13.18	21.68	23.97	24.65	18.35	13.95	19.03	14.13	9.00
Standard Deviation	0.483	0.474	1.50	1.60	1.91	1.60	2.07	2.45	2.17	2.01	1.84	1.82	1.75	0.00



Distances in mm	Tooth Height	Crown Height	Apex to left posterior tooth edge	Apex to left posterior crown edge	Apex to right posterior tooth edge	Apex to right posterior crown edge	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
L2														
N=10														
Minimum	1.71	0.54	11.35	8.65	9.52	7.86	13.35	16.66	16.32	12.88	7.46	12.63	8.20	8.00
Maximum	3.64	2	14.46	9.95	13.01	10.53	17.61	20.85	21.15	17.40	10.82	15.73	11.54	8.00
Arithmetic Mean	2.662	1.17	12.50	9.26	11.55	9.58	15.97	18.85	18.82	14.34	9.22	14.40	9.84	8.00
Standard Deviation	0.596	0.498	1.04	0.56	1.23	0.92	1.44	1.62	1.55	1.26	0.90	1.20	1.01	0.00
L3														
N=12														
Minimum	0.49	0.18	7.72	4.61	7.65	5.54	9.31	13.83	11.93	6.23	4.40	7.63	4.15	6.00
Maximum	2.88	1.03	11.45	8.68	12.25	9.99	15.92	19.71	20.79	13.44	8.58	14.52	9.87	6.00
Arithmetic Mean	1.956	0.587	10.59	7.77	10.73	8.39	14.24	17.95	17.81	11.46	7.14	11.68	7.44	6.00
Standard Deviation	0.735	0.222	1.04	1.09	1.16	1.13	1.70	1.61	2.12	1.87	1.14	1.63	1.37	0.00
L4														
N=15														
Minimum	0.26	0.01	7.00	4.53	7.06	4.73	8.65	9.70	12.14	7.40	4.57	7.11	4.33	5.00
Maximum	2.38	0.76	10.65	7.69	10.36	8.38	14.32	18.29	17.76	11.40	10.32	11.20	12.53	5.00
Arithmetic Mean	1.439	0.403	8.89	6.45	8.53	6.23	11.21	15.03	14.79	9.23	6.32	9.13	6.52	5.00
Standard Deviation	0.533	0.195	1.22	1.02	0.81	0.93	1.60	2.18	1.55	1.19	1.44	1.00	1.96	0.00
<b>Isolated Kansas specimens <i>P. martini</i></b>														
Specimens														
KUVP 55237	15.423	8.7542	35.145	23.34	33.448	20.881	32.61	48.352	32.385	23.438	35.117	52.057	24.313	12.00
KUVP 55245	5.0089	2.3265	12.751	10.166	11.407	6.2808	12.915	18.252	12.57	9.1615	11.281	17.429	9.7344	7.00
<b>Isolated Texas specimens of <i>P. martini</i></b>														
SMU 69031	1.35	0.72	17.25	15.85	20.91	14.93	27.02	31.64	30.58	16.96	12.48	17.34	11.77	6.00
SMU 76248	7.19	2.65	20.21	15.60	19.00	9.83	18.45	35.25	22.80	13.66	18.46	24.25	20.47	8.00
SMU 76249	12.77	8.09	22.42	17.60	23.80	11.64	19.50	34.75	26.01	13.73	20.53	25.76	17.99	10.00
SMU 76250 (5 teeth)	6.04	3.07	13.79	9.89	13.43	7.26	13.18	20.92	15.06	12.52	11.10	17.44	11.08	7.00
	3.15	1.42	11.00	7.41	9.51	5.45	9.79	18.39	11.41	7.37	8.84	12.84	9.99	7.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
	2.08	0.65	6.60	6.27	7.39	2.31	7.34	12.25	8.30	4.55	5.86	9.87	5.68	7.00
	6.60	2.94	12.89	8.21	12.85	5.63	9.76	20.76	15.35	7.19	9.38	13.40	9.28	7.00
	3.58	2.38	9.43	8.89	10.84	6.10	11.27	18.16	14.95	6.53	9.91	11.69	11.58	7.00
SMU 76264	6.77	3.15	16.30	10.24	17.28	7.91	12.32	28.61	19.39	9.00	12.58	18.48	12.53	6.00
SMU 76265	1.39	0.73	7.43	5.52	10.38	7.46	11.23	15.45	15.53	9.66	6.58	9.39	6.42	6.00
SMU 76427	3.13	1.41	11.32	7.22	13.73	6.53	9.27	23.90	13.35	8.99	10.57	12.08	12.17	6.00

*Ptychodus latissimus*

Specimens:	Texas specimens, isolated teeth													
SMU 62807	3.38	0.70	7.92	6.01	7.84	5.36	8.00	11.15	11.52	9.57	6.48	10.18	6.40	8.00
SMP 63286 (2 teeth)	4.65	2.76	8.49	6.61	10.64	7.93	14.03	8.50	11.91	5.34	5.34	9.71	6.25	5.00
	4.56	3.37	10.82	7.08	9.85	8.78	13.23	10.29	13.22	6.61	6.61	12.20	7.74	6.00
SMU 75590	7.34	3.55	14.30	9.64	11.89	7.65	13.72	17.95	22.43	13.01	9.44	14.72	8.38	5.00
SMU 75591	5.13	3.14	10.46	7.26	10.02	6.34	9.68	12.78	14.21	10.45	6.94	10.74	6.80	6.00
SMU 75592	4.41	3.01	9.54	5.87	7.68	4.38	6.98	10.47	9.35	9.08	5.26	10.25	4.59	6.00
SMU 76251 (5 teeth)	9.04	6.19	17.26	14.35	16.87	21.67	24.98	14.68	29.39	9.13	9.13	6.60	9.13	8.00
	4.73	4.19	12.30	13.19	14.43	22.32	19.88	16.37	26.33	10.85	10.85	12.97	11.42	6.00
	7.13	4.12	16.95	13.50	14.96	22.63	23.97	14.45	27.60	11.62	11.62	15.81	9.30	6.00
	5.63	3.29	10.72	8.70	10.57	14.16	13.81	12.84	14.53	7.64	7.64	11.98	8.49	6.00
	3.17	1.78	7.37	5.99	6.38	9.75	11.12	7.58	13.59	6.08	6.08	7.72	5.32	5.00
SMU 76432 19 teeth	4.86	3.64	10.49	7.05	10.75	10.07	15.32	9.37	8.93	6.79	6.79	14.62	7.86	6.00
	10.65	3.67	12.50	7.02	17.07	12.00	19.02	321.04	0.00	5.93	5.93	339.94	7.65	7.00
	6.88	6.95	15.15	10.66	15.05	13.97	21.02	16.25	19.18	11.65	11.65	14.36	363.33	8.00
	0.82	4.27	14.62	8.96	12.65	12.80	18.01	16.25	21.23	9.94	9.94	5.37	9.03	8.00
	4.74	3.43	15.09	7.27	10.06	10.53	19.62	8.56	15.67	4.63	4.63	7.76	5.69	7.00
	2.42	3.44	9.90	7.35	7.85	7.71	10.66	19.09	13.79	5.97	5.97	3.66	6.64	5.00
	4.00	2.28	8.06	4.97	8.23	7.80	11.43	6.46	12.95	4.75	4.75	8.33	5.26	5.00
	6.62	3.01	12.67	6.59	9.95	9.89	17.55	7.74	15.92	7.05	7.05	12.34	6.89	7.00
	4.41	3.66	11.44	7.03	9.72	10.61	12.80	10.90	8.92	5.81	5.81	9.03	7.03	7.00
	8.44	4.57	16.77	10.76	17.15	14.44	24.34	13.65	26.43	7.84	7.84	14.19	8.19	7.00
	6.11	3.23	11.39	7.26	11.06	10.49	15.66	9.52	15.71	5.38	5.38	12.86	6.34	6.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
	4.60	2.72	9.24	6.22	8.11	8.35	11.40	8.39	11.06	4.94	4.94	8.50	5.81	6.00
	5.71	2.67	8.94	6.10	9.78	7.87	11.81	12.23	18.95	5.40	5.40	5.52	6.46	6.00
	1.59	1.20	7.01	2.75	8.15	4.03	6.84	12.20	7.32	2.10	2.10	5.24	2.33	5.00
	6.28	3.32	11.45	6.75	9.41	8.47	14.45	10.51	12.84	5.29	5.29	10.59	5.37	6.00
	2.90	3.35	12.20	5.64	13.68	4.51	9.32	10.90	3.84	6.61	6.61	17.20	10.23	6.00
	4.31	1.71	8.23	4.26	9.93	7.45	13.14	7.77	14.87	2.68	2.68	7.96	3.10	5.00
	3.02	1.07	6.19	4.26	4.41	5.87	7.53	7.74	9.13	3.77	3.77	5.55	4.26	5.00
	3.60	1.78	7.02	4.66	5.99	4.80	7.69	4.14	9.16	4.09	4.09	7.73	4.55	5.00
	1.64	0.64	4.66	3.74	3.58	5.81	5.28	4.25	5.88	3.54	3.54	4.55	2.98	5.00

*Ptychodus mortoni*

Tooth File	SMU 76278 <i>P. mortoni</i> Lower dentition													
M1	9.07	3.10	15.21	5.59	16.85	5.77	7.20	20.49	18.95	13.59	7.35	13.74	7.03	18.00
M2	10.64	2.72	16.60	6.05	17.09	6.05	7.07	19.05	19.17	15.06	8.97	14.34	7.37	18.00
M3	9.69	3.89	16.07	6.93	17.43	6.82	8.19	19.52	20.10	14.22	7.69	13.06	8.06	18.00
M4	9.81	4.13	16.08	7.53	15.91	6.59	7.77	16.68	18.56	13.79	7.64	14.64	7.86	18.00
RPM1	8.86	3.44	14.67	6.18	16.92	7.42	8.57	19.50	17.87	14.66	7.97	13.96	8.70	15.00
RPM2	8.91	4.25	16.46	7.85	15.68	7.34	8.31	18.87	17.55	15.06	9.00	14.04	7.89	15.00
RPM3	9.30	3.12	15.36	6.23	14.39	5.72	8.01	17.63	17.15	14.28	8.58	14.59	7.58	15.00
RPM4	7.98	3.73	14.06	6.50	14.96	6.57	8.53	16.44	16.59	14.15	7.05	14.56	7.98	15.00
RPM5	7.96	3.19	14.45	5.88	14.59	5.61	7.45	16.71	17.60	14.63	7.64	14.61	7.00	15.00
RPM6	9.49	3.43	14.04	4.84	15.24	5.86	7.42	16.69	17.63	13.99	6.42	14.28	7.08	15.00
RPM7	8.59	2.69	13.95	5.75	12.10	5.06	7.86	16.04	16.85	13.30	7.37	12.85	6.72	15.00
2R1	9.30	3.18	15.99	6.04	12.94	4.75	6.80	17.59	15.96	12.85	5.68	11.52	5.35	12.00
2R2	7.33	3.61	15.27	5.29	13.70	5.19	6.06	15.43	12.85	12.97	0.00	18.29	6.12	12.00
2R3	8.12	0.03	13.90	5.58	13.65	7.14	4.69	16.25	17.91	13.35	10.37	13.10	4.37	12.00
2R4	7.60	0.84	15.06	5.00	11.50	4.62	7.44	16.42	17.87	13.20	7.75	11.41	5.28	12.00
2R5	8.34	2.00	14.69	5.75	12.81	5.97	7.86	15.93	16.55	12.77	6.14	12.66	7.50	12.00
2R6	6.52	3.15	13.56	5.78	11.46	4.95	6.91	15.49	16.60	11.88	5.79	13.86	6.38	12.00
2R7	8.72	2.42	13.48	4.72	13.15	4.92	6.14	15.30	15.89	12.75	5.94	12.74	5.82	12.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	Width F-G	Width B-C	Width E-D	Length B-E	Length F-I	Length C-D	Length G-H	
2R8	8.31	3.13	11.53	6.21	13.41	5.40	7.07	14.36	15.86	12.65	6.45	12.62	6.22	12.00
2R9	8.58	3.78	12.43	6.83	12.60	5.59	7.53	15.02	16.24	10.87	6.10	11.12	6.10	12.00
3R1	7.85	2.55	14.43	6.02	12.93	4.96	8.76	16.78	15.97	13.09	8.07	13.53	6.12	12.00
3R2	9.39	4.08	11.90	6.33	12.41	5.57	7.35	10.76	15.91	11.91	5.26	17.69	6.12	12.00
3R3	8.04	3.14	15.65	6.07	12.73	5.63	7.54	18.87	15.48	12.10	6.61	12.09	7.23	12.00
3R4	8.26	3.25	15.92	6.04	12.04	5.38	7.28	17.47	15.06	10.72	6.63	11.94	6.34	12.00
3R5	9.66	3.82	16.13	7.33	13.89	6.30	8.56	16.23	16.84	13.08	7.18	12.56	5.83	12.00
3R6	8.09	3.05	14.22	5.65	11.70	5.22	6.77	15.87	16.27	11.73	6.50	10.86	5.95	12.00
3R7	8.66	2.88	15.97	6.17	13.03	5.13	8.91	18.88	14.72	10.71	6.31	11.98	6.81	12.00
3R8	3.87	3.16	13.46	6.29	12.00	5.15	7.13	14.92	14.04	13.21	5.86	11.49	5.91	12.00
4R1	7.52	2.98	14.58	5.52	10.76	4.26	6.83	14.75	15.80	11.53	8.89	8.89	9.07	10.00
4R2	8.62	3.03	13.86	6.05	12.29	4.12	7.29	14.87	17.46	10.43	5.47	11.57	5.47	10.00
4R3	4.45	1.63	6.49	5.02	4.50	4.19	7.06	4.06	5.97	12.64	4.51	8.06	7.27	10.00
4R4	6.50	1.68	13.90	4.59	8.76	4.14	7.07	16.74	15.98	10.14	5.14	9.90	6.50	10.00
4R5	8.01	3.35	14.99	6.03	11.37	4.82	5.05	14.18	13.97	12.89	6.38	9.95	5.41	10.00
4R6	8.09	3.77	13.50	4.49	10.53	5.37	5.46	15.26	10.57	9.50	5.35	11.04	6.00	10.00
4R7	4.55	3.20	5.38	5.90	7.97	3.71	6.32	7.92	10.77	10.46	5.51	6.74	5.50	10.00
5R1	6.87	2.72	12.27	4.91	10.81	4.40	5.67	14.52	13.60	10.54	4.50	9.28	4.39	8.00
5R2	3.21	2.68	12.00	4.98	10.95	4.09	5.24	13.52	12.64	11.66	4.42	9.84	4.35	8.00
5R3	7.38	2.04	13.07	4.38	10.54	3.55	5.24	15.12	13.12	9.45	4.88	9.56	4.37	8.00
5R4	7.10	2.04	14.40	5.96	10.98	4.63	5.89	16.97	11.98	8.02	4.22	10.04	4.72	8.00
5R5	6.88	2.32	11.73	4.69	11.26	4.29	5.02	11.70	11.83	10.73	4.45	11.07	5.30	8.00
5R6	6.38	2.08	9.70	2.82	8.03	4.69	4.59	11.12	14.60	10.04	4.49	7.67	5.95	8.00
6R1	5.76	2.20	11.78	5.76	10.31	4.14	5.43	11.45	10.54	10.49	5.09	11.04	6.90	8.00
6R2	5.97	1.13	10.79	5.11	9.77	3.74	5.70	10.97	10.75	9.84	4.58	11.05	7.02	8.00
6R3	6.28	2.78	12.08	4.50	9.63	4.76	4.98	11.42	11.51	10.34	5.67	8.92	5.52	8.00
6R4	6.24	3.37	11.24	5.63	9.57	4.15	5.65	10.97	10.98	11.18	5.49	10.60	5.78	8.00
6R5	6.26	3.01	12.03	5.40	7.62	4.36	6.01	10.52	12.87	9.90	4.84	8.17	6.11	8.00
6R6	6.12	3.29	12.29	5.90	7.00	4.89	6.34	12.23	14.87	8.51	4.95	8.62	5.52	8.00
6R7	5.90	3.01	12.87	6.44	8.72	4.07	6.47	13.12	10.94	10.12	4.94	9.16	6.10	8.00
6R8	6.10	2.48	9.98	4.29	9.48	3.07	4.99	12.15	11.53	10.56	5.65	10.51	5.47	8.00
7R1	5.56	2.80	11.93	4.56	9.46	5.22	6.51	14.56	10.45	7.91	4.43	7.58	4.65	6.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
7R2	5.85	2.56	11.91	4.88	9.67	4.07	5.41	12.06	10.45	11.28	5.83	9.22	5.73	6.00
7R3	6.26	2.81	11.96	4.78	9.37	3.57	5.29	11.89	9.01	11.29	5.05	9.80	5.59	6.00
7R4	6.49	2.73	10.52	4.66	9.52	3.45	5.13	10.89	9.92	9.68	4.39	8.25	4.28	6.00
7R5	3.83	1.50	9.12	4.16	8.20	3.68	4.06	8.81	3.89	10.50	4.45	8.75	5.01	6.00
8R1	4.66	1.24	10.90	5.17	8.10	3.76	5.66	11.21	10.15	7.07	2.08	8.75	3.47	4.00
8R2	3.80	1.77	10.76	5.08	8.20	3.50	4.99	11.11	10.22	8.10	3.07	8.02	3.10	4.00
9R1	4.11	1.35	9.82	5.45	6.91	3.22	4.35	9.81	8.97	7.27	8.26	7.17	4.11	2.00
9R2	3.21	1.89	7.72	4.40	5.40	3.31	4.39	5.56	5.32	7.07	7.12	7.16	4.73	2.00
9R3	3.33	1.62	7.97	4.63	5.20	3.25	5.33	6.43	4.81	7.51	6.58	6.89	5.15	2.00
9R4	2.97	1.47	7.47	4.16	5.61	3.37	3.45	4.69	5.82	6.62	7.66	7.43	4.32	2.00
10R1	2.94	0.17	6.50	2.87	7.33	2.94	4.23	7.21	9.97	8.20	3.64	6.81	2.25	1.00
LPM1	3.77	1.10	13.37	5.29	15.13	6.01	7.75	19.28	18.07	13.31	7.87	15.70	9.99	15.00
LPM2	3.74	1.27	14.40	5.57	15.75	6.37	7.32	17.92	18.48	12.98	6.81	15.56	8.78	15.00
LPM3	2.55	1.22	13.06	5.11	15.69	6.83	10.72	17.48	19.71	13.70	9.94	14.40	6.24	15.00
LPM4	2.50	1.29	14.31	5.64	13.14	3.74	7.42	18.45	17.51	13.34	6.03	14.06	6.55	15.00
LPM5	2.45	1.10	13.96	6.45	14.56	5.93	10.65	16.48	18.77	11.86	7.13	13.88	7.10	15.00
LPM6	2.32	0.80	16.45	5.61	14.02	5.77	8.77	17.51	15.03	10.49	7.55	13.64	7.73	15.00
2L1	1.71	0.54	13.46	5.38	14.36	5.59	7.82	17.43	17.66	12.51	6.73	11.35	7.14	12.00
2L2	1.85	0.60	12.56	5.56	14.51	5.80	10.17	16.87	9.93	19.51	6.39	9.67	6.34	12.00
2L3	2.61	0.73	13.42	5.71	14.91	5.64	8.05	16.70	18.74	12.42	6.93	12.21	8.03	12.00
2L4	3.09	1.44	13.47	6.63	16.10	5.54	7.01	19.81	15.05	13.27	6.87	11.97	7.30	12.00
2L5	2.98	1.25	5.88	5.88	14.70	6.72	8.49	14.86	14.57	15.07	5.30	11.76	8.73	12.00
2L6	3.64	2.00	11.92	6.62	16.84	7.07	8.91	18.87	15.23	13.08	7.46	13.06	8.18	12.00
3L1	2.89	1.65	12.56	5.04	12.36	5.80	9.95	17.05	17.36	11.56	6.19	10.86	5.38	12.00
3L2	3.08	1.59	13.45	5.60	13.62	7.07	8.02	15.57	14.20	11.47	5.57	10.41	7.14	12.00
3L3	2.34	0.58	13.85	5.81	12.90	7.00	8.47	15.98	16.11	12.94	5.74	11.34	6.93	12.00
3L4	2.88	1.03	10.27	4.29	12.70	6.54	8.08	13.64	16.41	10.64	5.55	10.31	5.47	12.00
4L1	1.29	0.18	13.34	5.37	13.62	5.82	7.32	15.25	15.63	11.55	5.10	10.76	5.10	10.00
4L2	2.36	0.60	10.88	3.92	14.97	4.91	6.67	17.99	11.93	11.74	5.15	9.32	5.35	10.00
4L3	1.99	0.43	11.13	5.59	13.83	6.00	7.26	13.15	13.22	11.40	6.12	12.17	5.61	10.00
4L4	2.27	0.70	11.72	5.92	14.43	5.81	8.86	16.67	13.69	10.55	6.64	10.13	5.87	10.00
4L5	2.49	0.85	10.47	5.07	12.98	5.74	7.66	14.69	13.93	9.67	11.39	12.10	8.93	10.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
4L6	0.49	0.42	10.99	5.72	12.06	5.55	6.99	11.83	12.95	10.81	4.75	12.63	6.41	10.00
4L7	2.12	0.54	11.84	5.32	13.12	5.34	5.74	10.59	7.73	12.49	9.88	13.85	8.27	10.00
4L8	1.02	0.47	11.04	4.39	12.92	5.39	5.30	12.55	17.38	7.98	3.87	10.97	4.42	10.00
5L1	2.76	0.74	10.19	5.28	11.52	4.61	6.09	14.44	13.33	8.93	5.71	9.29	4.93	8.00
5L2	1.46	0.50	12.86	5.00	8.90	5.97	5.50	12.24	13.85	8.08	10.56	11.26	8.00	8.00
5L3	1.57	0.52	11.68	5.19	11.47	5.09	5.48	12.62	13.39	6.01	9.74	11.21	6.76	8.00
5L4	1.51	0.30	9.57	4.92	10.47	5.35	4.95	11.60	14.03	10.23	10.54	11.96	6.93	8.00
5L5	2.02	0.62	7.86	6.93	13.07	6.62	7.17	16.54	8.32	2.47	10.85	12.98	7.89	8.00
5L6	1.30	0.38	9.11	4.25	11.39	5.83	7.24	10.53	12.03	9.79	5.29	11.04	4.73	8.00
5L7	1.05	0.16	11.67	7.48	12.45	6.27	8.74	15.24	12.41	10.12	6.13	9.16	5.76	8.00
5L8	1.72	0.32	10.49	5.77	11.74	5.31	7.12	16.38	12.49	10.68	7.40	6.53	5.15	8.00
6L1	1.28	0.32	7.19	3.48	11.04	4.29	6.53	10.51	12.07	8.92	3.74	10.74	5.20	8.00
6L2	2.38	0.55	11.06	4.27	10.86	5.12	4.24	7.06	8.35	12.09	8.99	11.13	5.73	8.00
6L3	1.68	0.01	8.75	3.94	12.69	4.71	5.31	14.80	9.63	10.29	4.63	7.85	3.96	8.00
6L4	1.14	0.35	8.65	4.94	11.89	5.47	5.46	11.11	9.76	3.47	6.32	13.51	6.78	8.00
6L5	0.26	0.58	8.91	4.16	11.62	4.90	5.39	10.87	9.95	8.69	5.92	10.81	5.42	8.00
6L6	1.65	0.54	10.06	4.35	10.27	5.42	5.55	13.87	11.55	9.63	11.43	11.21	7.25	8.00
6L7	1.82	0.76	9.51	4.69	9.54	5.05	6.17	10.97	11.76	8.01	4.18	9.83	5.38	8.00
6L8	0.60	0.22	10.97	5.43	11.24	6.31	6.04	15.27	8.35	5.43	8.07	16.29	9.40	8.00
6L9	1.61	0.42	8.60	4.56	10.89	5.08	7.02	10.78	10.19	9.35	5.14	10.01	4.18	8.00
7L1	6.49	3.63	9.37	6.71	12.70	5.23	6.66	9.70	7.16	8.65	5.72	11.21	4.90	6.00
7L2	6.06	1.72	8.52	3.91	8.72	3.84	3.52	8.66	13.42	8.59	9.14	7.00	4.56	6.00
8L1	5.70	3.16	9.45	5.39	10.14	3.73	4.49	10.69	10.34	7.51	5.67	7.18	3.89	4.00
8L2	5.96	2.51	9.39	4.66	8.87	4.19	5.01	8.70	10.82	8.81	5.03	7.66	3.47	4.00
8L3	4.21	2.35	10.10	5.83	11.05	4.66	6.69	11.00	10.94	7.60	4.32	9.27	4.25	4.00
8L4	5.45	2.26	9.18	4.41	7.20	3.69	5.11	9.90	10.18	10.30	4.27	8.74	3.42	4.00
9L1	5.04	1.52	9.31	4.50	10.81	5.11	5.62	10.46	9.78	7.36	4.53	7.37	4.46	2.00
9L2	3.01	0.51	6.42	3.18	6.16	3.21	2.04	5.96	5.81	6.78	4.53	4.73	4.46	2.00
10L1	3.74	1.82	6.97	3.48	5.66	2.26	3.26	8.12	8.03	6.99	3.65	5.79	2.99	1.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
N=4														
Minimum	9.07	2.72	15.21	5.59	15.91	5.77	7.07	16.68	18.56	13.59	7.35	13.06	7.03	18.00
Maximum	10.64	4.13	16.60	7.53	17.43	6.82	8.19	20.49	20.10	15.06	8.97	14.64	8.06	18.00
Arithmetic Mean	9.803	3.46	15.99	6.52	16.82	6.31	7.56	18.93	19.20	14.17	7.91	13.94	7.58	18.00
Standard Deviation	0.646	0.661	0.58	0.87	0.65	0.48	0.52	1.62	0.65	0.65	0.72	0.70	0.47	0.00
RPM														
N=7														
Minimum	7.96	2.69	13.95	4.84	12.10	5.06	7.42	16.04	16.59	13.30	6.42	12.85	6.72	15.00
Maximum	9.49	4.25	16.46	7.85	16.92	7.42	8.57	19.50	17.87	15.06	9.00	14.61	8.70	15.00
Arithmetic Mean	8.727	3.407	14.71	6.18	14.84	6.23	8.02	17.41	17.32	14.30	7.72	14.13	7.56	15.00
Standard Deviation	0.595	0.493	0.91	0.91	1.47	0.90	0.48	1.32	0.47	0.57	0.89	0.62	0.69	0.00
R2														
N=9														
Minimum	6.52	0.03	11.53	4.72	11.46	4.62	4.69	14.36	12.85	10.87	0.00	11.12	4.37	12.00
Maximum	9.3	3.78	15.99	6.83	13.70	7.14	7.86	17.59	17.91	13.35	10.37	18.29	7.50	12.00
Arithmetic Mean	8.091	2.46	13.99	5.69	12.80	5.39	6.72	15.75	16.19	12.59	6.03	13.04	5.91	12.00
Standard Deviation	0.829	1.287	1.42	0.64	0.83	0.78	0.97	0.93	1.48	0.77	2.71	2.16	0.87	0.00
R3														
N=8														
Minimum	3.87	2.55	11.90	5.65	11.70	4.96	6.77	10.76	14.04	10.71	5.26	10.86	5.83	12.00
Maximum	9.66	4.08	16.13	7.33	13.89	6.30	8.91	18.88	16.84	13.21	8.07	17.69	7.23	12.00
Arithmetic Mean	7.978	3.241	14.71	6.24	12.59	5.42	7.79	16.22	15.54	12.07	6.55	12.77	6.29	12.00
Standard Deviation	1.784	0.493	1.50	0.49	0.71	0.42	0.83	2.61	0.90	1.01	0.84	2.13	0.49	0.00
R4														
N=7														
Minimum	4.45	1.63	5.38	4.49	4.50	3.71	5.05	4.06	5.97	9.50	4.51	6.74	5.41	10.00
Maximum	8.62	3.77	14.99	6.05	12.29	5.37	7.29	16.74	17.46	12.89	8.89	11.57	9.07	10.00
Arithmetic Mean	6.82	2.806	11.81	5.37	9.46	4.37	6.44	12.54	12.93	11.09	5.89	9.45	6.46	10.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Standard Deviation	1.714	0.828	4.06	0.67	2.64	0.55	0.87	4.68	4.04	1.30	1.43	1.69	1.33	0.00
R5														
N=6														
Minimum	3.21	2.04	9.70	2.82	8.03	3.55	4.59	11.12	11.83	8.02	4.22	7.67	4.35	8.00
Maximum	7.38	2.72	14.40	5.96	11.26	4.69	5.89	16.97	14.60	11.66	4.88	11.07	5.95	8.00
Arithmetic Mean	6.303	2.313	12.19	4.62	10.43	4.28	5.27	13.82	12.96	10.07	4.50	9.58	4.85	8.00
Standard Deviation	1.551	0.317	1.56	1.03	1.20	0.42	0.46	2.19	1.04	1.25	0.21	1.12	0.65	0.00
R6														
N=8														
Minimum	5.76	1.13	9.98	4.29	7.00	3.07	4.98	10.52	10.54	8.51	4.58	8.17	5.47	6.00
Maximum	6.28	3.37	12.87	6.44	10.31	4.89	6.47	13.12	14.87	11.18	5.67	11.05	7.02	6.00
Arithmetic Mean	6.079	2.659	11.63	5.38	9.01	4.15	5.70	11.60	11.75	10.12	5.15	9.76	6.05	6.00
Standard Deviation	0.188	0.731	0.92	0.72	1.15	0.57	0.56	0.85	1.45	0.78	0.40	1.16	0.61	0.00
R7														
N=5														
Minimum	3.83	1.5	9.12	4.16	8.20	3.45	4.06	8.81	3.89	7.91	4.39	7.58	4.28	4.00
Maximum	6.49	2.81	11.96	4.88	9.67	5.22	6.51	14.56	10.45	11.29	5.83	9.80	5.73	4.00
Arithmetic Mean	5.598	2.48	11.09	4.61	9.25	4.00	5.28	11.64	8.74	10.13	4.83	8.72	5.05	4.00
Standard Deviation	1.052	0.557	1.26	0.28	0.59	0.72	0.87	2.08	2.78	1.41	0.62	0.85	0.62	0.00
R8														
N=2														
Minimum	3.8	1.24	10.76	5.08	8.10	3.50	4.99	11.11	10.15	7.07	2.08	8.02	3.10	2.00
Maximum	4.66	1.77	10.90	5.18	8.20	3.76	5.66	11.21	10.22	8.11	3.07	8.75	3.47	2.00
Arithmetic Mean	4.23	1.505	10.83	5.13	8.15	3.63	5.32	11.16	10.18	7.59	2.58	8.39	3.28	2.00
Standard Deviation	0.608	0.375	0.10	0.07	0.07	0.18	0.47	0.06	0.05	0.73	0.70	0.52	0.27	0.00
R9														
N=4														



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Minimum	2.97	1.35	7.47	4.16	5.20	3.22	3.45	4.69	4.81	6.62	6.58	6.89	4.11	1.00
Maximum	4.11	1.89	9.82	5.45	6.91	3.37	5.33	9.81	8.97	7.52	8.26	7.43	5.15	1.00
Arithmetic Mean	3.405	1.583	8.25	4.66	5.78	3.29	4.38	6.62	6.23	7.12	7.41	7.16	4.58	1.00
Standard Deviation	0.493	0.233	1.07	0.56	0.77	0.07	0.77	2.24	1.88	0.38	0.72	0.22	0.46	0.00
R10														
N=1														
Minimum	2.94	0.17	6.50	2.87	7.33	2.94	4.23	7.21	9.97	8.20	3.64	6.81	2.25	15.00
Maximum	2.94	0.17	6.50	2.87	7.33	2.94	4.23	7.21	9.97	8.20	3.64	6.81	2.25	15.00
Arithmetic Mean	2.94	0.17	6.50	2.87	7.33	2.94	4.23	7.21	9.97	8.20	3.64	6.81	2.25	15.00
Standard Deviation														0.00
LPM														
N=6														
Minimum	2.32	0.8	13.06	5.11	13.14	3.74	7.32	16.48	15.03	10.49	6.03	13.64	6.25	12.00
Maximum	3.77	1.29	16.45	6.45	15.75	6.83	10.72	19.28	19.71	13.70	9.94	15.70	9.99	12.00
Arithmetic Mean	2.888	1.13	14.26	5.61	14.72	5.77	8.77	17.85	17.93	12.61	7.55	14.54	7.73	12.00
Standard Deviation	0.676	0.181	1.19	0.46	1.02	1.07	1.57	0.95	1.60	1.22	1.33	0.88	1.43	0.00
L2														
N=6														
Minimum	1.71	0.54	5.88	5.38	14.36	5.54	7.01	14.86	9.93	12.42	5.30	9.67	6.35	12.00
Maximum	3.64	2	13.47	6.63	16.84	7.07	10.17	19.81	18.74	19.51	7.46	13.06	8.73	12.00
Arithmetic Mean	2.647	1.093	11.78	5.96	15.24	6.06	8.41	17.42	15.20	14.31	6.61	11.67	7.62	12.00
Standard Deviation	0.749	0.574	2.96	0.54	1.00	0.66	1.08	1.74	3.06	2.72	0.73	1.13	0.86	0.00
L3														
N=4														
Minimum	2.34	0.58	10.27	4.29	12.36	5.80	8.02	13.64	14.20	10.64	5.55	10.31	5.38	10.00
Maximum	3.08	1.65	13.85	5.81	13.62	7.07	9.95	17.05	17.36	12.94	6.19	11.34	7.14	10.00
Arithmetic Mean	2.797	1.213	12.53	5.18	12.89	6.60	8.63	15.56	16.02	11.65	5.76	10.73	6.23	10.00
Standard Deviation	0.319	0.506	1.60	0.68	0.53	0.59	0.90	1.42	1.33	0.95	0.30	0.47	0.94	0.00

Distances in mm	Tooth Height	Crown Height	Apex to left posterior tooth edge	Apex to left posterior crown edge	Apex to right posterior tooth edge	Apex to right posterior crown edge	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
L4														
N=8														
Minimum	0.49	0.18	10.47	3.92	12.06	4.91	5.30	10.59	7.73	7.98	3.87	9.32	4.42	8.00
Maximum	2.49	0.85	13.34	5.92	14.97	6.00	8.86	17.99	17.38	12.49	11.39	13.85	8.93	8.00
Arithmetic Mean	1.754	0.524	11.43	5.16	13.49	5.57	6.98	14.09	13.31	10.77	6.61	11.49	6.25	8.00
Standard Deviation	0.729	0.201	0.89	0.69	0.92	0.35	1.11	2.51	2.82	1.41	2.65	1.47	1.57	0.00
L5														
N=8														
Minimum	1.05	0.16	7.86	4.25	8.90	4.61	4.95	10.53	8.32	2.47	5.29	6.53	4.73	8.00
Maximum	2.76	0.74	12.86	7.48	13.07	6.62	8.75	16.54	14.03	10.68	10.85	12.98	8.00	8.00
Arithmetic Mean	1.674	0.443	10.43	5.60	11.38	5.63	6.54	13.70	12.48	8.29	8.28	10.43	6.27	8.00
Standard Deviation	0.523	0.188	1.61	1.09	1.26	0.66	1.26	2.27	1.83	2.80	2.39	2.02	1.31	0.00
L6														
N=9														
Minimum	0.26	0.01	7.19	3.48	9.54	4.29	4.24	7.06	8.35	3.47	3.74	7.85	3.96	6.00
Maximum	2.38	0.76	11.06	5.43	12.69	6.31	7.02	15.27	12.07	12.09	11.43	16.29	9.40	6.00
Arithmetic Mean	1.38	0.417	9.30	4.42	11.12	5.15	5.74	11.69	10.18	8.43	6.49	11.26	5.92	6.00
Standard Deviation	0.646	0.222	1.24	0.57	0.91	0.56	0.81	2.56	1.38	2.58	2.54	2.40	1.68	0.00
L7														
N=2														
Minimum	6.06	1.72	8.52	3.91	8.72	3.84	3.52	8.66	7.16	8.59	5.72	7.00	4.56	4.00
Maximum	6.49	3.63	9.37	6.71	12.70	5.23	6.66	9.70	13.42	8.65	9.15	11.21	4.90	4.00
Arithmetic Mean	6.275	2.675	8.95	5.31	10.71	4.53	5.09	9.18	10.29	8.62	7.43	9.10	4.73	4.00
Standard Deviation	0.304	1.351	0.60	1.98	2.81	0.98	2.22	0.74	4.42	0.05	2.42	2.98	0.24	0.00
L8														
N=4														
Minimum	4.21	2.26												

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Maximum	5.96	3.16	9.18	4.41	7.20	3.69	4.50	8.70	10.18	7.52	4.27	7.18	3.42	4.00
Arithmetic Mean	5.33	2.57	10.10	5.83	11.05	4.66	6.69	11.00	10.94	10.30	5.67	9.27	4.25	4.00
Standard Deviation	0.775	0.407	9.53	5.07	9.32	4.07	5.33	10.07	10.57	8.56	4.83	8.21	3.76	4.00
Standard Deviation			0.40	0.65	1.67	0.46	0.95	1.02	0.37	1.30	0.66	0.96	0.39	0.00
L9														
N=2														
Minimum	3.01	0.51	6.42	3.18	6.16	3.21	2.04	5.96	5.81	6.78	4.53	4.73	4.46	2.00
Maximum	5.04	1.52	9.31	4.50	10.81	5.11	5.63	10.46	9.78	7.36	4.53	7.38	4.46	2.00
Arithmetic Mean	4.025	1.015	7.87	3.84	8.49	4.16	3.83	8.21	7.80	7.07	4.53	6.05	4.46	2.00
Standard Deviation	1.435	0.714	2.05	0.93	3.29	1.35	2.53	3.18	2.81	0.41	0.00	1.87	0.00	0.00
L10														
N=1														
Minimum	3.74	1.82	6.98	3.48	5.66	2.26	3.26	8.12	8.03	6.99	3.66	5.79	2.99	1.00
Maximum	3.74	1.82	6.98	3.48	5.66	2.26	3.26	8.12	8.03	6.99	3.66	5.79	2.99	1.00
Arithmetic Mean	3.74	1.82	6.98	3.48	5.66	2.26	3.26	8.12	8.03	6.99	3.66	5.79	2.99	1.00
Standard Deviation														0.00

Tooth File	SMU 76359 <i>P. mortoni</i> Lower dentition													
M1	10.27	4.71	22.73	15.19	22.54	14.88	22.33	30.22	30.48	19.62	13.29	19.41	13.19	cw
RPM1	10.54	4.92	15.29	7.89	15.76	9.40	9.30	17.36	17.61	13.86	6.78	14.51	8.26	12.00
RPM2	9.71	5.28	14.60	8.02	16.73	7.71	9.83	17.82	18.20	11.30	7.00	13.42	7.00	12.00
RPM3	9.17	3.91	14.76	6.57	14.23	7.64	8.65	17.19	17.02	13.06	7.57	12.35	6.82	12.00
RPM4	9.61	4.15	14.12	6.94	15.90	7.32	8.26	17.97	16.97	12.60	6.94	13.68	6.89	12.00
RPM5	8.38	3.48	13.25	5.78	15.11	6.02	7.24	17.95	15.95	13.90	7.12	13.38	7.12	12.00
RPM6	5.91	3.71	8.71	5.87	11.93	6.24	7.60	12.70	13.48	11.09	7.72	10.72	6.64	12.00
2R1	9.29	0.51	16.39	8.14	13.22	5.38	8.82	17.34	15.03	13.91	9.54	12.12	5.70	10.00
2R2	3.74	1.82	15.58	6.73	14.38	6.60	7.20	15.64	18.29	12.13	6.32	13.23	6.32	10.00
2R3	9.49	3.43	14.04	7.00	9.03	6.74	7.19	12.24	15.57	13.50	7.56	10.85	6.47	10.00
2R4	8.59	2.69	13.90	7.14	12.34	6.25	7.97	14.85	15.81	11.98	5.74	10.61	4.53	10.00
2R5	9.30	3.18	13.08	5.96	11.77	5.77	8.23	14.72	16.64	11.22	4.74	11.48	5.71	10.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges	
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Crown	Tooth	Crown	Tooth		Crown
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length		
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
2R6	7.33	3.61	14.35	7.66	12.84	6.39	7.97	15.78	13.89	13.28	5.11	11.49	5.47	10.00	
3R1	8.12	0.03	12.68	4.97	10.65	4.02	5.00	13.20	14.51	10.29	4.85	10.05	4.01	5.00	
3R2	7.60	0.84	13.24	4.54	10.03	3.85	5.00	14.76	13.36	10.56	4.41	8.74	3.61	5.00	
3R3	8.34	2.00	13.08	4.65	11.00	4.31	5.12	14.40	13.04	9.59	3.56	10.36	3.81	5.00	
3R4	6.52	3.15	11.69	4.45	10.56	4.11	4.94	14.12	12.90	10.70	4.46	9.72	3.33	5.00	
4R1	8.72	2.42	12.01	5.07	10.33	4.12	4.24	11.86	11.13	9.86	4.68	9.36	4.47	5.00	
4R2	8.31	3.13	10.30	4.29	10.35	3.51	4.54	10.91	12.20	11.10	4.03	9.57	3.29	5.00	
4R3	8.58	3.78	7.72	3.59	8.48	3.60	4.47	9.66	10.06	10.23	3.82	9.15	3.58	5.00	
5R1	7.85	2.55	8.38	3.61	7.73	2.19	3.93	10.32	9.67	7.85	1.61	7.47	2.55	2.00	
5R2	9.39	4.08	9.24	3.38	7.70	2.89	3.90	11.12	9.73	7.20	1.65	6.85	3.05	2.00	
5R3	8.04	3.14	7.93	2.21	7.06	2.58	3.49	10.29	9.23	7.11	1.95	7.43	2.80	2.00	
6R1	8.26	3.25	8.65	4.37	5.07	2.83	4.86	9.02	7.62	5.83	3.21	5.78	3.16	2.00	
LPM1	9.66	3.82	19.54	7.68	18.16	7.74	10.35	22.86	20.07	15.05	7.06	16.11	7.69	10.00	
LPM2	8.09	3.05	15.95	8.20	16.52	8.58	11.32	19.51	18.39	14.80	8.32	15.37	8.67	10.00	
LPM3	8.66	2.88	16.87	7.17	11.76	8.55	10.88	18.97	20.61	16.44	8.59	15.69	9.47	10.00	
2L1	3.87	3.16	12.64	5.80	14.43	5.90	7.18	16.09	13.88	13.28	6.26	11.33	5.85	5.00	
2L2	7.52	2.98	9.86	6.59	11.99	6.30	8.58	13.73	10.21	11.39	6.26	10.65	5.32	8.00	
3L1	8.62	3.03	12.76	4.91	13.90	5.73	7.29	15.56	15.76	10.85	5.15	10.38	2.71	12.00	
4L1	4.45	1.63	9.60	3.82	10.46	4.14	5.47	11.73	12.55	8.84	3.46	9.32	3.63	8.00	
5L1	6.50	1.68	10.71	4.76	10.67	5.46	5.63	11.33	12.11	9.51	3.73	9.01	5.23	5.00	

SUMMARY SMU 76359 *P. mortoni*

Medial														
N=1														
Minimum	10.27	4.71	22.73	15.19	22.54	14.88	22.33	30.22	30.48	19.62	13.29	19.41	13.19	cw
Maximum	10.27	4.71	22.73	15.19	22.54	14.88	22.33	30.22	30.48	19.62	13.29	19.41	13.19	
Arithmetic Mean	10.27	4.71	22.73	15.19	22.54	14.88	22.33	30.22	30.48	19.62	13.29	19.41	13.19	
Standard Deviation														
RPM														
N=6														
Minimum	5.91	3.48	8.71	5.78	11.93	6.02	7.24	12.70	13.48	11.09	6.78	10.72	6.64	12.00

Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			left	left	right	right	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			posterior	posterior	posterior	posterior	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
Maximum	10.54	5.28	15.29	8.02	16.73	9.41	9.83	17.97	18.20	13.90	7.72	14.51	8.26	12.00
Arithmetic Mean	8.887	4.242	13.46	6.84	14.94	7.39	8.48	16.83	16.54	12.64	7.19	13.01	7.12	12.00
Standard Deviation	1.621	0.71	2.43	0.96	1.70	1.22	0.99	2.05	1.68	1.22	0.37	1.32	0.58	0.00
R2														
N=6														
Minimum	3.74	0.51	13.08	5.96	9.03	5.38	7.19	12.24	13.89	11.22	4.74	10.61	4.53	10.00
Maximum	9.49	3.61	16.39	8.14	14.38	6.74	8.82	17.34	18.29	13.91	9.54	13.23	6.47	10.00
Arithmetic Mean	7.957	2.54	14.56	7.10	12.27	6.19	7.90	15.10	15.87	12.67	6.50	11.63	5.70	10.00
Standard Deviation	2.214	1.184	1.21	0.75	1.81	0.52	0.62	1.68	1.49	1.05	1.79	0.95	0.69	0.00
R3														
N=4														
Minimum	6.52	0.03	11.69	4.45	10.03	3.85	4.94	13.20	12.90	9.59	3.56	8.74	3.33	5.00
Maximum	8.34	3.15	13.24	4.97	11.00	4.31	5.12	14.76	14.51	10.70	4.85	10.36	4.01	5.00
Arithmetic Mean	7.645	1.505	12.67	4.65	10.56	4.07	5.01	14.12	13.45	10.29	4.32	9.72	3.69	5.00
Standard Deviation	0.812	1.362	0.70	0.22	0.40	0.19	0.08	0.67	0.73	0.50	0.55	0.70	0.29	0.00
R4														
N=3														
Minimum	8.31	2.42	7.72	3.59	8.48	3.51	4.24	9.66	10.06	9.86	3.83	9.15	3.29	5.00
Maximum	8.72	3.78	12.01	5.07	10.35	4.12	4.54	11.86	12.20	11.10	4.68	9.57	4.47	5.00
Arithmetic Mean	8.537	3.11	10.01	4.32	9.72	3.74	4.42	10.81	11.13	10.40	4.18	9.36	3.78	5.00
Standard Deviation	0.208	0.68	2.16	0.74	1.07	0.33	0.15	1.10	1.07	0.64	0.45	0.21	0.61	0.00
R5														
N=3														
Minimum	7.85	2.55	7.93	2.21	7.06	2.19	3.49	10.29	9.23	7.11	1.61	6.85	2.55	2.00
Maximum	9.39	4.08	9.24	3.61	7.73	2.89	3.93	11.12	9.73	7.86	1.95	7.47	3.05	2.00
Arithmetic Mean	8.427	3.257	8.52	3.07	7.50	2.55	3.77	10.58	9.54	7.39	1.74	7.25	2.80	2.00
Standard Deviation	0.84	0.772	0.67	0.75	0.38	0.35	0.25	0.47	0.27	0.41	0.19	0.35	0.25	0.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
<b>R6</b>														
N=1														
Minimum	8.26	3.25	8.65	4.37	5.07	2.83	4.86	9.02	7.63	5.83	3.21	5.78	3.17	2.00
Maximum	8.26	3.25	8.65	4.37	5.07	2.83	4.86	9.02	7.63	5.83	3.21	5.78	3.17	2.00
Arithmetic Mean	8.26	3.25	8.65	4.37	5.07	2.83	4.86	9.02	7.63	5.83	3.21	5.78	3.17	2.00
Standard Deviation														0.00
<b>LPM</b>														
N=3														
Minimum	8.09	2.88	15.95	7.17	11.76	7.74	10.35	18.97	18.39	14.80	7.06	15.37	7.69	10.00
Maximum	9.66	3.82	19.54	8.20	18.16	8.58	11.32	22.86	20.61	16.44	8.59	16.11	9.47	10.00
Arithmetic Mean	8.803	3.25	17.45	7.68	15.48	8.29	10.85	20.44	19.69	15.43	7.99	15.72	8.61	10.00
Standard Deviation	0.795	0.501	1.86	0.52	3.32	0.48	0.49	2.11	1.16	0.88	0.82	0.37	0.89	0.00
<b>L2</b>														
N=2														
Minimum	3.87	2.98	9.86	5.80	11.99	5.90	7.18	13.73	10.21	11.39	6.26	10.65	5.32	5.00
Maximum	7.52	3.16	12.64	6.59	14.43	6.30	8.58	16.09	13.88	13.28	6.26	11.33	5.85	5.00
Arithmetic Mean	5.695	3.07	11.25	6.19	13.21	6.10	7.88	14.91	12.05	12.33	6.26	10.99	5.58	5.00
Standard Deviation	2.581	0.127	1.97	0.56	1.73	0.28	0.99	1.66	2.60	1.33	0.00	0.48	0.37	0.00
<b>L3</b>														
N=1														
	1													
Minimum	8.62	3.03	12.76	4.91	13.90	5.73	7.29	15.56	15.76	10.85	5.15	10.38	2.71	12.00
Maximum	8.62	3.03	12.76	4.91	13.90	5.73	7.29	15.56	15.76	10.85	5.15	10.38	2.71	12.00
Arithmetic Mean	8.62	3.03	12.76	4.91	13.90	5.73	7.29	15.56	15.76	10.85	5.15	10.38	2.71	12.00
Standard Deviation														0.00
<b>L4</b>														
N=1														
Minimum	4.45	1.63	9.60	3.82	10.46	4.14	5.47	11.73	12.55	8.84	3.46	9.32	3.63	8.00
Maximum	4.45	1.63	9.60	3.82	10.46	4.14	5.47	11.73	12.55	8.84	3.46	9.32	3.63	8.00

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Arithmetic Mean	4.45	1.63	9.60	3.82	10.46	4.14	5.47	11.73	12.55	8.84	3.46	9.32	3.63	8.00
Standard Deviation	.	.	.	.	.	.	.	.	.	.	.	.	.	0.00
L5														
N=1														
Minimum	6.5	1.68	10.71	4.76	10.67	5.46	5.63	11.33	12.11	9.51	3.73	9.01	5.23	5.00
Maximum	6.5	1.68	10.71	4.76	10.67	5.46	5.63	11.33	12.11	9.51	3.73	9.01	5.23	5.00
Arithmetic Mean	6.5	1.68	10.71	4.76	10.67	5.46	5.63	11.33	12.11	9.51	3.73	9.01	5.23	5.00
Standard Deviation	.	.	.	.	.	.	.	.	.	.	.	.	.	0.00

Tooth File	FHSM VP 335 <i>P. mortoni</i> Upper dentition													
M1	4.46	1.51	9.10	3.65	10.46	3.07	5.19	15.67	13.93	12.80	5.23	9.41	4.22	0.00
M2	4.12	1.16	8.34	3.67	11.81	2.81	4.37	17.86	12.44	7.89	4.66	12.13	3.92	0.00
M3	5.13	1.39	9.60	4.99	11.27	2.20	4.94	17.56	12.45	6.04	5.94	12.19	3.78	0.00
M4	4.10	1.17	8.50	4.57	11.33	1.52	4.29	17.58	12.44	5.64	5.06	12.80	4.44	0.00
M5	4.38	1.72	8.99	4.39	11.51	2.45	4.87	18.11	12.23	5.89	5.25	11.81	4.45	0.00
M6	3.42	1.01	7.96	4.04	12.90	2.33	5.62	19.02	12.74	5.98	4.68	13.24	2.94	0.00
M7	4.20	0.86	9.09	4.60	12.75	2.49	4.96	19.09	13.85	5.09	5.72	15.19	3.45	0.00
M8	3.90	1.28	9.32	5.10	10.08	1.76	4.80	17.60	11.41	4.66	5.60	11.03	3.32	0.00
M9	3.69	1.31	8.78	4.58	11.94	1.74	4.76	18.59	10.70	8.73	5.10	12.42	3.90	0.00
M10	4.15	1.14	9.15	4.58	12.19	2.70	4.47	19.01	11.50	7.61	5.22	12.85	4.58	0.00
M11	3.13	1.13	9.21	4.82	12.34	1.67	5.16	20.59	11.72	5.92	5.73	12.33	3.33	0.00
M12	4.41	0.64	9.15	4.25	11.36	3.10	5.04	17.85	11.28	6.34	5.80	11.58	4.23	0.00
M13	3.42	1.00	8.55	5.22	11.88	1.68	5.79	19.12	12.23	4.97	5.90	11.88	3.59	0.00
M14	4.02	1.08	8.61	5.53	10.68	1.20	5.47	17.42	12.25	3.29	6.23	11.11	3.87	0.00
M15	4.17	1.63	8.69	4.99	10.60	2.02	5.38	17.20	11.00	4.98	6.41	11.07	5.54	0.00
M16	3.77	1.27	8.59	4.23	11.32	1.99	4.76	18.19	11.59	6.40	5.30	12.12	4.34	0.00
M17	3.56	0.93	8.54	4.31	9.67	2.17	4.46	16.64	12.61	4.78	4.51	11.16	3.68	0.00
M18	3.42	1.45	8.35	4.20	11.36	1.71	4.50	17.53	13.15	5.30	5.47	13.93	4.27	0.00
M19	4.20	0.68	10.20	3.95	10.73	2.68	4.64	18.67	12.26	5.86	5.11	12.07	4.09	0.00
M20	4.38	1.12	9.25	5.11	10.88	2.37	4.53	17.29	11.62	5.35	5.20	12.85	3.97	0.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
M21	4.28	1.48	7.91	4.81	11.09	2.39	5.09	16.51	12.63	6.92	5.88	11.05	4.17	0.00
M22	3.66	1.13	8.26	3.76	11.06	2.24	4.04	17.23	11.47	7.03	4.66	12.73	4.57	0.00
M23	3.66	1.09	8.53	4.51	10.10	2.35	4.92	16.67	10.53	6.04	5.67	10.66	4.54	0.00
M24	3.66	1.08	7.83	3.53	10.25	2.31	4.25	16.02	10.66	6.72	4.93	11.46	4.06	0.00
M25	4.00	1.30	9.09	4.52	10.16	2.85	5.14	16.96	11.09	5.57	6.02	10.81	4.97	0.00
M26	3.57	1.12	8.18	2.76	10.48	1.97	4.08	17.19	9.74	3.86	3.53	10.53	3.99	0.00
M27	2.99	1.53	8.74	4.66	9.72	2.43	4.94	16.84	10.79	4.83	5.86	10.92	3.80	0.00
M28	3.38	1.25	9.10	4.80	9.48	3.26	4.53	16.41	11.33	6.22	5.57	10.86	4.67	0.00
M29	3.78	1.62	8.14	4.41	10.03	2.69	4.62	15.90	11.12	5.09	5.65	10.91	5.22	0.00
M30	4.15	1.66	8.76	4.62	11.26	2.80	5.22	17.67	10.90	5.48	6.13	12.31	5.18	0.00
M31	3.59	1.18	8.07	3.75	9.87	1.78	4.23	16.20	10.31	5.24	5.00	11.45	3.66	0.00
M32	3.03	1.18	7.15	2.13	9.13	4.26	4.74	14.98	4.71	4.30	5.10	17.11	4.69	0.00
M33	3.31	0.95	7.80	3.99	12.01	5.75	9.35	18.38	11.32	6.72	5.39	12.75	7.85	0.00
M34	3.39	1.23	9.08	4.04	11.20	2.17	4.97	18.62	12.30	4.71	5.32	11.83	4.31	0.00
RPM1	10.07	5.48	22.61	15.21	21.85	9.26	15.50	36.11	25.35	15.53	15.81	24.90	13.53	***
RPM2	10.50	6.04	21.79	14.94	21.13	8.02	15.59	36.05	26.32	12.88	16.13	21.47	12.77	***
RPM3	10.16	6.43	23.08	15.69	20.31	8.85	14.90	35.92	25.08	11.22	15.82	23.08	12.78	***
RPM4	9.14	4.38	21.21	13.14	19.56	7.59	15.50	33.80	20.78	10.45	13.55	29.19	9.45	***
RPM5	7.21	3.81	20.20	13.23	19.34	7.69	14.11	34.08	26.72	11.64	14.31	23.07	11.86	***
RPM6	10.08	6.80	23.11	16.35	20.60	8.96	15.39	36.94	24.71	9.97	16.65	23.23	13.22	***
RPM7	8.91	6.32	21.33	15.52	20.05	8.74	16.77	34.31	28.93	16.55	15.68	25.70	12.07	***
RPM8	10.28	5.81	21.64	15.03	20.39	8.67	17.13	35.21	23.26	17.38	15.40	23.47	12.81	***
RPM9	9.86	5.77	21.67	14.83	20.36	8.35	15.61	35.98	21.63	14.02	15.63	25.33	12.62	***
RPM10	8.32	3.08	22.12	13.46	17.78	8.16	13.89	34.44	23.43	10.33	14.93	22.97	12.18	***
RPM11	9.83	5.38	23.28	14.75	19.63	8.99	15.50	36.36	24.54	11.06	16.45	22.18	12.65	***
RPM12	9.81	5.45	21.89	13.61	20.61	8.56	14.82	36.18	24.39	14.52	15.07	22.36	11.21	***
RPM13	8.76	5.07	21.97	13.33	19.08	8.31	13.79	34.80	24.69	12.21	14.99	23.70	11.14	***
RPM14	9.36	5.65	20.03	14.25	20.56	11.94	18.60	34.13	24.02	12.26	17.82	22.65	12.90	***
RPM15	9.69	5.55	22.12	14.37	19.73	8.32	15.51	35.13	25.31	11.17	14.81	22.85	11.32	***
RPM16	11.00	7.50	22.46	18.25	20.02	9.36	17.97	33.65	24.73	12.48	17.57	21.79	13.09	***
RPM17	7.25	3.69	19.92	15.26	17.44	7.25	16.39	32.43	24.37	13.80	15.92	22.26	11.91	***
RPM18	7.91	4.36	21.01	13.39	17.02	7.44	14.53	31.82	24.15	11.64	14.69	22.17	11.04	***



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
RPM19	13.12	8.59	25.38	15.70	22.63	10.62	14.17	37.98	25.66	8.92	15.82	23.56	13.93	***
RPM20	10.16	6.03	20.23	14.42	20.16	8.66	15.38	33.17	23.44	14.31	14.97	24.00	12.70	***
2R1	1.94	2.53	21.19	13.62	13.94	13.30	10.55	15.14	22.66	20.71	29.71	15.99	12.85	***
2R2	14.12	2.70	21.14	14.76	14.91	14.29	10.58	13.87	21.66	21.36	31.44	17.34	12.74	***
2R3	6.75	3.49	15.95	10.55	15.79	6.89	12.28	27.25	18.01	11.61	12.35	22.37	9.24	***
2R4	6.32	1.56	17.27	11.37	10.76	11.77	9.63	13.39	21.23	20.04	28.20	14.48	13.15	***
2R5	5.09	1.60	16.64	12.28	11.75	12.83	9.53	11.60	20.55	20.45	27.31	14.80	13.75	***
2R6	5.84	1.04	15.91	12.07	11.19	11.99	10.09	12.12	19.17	18.25	28.80	14.20	12.63	***
2R7	5.84	1.41	15.67	10.85	11.07	10.76	10.14	11.41	18.57	18.74	27.45	15.94	11.49	***
2R8	6.75	3.19	15.53	8.90	15.58	5.89	10.36	26.12	19.29	12.45	9.87	18.34	6.63	***
2R9	7.25	3.81	16.06	10.80	15.78	6.05	11.27	25.76	17.92	14.99	11.35	19.17	8.47	***
2R10	8.10	3.37	17.30	11.47	10.03	6.17	12.01	12.10	33.41	9.87	11.39	14.65	7.72	***
2R11	2.98	1.68	15.70	10.80	9.99	9.74	11.14	12.04	19.92	19.84	27.47	15.29	11.16	***
2R12	2.40	0.84	16.15	11.80	10.03	10.56	11.35	13.70	18.18	19.08	27.58	12.89	11.54	***
2R13	7.65	4.70	15.80	11.12	15.92	6.23	11.83	25.40	19.00	11.72	11.15	20.17	9.02	***
2R14	6.94	3.79	16.24	9.87	15.07	6.19	11.64	25.57	18.03	10.89	11.31	19.62	8.02	***
2R15	7.63	4.22	16.72	10.23	15.28	6.42	11.32	26.12	18.07	11.49	10.82	19.04	8.38	***
2R16	7.27	4.20	15.62	11.30	15.22	6.30	11.70	25.64	12.51	11.73	11.19	24.75	8.01	***
2R17	5.80	3.10	14.93	9.52	15.57	5.69	11.13	25.69	14.86	10.37	9.47	25.54	7.97	***
2R18	8.74	4.76	16.89	10.92	15.65	7.32	11.66	25.98	18.46	10.37	10.49	17.98	8.89	***
2R19	8.20	4.30	17.49	11.70	15.73	5.31	12.37	27.60	19.50	11.99	10.12	16.56	7.87	***
2R20	8.31	4.95	16.00	10.05	15.81	6.12	11.00	26.23	17.28	9.83	8.65	19.82	8.40	***
2R21	8.44	4.33	16.93	11.60	15.78	6.34	12.29	26.73	18.84	10.98	9.31	16.42	7.55	***
3R1	8.21	1.74	16.59	10.20	11.44	11.67	8.64	13.17	16.23	19.89	25.38	11.84	11.72	***
3R2	7.83	4.93	14.59	10.72	15.17	6.55	12.00	22.91	18.92	11.97	9.91	18.78	9.17	***
3R3	7.67	4.37	14.53	9.31	15.60	6.85	10.50	23.74	17.38	11.52	8.54	19.02	7.62	***
3R4	7.45	4.53	13.80	10.03	15.41	6.84	11.69	22.63	13.67	12.17	10.70	22.57	8.69	***
3R5	9.09	5.71	15.25	11.51	15.70	7.86	12.33	23.49	17.02	11.97	11.61	17.13	9.71	***
3R6	8.20	5.35	15.23	11.66	15.28	7.15	12.10	23.97	18.10	9.82	11.97	17.65	8.84	***
3R7	9.08	5.42	16.87	11.17	16.22	7.19	11.42	26.15	17.50	8.80	11.35	18.59	8.52	***
3R8	7.45	5.16	13.45	10.15	14.39	6.65	8.94	22.92	16.36	10.40	11.70	16.29	8.12	***
3R9	8.24	4.41	14.23	10.91	14.41	6.80	13.19	22.33	16.51	10.19	11.03	18.02	7.91	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
3R10	8.12	5.06	14.59	11.45	13.50	7.30	12.65	20.19	14.94	10.31	11.44	19.12	7.80	***
3R11	8.94	5.44	15.45	11.13	15.16	7.26	11.18	24.09	17.41	10.35	9.55	15.23	8.58	***
3R12	8.92	5.47	17.01	11.06	15.58	7.27	10.86	25.45	17.18	7.98	11.54	16.73	8.95	***
3R13	9.50	5.68	16.77	11.98	15.78	7.28	10.67	25.29	15.79	8.62	10.76	16.66	10.04	***
3R14	6.23	3.80	13.06	9.41	13.33	4.76	10.24	22.54	16.15	8.06	8.77	15.69	6.99	***
3R15	7.19	3.46	12.86	9.50	13.50	5.57	9.99	21.11	16.21	8.97	7.65	14.89	6.48	***
4R1	5.94	2.47	12.86	8.19	13.25	5.09	10.23	22.51	15.42	8.76	6.28	17.04	5.85	***
4R2	5.66	2.36	13.32	7.97	13.52	6.49	10.99	22.62	22.48	9.60	6.42	11.43	6.95	***
4R3	5.67	2.16	12.53	8.68	12.76	5.48	9.81	20.84	23.46	9.84	7.05	10.29	6.52	***
4R4	2.57	3.13	13.21	9.41	9.66	6.29	10.10	9.61	18.16	15.72	4.95	11.22	6.50	***
4R5	4.29	3.55	13.37	8.83	9.47	5.85	10.61	9.27	16.52	17.42	9.58	13.21	6.03	***
4R6	1.63	3.29	13.34	9.41	9.64	5.55	11.25	8.87	18.48	15.83	7.31	12.51	6.63	***
4R7	1.26	3.16	13.65	9.95	10.24	5.61	10.94	9.62	17.66	16.80	6.93	12.56	11.49	***
4R8	1.79	3.43	12.85	8.69	10.00	6.04	10.93	11.15	16.77	16.52	7.93	10.72	7.14	***
4R9	2.20	2.95	13.76	8.39	9.48	5.74	9.66	10.39	15.89	17.68	7.37	12.30	6.77	***
4R10	4.26	3.00	12.82	8.86	8.88	5.38	10.33	10.94	16.85	15.93	6.51	10.42	7.40	***
4R11	1.82	3.18	12.87	8.24	9.62	5.53	10.16	10.16	16.56	16.52	7.15	11.76	6.59	***
4R12	2.78	3.66	12.50	8.97	9.59	5.42	9.79	8.66	15.58	15.87	9.89	11.66	7.11	***
4R13	1.30	1.91	11.73	6.62	9.13	4.84	8.09	9.60	19.13	14.99	6.76	11.36	6.51	***
4R14	1.73	2.94	12.74	9.75	8.92	5.52	11.04	10.28	17.07	14.66	8.25	11.27	7.38	***
4R15	3.23	2.39	12.55	8.08	8.93	5.43	9.22	8.56	17.25	15.60	7.17	11.61	6.26	***
4R16	1.78	3.18	13.94	7.69	10.39	5.97	9.70	9.62	16.14	15.72	6.01	11.48	6.00	***
4R17	4.99	2.59	6.53	5.70	14.08	5.86	9.28	16.01	16.45	13.66	6.13	14.44	5.99	***
4R18	5.36	2.23	13.03	8.22	13.89	6.10	10.41	20.88	16.82	10.38	8.30	15.43	7.46	***
4R19	5.45	2.52	13.14	7.04	12.56	5.79	8.82	20.66	16.99	9.85	7.92	14.21	6.70	***
4R20	4.03	1.44	8.42	3.47	10.86	4.34	5.28	15.70	12.77	9.52	7.45	14.30	6.78	***
5R1	6.59	3.37	12.49	8.17	13.29	6.26	9.65	20.91	13.68	7.88	7.68	16.46	6.41	***
5R2	6.36	3.25	12.23	8.52	12.53	5.40	9.48	18.48	14.53	10.14	7.10	18.45	6.23	***
5R3	4.27	1.74	11.65	7.76	10.06	5.25	10.31	19.27	13.75	8.46	6.30	13.33	6.04	***
5R4	5.33	2.08	11.38	7.55	11.77	5.49	9.88	18.19	12.55	8.53	7.30	16.91	5.91	***
5R5	6.16	3.05	11.78	8.61	11.44	5.02	10.26	18.68	13.31	9.39	7.98	14.04	6.74	***
5R6	5.51	2.51	11.37	9.08	11.09	4.78	10.58	18.25	12.64	8.99	8.19	15.36	6.48	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	Width F-G	Width B-C	Width E-D	Length B-E	Length F-I	Length C-D	Length G-H	
5R7	5.02	2.33	10.51	7.34	12.27	5.33	9.23	17.96	13.57	8.48	6.54	16.60	6.93	***
5R8	5.38	2.43	10.78	7.59	10.63	5.37	9.96	16.86	13.84	9.53	8.15	12.55	6.89	***
5R9	5.48	2.32	11.26	7.83	10.52	5.19	10.53	16.83	11.51	8.82	6.91	13.83	5.44	***
5R10	5.41	2.12	11.65	7.75	9.33	4.71	9.30	15.65	12.71	8.96	7.73	13.75	5.70	***
5R11	4.75	2.12	10.71	6.32	9.03	4.38	8.15	15.92	11.79	6.41	6.40	11.64	5.82	***
5R12	5.52	2.38	10.12	6.75	9.64	4.79	8.42	15.17	11.84	7.29	6.51	11.69	5.21	***
5R13	5.46	2.68	10.91	7.32	10.13	4.35	8.51	16.52	10.94	8.38	7.27	11.98	5.39	***
5R14	5.02	2.52	10.05	7.27	9.33	4.32	9.10	15.29	13.32	8.51	6.81	10.71	5.38	***
5R15	3.99	1.81	9.90	6.48	8.98	4.30	8.20	15.85	11.91	6.52	7.55	12.51	5.97	***
5R16	4.55	2.08	9.44	6.64	9.42	4.57	8.08	15.38	11.70	7.34	7.39	11.28	6.08	***
5R17	5.20	2.45	10.50	5.66	9.06	4.68	7.00	15.31	11.85	5.98	5.14	10.83	5.60	***
5R18	4.52	1.76	9.52	4.92	9.78	3.54	6.22	14.84	12.18	8.45	5.71	13.32	4.75	***
6R1	5.07	2.13	9.84	6.65	10.29	4.23	8.93	15.97	12.38	11.87	5.63	12.25	3.96	***
6R2	3.85	1.49	11.31	5.36	11.43	5.44	7.43	18.26	11.10	10.26	5.26	15.81	5.54	***
6R3	4.80	2.35	9.54	5.90	11.21	4.56	7.65	16.13	9.83	11.07	4.97	17.64	5.30	***
6R4	4.59	1.99	9.52	5.85	10.07	3.67	6.93	15.95	13.25	8.14	5.42	12.14	5.25	***
6R5	4.49	1.58	9.61	5.90	10.02	4.34	8.32	16.22	13.52	7.14	5.34	11.92	4.31	***
6R6	4.08	2.13	9.09	6.43	10.46	4.31	8.61	15.74	13.50	9.73	5.63	12.16	5.00	***
6R7	4.33	2.90	10.09	6.63	10.40	5.20	8.98	16.29	13.23	7.60	6.12	11.39	4.75	***
6R8	5.22	2.45	10.08	6.08	11.48	4.58	7.68	16.53	8.46	9.69	5.46	18.44	5.63	***
6R9	4.51	2.20	10.01	5.96	11.57	4.99	7.82	16.89	13.50	6.35	5.36	15.04	4.93	***
6R10	4.87	2.60	9.83	5.94	11.50	5.11	6.93	16.27	13.23	8.10	5.57	13.58	5.02	***
6R11	2.82	0.91	8.33	5.91	10.54	4.67	8.58	15.86	12.28	8.00	6.71	13.65	5.46	***
6R12	5.03	3.05	9.72	6.82	10.64	4.56	7.57	16.46	12.04	7.64	6.44	12.28	5.59	***
6R13	4.97	2.87	10.06	6.60	10.99	5.42	7.92	15.91	13.25	9.25	5.85	12.64	5.60	***
6R14	5.31	2.32	9.73	5.19	10.91	5.37	6.42	16.03	10.32	8.09	4.70	13.28	4.27	***
6R15	5.26	2.78	10.13	5.96	11.37	4.87	7.17	16.17	11.14	8.85	4.59	14.43	5.30	***
7R1	4.23	1.71	9.26	4.31	8.25	4.46	6.06	12.24	7.97	9.77	4.92	13.58	4.72	***
7R2	2.98	1.07	7.01	3.82	7.78	4.38	6.79	11.44	11.76	5.69	4.62	12.59	4.20	***
7R3	4.12	1.16	7.25	4.07	8.01	4.42	6.42	11.84	9.87	7.73	4.77	13.09	4.46	***
7R4	5.13	1.39	7.35	4.16	8.02	3.72	5.89	12.32	8.70	7.29	3.91	13.50	3.89	***
7R5	4.10	1.17	8.77	4.53	8.00	4.16	5.92	12.64	9.21	7.45	4.18	14.60	3.92	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
7R6	4.38	1.72	8.05	3.83	7.79	3.65	4.86	12.57	9.28	7.84	4.42	13.03	4.42	***
7R7	3.42	1.01	8.45	3.22	8.81	3.87	4.99	13.72	9.60	6.13	4.04	13.54	3.60	***
7R8	4.20	0.86	7.43	3.09	7.31	3.65	5.36	11.44	10.36	9.30	3.74	10.51	3.23	***
7R9	3.90	1.28	8.42	4.86	7.62	3.86	5.66	13.38	7.80	5.88	5.03	12.00	4.14	***
7R10	3.69	1.31	8.69	4.14	7.70	4.43	6.79	12.40	9.00	6.99	2.67	12.46	4.13	***
7R11	4.15	1.14	7.55	4.45	8.94	3.73	7.04	12.05	11.37	5.51	3.39	16.74	3.89	***
7R12	3.13	1.13	6.87	4.64	8.69	3.27	6.87	11.69	6.45	8.30	3.43	15.50	3.89	***
7R13	4.41	0.64	7.19	4.31	7.55	3.38	5.97	11.70	6.93	8.26	3.25	12.98	3.94	***
7R14	3.42	1.00	7.46	4.57	7.74	3.23	5.49	11.63	6.95	7.29	5.00	13.68	3.71	***
8R1	4.02	1.08	7.97	3.30	9.22	4.97	4.19	11.35	10.31	7.44	3.73	10.62	7.09	***
8R2	4.17	1.63	5.76	3.66	6.40	2.78	5.39	4.06	12.17	10.83	2.96	6.91	4.01	***
8R3	3.77	1.27	5.31	3.48	5.83	3.06	4.74	4.09	10.35	10.14	3.45	6.64	3.89	***
8R4	3.56	0.93	6.58	3.68	7.05	2.39	5.27	3.74	15.49	11.09	2.39	7.15	3.80	***
8R5	3.42	1.45	5.58	3.72	6.05	2.75	5.85	4.09	11.24	10.93	3.74	6.62	3.92	***
8R6	4.20	0.68	6.83	3.28	6.33	2.99	4.89	4.56	12.77	11.50	2.77	6.89	4.29	***
8R7	4.38	1.12	6.55	3.95	6.17	2.99	5.55	3.85	9.18	9.79	2.93	7.00	4.01	***
8R8	4.28	1.48	6.08	3.46	6.29	3.22	5.47	4.21	11.69	10.87	3.73	6.84	4.25	***
8R9	3.66	1.13	6.61	4.15	6.26	3.05	4.74	4.28	8.90	9.65	4.45	6.78	3.74	***
8R10	3.66	1.09	6.15	3.28	5.64	3.16	4.78	3.19	10.89	10.51	3.28	6.95	4.23	***
8R11	3.66	1.08	6.57	3.90	6.17	3.04	4.89	3.57	11.87	10.07	3.73	6.39	3.89	***
8R12	4.00	1.30	5.82	3.00	5.17	3.13	4.44	5.40	10.32	12.22	1.95	6.12	3.43	***
8R13	3.57	1.12	6.53	3.57	6.38	3.42	4.51	3.39	7.98	9.17	3.67	7.57	4.21	***
8R14	2.99	1.53	5.57	3.03	4.88	2.40	4.33	4.60	10.83	8.48	3.37	5.80	3.48	***
9R1	2.60	1.02	5.78	3.11	9.34	2.79	4.45	10.12	10.97	10.21	4.23	11.31	4.37	***
9R2	2.96	1.11	6.09	4.05	9.24	2.86	4.08	9.95	10.77	10.31	3.88	10.22	3.61	***
9R3	2.68	1.32	5.25	3.62	8.62	2.52	4.26	9.74	10.52	9.44	3.68	8.58	4.11	***
9R4	2.48	1.32	5.90	4.20	9.27	3.22	5.38	10.39	10.77	9.66	4.74	9.41	4.61	***
9R5	3.31	1.13	8.22	3.19	8.64	3.19	5.18	14.32	9.50	6.98	3.53	9.92	2.44	***
9R6	3.64	1.44	6.85	3.81	9.24	2.96	5.21	10.23	11.43	9.24	2.94	9.01	3.28	***
9R7	2.87	0.72	5.90	3.04	8.96	3.02	4.77	10.16	9.73	8.34	3.15	9.67	3.60	***
9R8	2.86	1.13	6.37	3.50	9.30	2.42	4.69	10.50	11.51	9.66	2.88	9.63	3.68	***
9R9	1.99	0.73	5.44	3.41	8.78	2.69	4.90	9.96	11.09	9.78	2.26	9.23	3.39	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
9R10	2.13	0.94	5.04	3.76	8.34	1.96	4.98	9.22	9.19	8.98	2.54	10.14	3.35	***
9R11	2.37	1.21	5.56	3.36	8.32	2.36	3.98	9.02	10.16	9.25	2.69	9.65	4.33	***
9R12	2.38	1.18	5.03	2.61	8.99	2.55	3.89	9.93	9.86	8.74	2.35	9.63	2.86	***
9R13	2.72	1.02	5.72	2.65	9.32	3.12	4.20	10.24	9.56	8.62	2.26	10.09	2.77	***
9R14	2.17	1.37	5.29	2.70	8.98	3.18	4.49	8.65	14.68	8.07	2.70	3.59	3.11	***
9R15	1.92	0.76	4.98	3.36	8.72	2.51	5.10	9.21	11.73	8.82	2.65	6.83	3.00	***
9R16	2.07	1.21	4.61	3.09	9.09	2.72	3.83	9.68	9.87	8.98	2.40	8.72	3.78	***
9R17	2.25	1.25	5.17	3.49	8.14	2.79	4.45	8.97	10.21	8.46	2.74	9.20	3.77	***
9R18	2.12	0.63	6.23	3.69	8.83	3.23	5.45	9.18	10.78	8.26	2.76	9.95	3.34	***
9R19	1.67	0.24	5.49	3.83	8.70	2.94	5.64	9.95	9.64	7.87	2.97	10.76	2.85	***
10R1	2.46	1.09	5.09	3.59	7.93	1.92	4.13	9.72	9.44	7.31	2.61	8.00	3.57	***
10R2	1.90	1.10	3.84	2.45	7.37	2.33	3.37	7.77	6.68	7.43	3.03	9.05	3.48	***
10R3	1.51	0.79	4.29	2.62	7.26	2.10	4.08	8.03	9.06	7.94	2.15	7.71	2.70	***
10R4	1.70	0.94	3.92	2.96	6.92	2.21	4.31	7.65	7.51	6.82	2.12	9.05	2.90	***
10R5	1.54	0.62	4.61	2.79	7.14	2.13	4.00	9.13	8.50	7.19	2.38	7.88	2.30	***
10R6	1.97	1.10	5.30	3.45	6.84	2.14	3.84	10.16	8.93	6.89	3.37	7.30	2.91	***
10R7	1.42	0.44	4.23	2.68	6.63	1.94	3.82	8.64	8.63	7.43	1.91	7.63	2.77	***
LPM1	0.58	0.10	23.29	18.40	28.86	19.72	29.83	39.82	23.05	10.03	14.24	29.25	15.54	***
LPM2	5.84	1.41	23.30	18.08	26.01	17.41	25.37	33.44	25.36	25.00	10.68	9.26	12.73	***
LPM3	6.75	3.19	20.14	15.01	21.86	13.53	22.70	30.07	24.29	28.96	12.65	11.41	13.68	***
LPM4	7.25	3.81	19.63	13.97	26.21	13.25	21.82	38.71	22.13	10.09	13.16	23.31	12.23	***
LPM5	8.10	3.37	17.90	13.80	27.04	14.23	23.22	38.00	23.94	9.01	11.00	23.23	13.39	***
LPM6	2.98	1.68	19.80	14.11	26.55	13.09	21.58	40.41	24.25	5.73	12.41	25.67	13.94	***
LPM7	2.40	0.84	17.83	11.74	27.32	13.08	20.10	39.27	22.98	8.68	9.94	25.39	11.89	***
LPM8	7.65	4.70	18.16	12.64	27.96	13.34	21.21	39.39	22.01	7.57	10.53	23.60	10.33	***
LPM9	6.94	3.79	19.05	13.56	27.33	14.67	22.66	39.76	20.49	7.95	9.99	23.28	12.00	***
LPM10	7.63	4.22	18.62	7.72	26.89	12.83	14.07	40.58	22.04	5.54	12.12	24.84	14.26	***
LPM11	7.27	4.20	18.21	7.96	26.28	14.89	15.59	37.73	21.67	8.28	11.90	23.12	14.62	***
LPM12	5.80	3.10	17.20	7.16	27.12	12.96	14.36	39.44	23.30	4.77	11.79	25.54	14.17	***
LPM13	8.74	4.76	18.87	8.69	26.73	15.74	15.81	38.01	21.43	8.01	12.73	23.84	16.44	***
LPM14	8.20	4.30	18.44	8.20	26.69	12.93	13.37	39.09	22.44	5.85	13.17	24.57	14.56	***
LPM15	8.31	4.95	17.82	7.61	25.31	12.23	13.59	38.76	19.98	6.91	12.19	24.10	13.82	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
LPM16	8.44	4.33	16.75	6.82	25.48	12.72	14.00	36.94	19.26	8.71	11.51	24.59	13.53	***
LPM17	8.21	1.74	15.86	6.23	25.42	13.86	14.05	36.44	19.74	7.16	12.33	23.38	14.10	***
2L1	7.83	4.93	15.48	10.46	21.81	5.89	8.67	31.93	28.15	6.13	13.56	12.01	12.09	***
2L2	7.67	4.37	15.32	6.86	22.87	11.17	12.25	33.48	18.58	5.60	8.20	19.96	9.64	***
2L3	7.45	4.53	15.87	6.69	21.84	10.64	11.89	33.83	17.90	6.45	8.98	20.34	9.88	***
2L4	9.09	5.71	14.41	6.08	21.37	10.83	11.84	30.52	18.22	6.52	8.67	19.87	9.55	***
2L5	8.20	5.35	17.01	5.93	21.23	9.84	12.17	32.20	16.04	8.28	8.24	19.21	7.68	***
2L6	9.08	5.42	15.41	6.04	21.97	8.91	10.87	31.69	16.09	6.86	11.80	19.37	6.69	***
2L7	7.45	5.16	15.37	6.57	21.44	12.04	13.04	32.05	16.60	5.70	8.15	19.75	11.07	***
2L8	8.24	4.41	15.15	7.14	21.77	8.54	10.97	33.63	19.13	5.49	8.05	18.57	7.90	***
2L9	8.12	5.06	14.57	7.24	21.38	9.93	13.19	30.62	27.44	6.44	8.75	13.83	9.78	***
2L10	8.94	5.44	14.96	6.51	22.45	10.82	11.34	33.16	16.45	5.87	9.45	19.60	8.99	***
2L11	8.92	5.47	14.04	6.38	21.97	11.30	12.53	31.48	15.54	8.35	8.05	18.89	9.94	***
2L12	9.50	5.68	14.73	5.71	21.24	8.71	10.73	32.20	19.57	5.52	7.80	17.44	7.72	***
2L13	6.23	3.80	14.82	6.39	20.81	9.93	12.24	31.80	18.64	5.24	8.18	17.02	8.85	***
2L14	7.19	3.46	14.91	5.67	22.58	8.73	10.82	33.63	20.64	5.16	8.60	18.15	7.89	***
2L15	5.94	2.47	14.17	5.77	20.67	9.80	12.15	31.65	19.01	4.80	7.95	17.07	8.61	***
2L16	5.66	2.36	14.68	6.25	21.00	9.55	11.77	32.15	17.85	6.14	7.47	17.91	8.63	***
2L17	5.67	2.16	15.63	6.75	19.98	11.11	12.27	30.44	19.39	4.49	8.98	16.98	10.89	***
2L18	2.57	3.13	14.75	6.55	20.67	9.96	11.14	31.11	17.58	4.36	9.26	18.93	9.06	***
2L19	4.29	3.55	15.23	7.36	20.27	12.51	14.13	29.89	17.12	5.55	8.65	18.77	11.14	***
2L20	1.63	3.29	11.74	7.00	20.72	11.64	13.02	26.61	16.18	7.86	9.20	18.44	10.47	***
2L21	1.26	3.16	18.37	11.12	9.46	9.28	8.69	21.53	16.97	9.88	14.67	13.40	11.12	***
3L1	1.79	3.43	15.63	6.50	18.09	8.49	10.05	29.15	19.57	4.39	9.91	16.97	9.18	***
3L2	2.20	2.95	15.75	7.60	19.02	10.69	11.40	28.56	17.71	5.14	9.26	16.95	9.94	***
3L3	4.26	3.00	15.76	7.14	19.86	9.79	11.60	28.66	17.91	5.73	8.50	16.88	8.91	***
3L4	1.82	3.18	13.83	6.15	18.36	8.76	10.47	28.20	16.88	6.71	8.41	16.20	8.01	***
3L5	2.78	3.66	14.86	6.36	18.32	9.08	10.73	29.01	17.80	5.48	8.14	17.55	9.84	***
3L6	1.30	1.91	15.74	7.98	20.84	9.99	10.58	30.53	15.77	6.79	8.14	18.64	11.05	***
3L7	1.73	2.94	15.29	6.88	20.12	9.34	10.00	29.80	17.20	6.75	7.77	16.29	8.95	***
3L8	3.23	2.39	13.93	5.78	19.07	8.28	10.01	27.43	16.01	7.65	7.87	16.14	7.72	***
3L9	1.78	3.18	14.02	5.92	18.74	7.95	9.92	27.44	16.15	6.35	7.00	16.42	7.05	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
3L10	4.99	2.59	14.04	7.06	17.73	7.25	10.71	27.67	17.28	7.18	6.94	14.93	5.70	***
3L11	5.36	2.23	12.77	6.28	17.91	8.77	10.06	26.40	17.21	5.49	7.12	15.69	7.41	***
3L12	5.45	2.52	14.58	6.51	17.82	7.84	8.99	27.97	18.43	4.99	6.11	15.57	7.89	***
3L13	4.03	1.44	14.11	5.99	18.79	8.92	10.81	27.71	19.45	4.03	6.47	16.96	7.64	***
3L14	6.59	3.37	15.34	7.19	18.76	9.20	9.86	28.53	16.22	5.86	8.56	17.12	9.05	***
3L15	6.36	3.25	15.64	6.97	18.85	8.80	10.43	27.72	16.58	6.84	7.70	15.36	7.54	***
3L16	4.27	1.74	13.25	6.09	17.32	7.42	8.99	27.14	18.99	6.20	6.07	12.42	8.00	***
3L17	5.33	2.08	13.97	6.59	16.75	7.92	9.59	27.23	17.23	7.62	7.90	14.14	6.78	***
3L18	6.16	3.05	12.98	6.30	18.44	7.78	9.82	26.59	14.68	6.73	6.56	18.15	6.35	***
3L19	5.51	2.51	13.54	6.56	17.34	8.08	8.63	24.83	14.86	6.38	6.70	17.69	8.28	***
4L1	5.02	2.33	13.30	6.94	8.35	8.35	10.36	18.64	15.04	7.10	5.67	9.28	7.23	***
4L2	5.38	2.43	14.01	6.40	16.91	6.71	9.70	24.47	15.90	6.10	6.73	14.14	6.02	***
4L3	5.48	2.32	12.29	6.02	16.75	7.60	7.96	25.26	15.80	6.43	7.42	15.42	8.21	***
4L4	5.41	2.12	13.91	6.44	16.76	7.44	8.01	25.59	15.36	6.80	5.94	15.56	8.52	***
4L5	4.75	2.12	12.91	6.18	17.24	8.06	9.47	25.79	15.92	5.19	6.70	16.45	8.02	***
4L6	5.52	2.38	13.28	6.40	15.20	7.63	9.67	26.38	18.04	4.90	6.63	13.55	7.50	***
4L7	5.46	2.68	13.83	7.06	17.20	7.99	9.73	24.48	16.48	4.98	6.30	13.97	6.49	***
4L8	5.02	2.52	12.96	5.48	16.37	6.42	7.79	25.47	15.71	5.68	5.91	14.70	7.84	***
4L9	3.99	1.81	13.39	6.42	15.80	5.90	8.17	24.95	11.50	6.59	5.84	18.69	6.18	***
4L10	4.55	2.08	13.36	6.47	10.57	6.18	9.61	21.04	13.63	8.41	6.25	10.92	6.75	***
4L11	5.20	2.45	13.18	5.97	16.38	6.86	8.58	24.63	16.85	6.46	6.51	13.44	6.73	***
4L12	4.52	1.76	12.73	5.85	15.25	7.29	8.71	23.24	13.80	8.63	6.99	13.90	6.54	***
4L13	5.07	2.13	13.48	7.66	16.55	8.25	9.82	23.97	13.65	7.68	6.77	14.53	7.49	***
4L14	3.85	1.49	13.08	5.91	16.39	6.29	8.38	25.26	0.00	20.24	4.55	12.39	5.49	***
4L15	4.80	2.35	14.28	6.30	16.71	7.48	7.94	26.05	21.25	4.99	5.62	9.11	6.22	***
4L16	4.59	1.99	13.24	7.05	16.72	9.56	9.25	23.65	13.92	5.12	7.47	13.77	7.22	***
4L17	4.49	1.58	13.62	6.48	15.70	8.99	9.87	23.44	13.32	6.52	6.04	14.39	7.87	***
4L18	4.08	2.13	12.01	5.85	15.24	6.95	6.79	22.05	13.53	5.91	5.13	13.91	8.15	***
4L19	4.33	2.90	14.65	8.27	15.80	7.93	6.88	26.11	14.96	10.86	6.15	25.11	13.00	***
4L20	5.22	2.45	10.76	5.99	13.94	7.49	9.25	21.23	13.72	7.34	5.97	12.72	6.59	***
4L21	4.51	2.20	11.70	6.86	15.88	7.95	7.07	20.53	0.00	17.13	7.75	15.60	8.93	***
5L1	4.87	2.60	13.01	5.81	10.01	6.89	7.55	7.76	13.09	19.02	5.84	14.37	7.18	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
5L2	2.82	0.91	13.54	5.82	15.52	7.36	8.82	22.53	13.07	7.46	5.88	14.84	8.34	***
5L3	5.03	3.05	12.10	5.67	14.91	6.79	7.50	21.29	19.33	7.50	4.84	9.80	7.00	***
5L4	4.97	2.87	12.46	5.03	9.23	5.51	7.72	6.58	10.43	21.87	4.36	13.82	5.59	***
5L5	5.31	2.32	11.59	5.45	9.00	5.74	7.36	6.98	9.56	21.18	5.04	14.04	5.12	***
5L6	5.26	2.78	10.75	5.11	12.84	5.30	7.75	19.32	19.33	6.33	5.87	9.79	4.92	***
5L7	4.23	1.71	11.79	5.96	14.32	7.26	7.12	19.75	19.88	5.35	5.46	10.30	8.33	***
5L8	2.98	1.07	11.08	4.91	8.49	5.74	7.65	6.10	12.75	16.69	5.77	15.21	5.44	***
5L9	2.98	1.64	11.76	5.79	15.81	7.60	7.32	21.71	12.26	6.60	5.65	12.15	6.97	***
5L10	2.34	0.62	11.14	5.05	7.91	4.43	7.04	7.61	12.28	18.02	5.72	14.28	6.18	***
5L11	2.41	2.10	10.71	4.25	12.03	5.37	6.86	17.89	19.36	5.37	4.59	8.53	6.64	***
5L12	2.65	2.33	10.74	4.56	8.13	5.49	7.33	7.21	8.94	21.07	5.51	11.17	6.09	***
5L13	1.23	0.27	10.73	5.54	13.43	6.06	7.42	20.42	12.51	5.08	3.94	13.13	5.94	***
6L1	0.87	0.25	8.27	3.62	5.84	4.10	5.04	5.21	11.29	17.41	4.72	11.65	4.87	***
6L2	1.61	2.54	9.32	3.42	7.03	4.79	6.16	6.31	11.13	19.11	3.61	10.50	3.94	***
6L3	1.17	1.19	11.44	4.81	8.75	4.83	6.04	7.26	9.89	16.16	4.80	12.55	5.50	***
6L4	2.80	1.07	9.22	4.65	8.03	5.45	6.44	5.73	9.66	15.99	3.96	9.53	4.59	***
6L5	3.02	1.06	9.43	3.47	6.54	4.49	6.01	6.37	8.40	17.76	3.67	10.23	4.40	***
6L6	2.80	1.64	9.30	4.07	6.56	4.11	5.97	5.32	9.70	16.55	3.44	8.97	4.61	***
6L7	1.99	1.40	8.69	8.43	6.74	4.49	11.71	5.17	7.01	16.53	6.11	9.70	4.63	***
6L8	2.71	1.80	10.29	5.33	8.52	5.59	7.65	6.31	10.56	14.47	16.84	10.22	5.20	***
6L9	3.43	1.83	8.70	4.72	7.25	4.73	6.88	15.84	13.43	4.72	5.89	8.16	4.72	***
6L10	3.18	1.40	9.17	7.13	8.24	6.42	4.48	5.48	8.90	14.20	10.49	10.22	5.52	***
6L11	1.91	1.14	10.67	7.61	8.30	4.89	6.17	14.81	10.51	6.99	10.95	11.08	5.53	***
6L12	2.24	1.12	8.85	7.03	6.77	5.08	4.65	5.88	9.95	14.17	11.33	10.61	3.75	***
6L13	3.27	1.37	8.84	7.26	9.57	5.46	5.10	14.41	13.03	6.22	10.92	9.43	4.94	***
6L14	2.43	1.12	9.74	8.36	7.96	4.66	4.76	14.28	12.39	5.57	12.87	7.31	3.22	***
6L15	1.99	0.97	10.29	11.72	7.72	4.49	8.03	13.50	16.87	5.23	15.72	8.36	3.53	***
6L16	2.59	0.92	8.86	3.63	7.36	4.95	5.79	13.11	9.06	7.13	3.16	8.40	4.23	***
7L1	3.69	1.45	11.15	4.63	9.32	4.39	4.17	16.47	0.00	18.31	6.97	9.00	5.51	***
7L2	3.15	5.61	10.03	11.43	6.86	8.37	16.18	6.00	13.69	6.98	7.88	13.74	7.95	***
7L3	3.37	5.42	10.47	8.78	7.34	11.12	7.95	5.32	11.62	7.54	9.53	13.58	11.55	***
7L4	1.47	1.21	10.44	10.74	8.23	8.18	11.55	6.00	15.32	6.98	7.14	14.55	7.57	***



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
7L5	3.00	1.73	10.08	7.96	7.53	2.11	7.57	6.22	12.74	7.67	6.71	13.53	4.87	***
7L6	4.39	1.69	9.84	3.72	10.28	4.42	4.87	16.18	11.55	7.88	4.69	7.95	3.98	***
7L7	4.45	1.74	11.07	4.48	7.99	5.15	5.66	14.03	7.09	7.44	3.76	8.44	4.61	***
7L8	5.40	1.79	9.89	3.97	10.26	4.17	5.33	13.80	7.88	6.37	2.91	10.22	4.45	***
7L9	4.73	1.47	9.93	3.75	9.77	4.66	5.62	15.29	8.59	5.98	3.86	9.54	3.63	***
7L10	3.56	1.02	9.00	3.96	7.34	4.65	5.11	12.84	11.70	6.37	4.58	7.57	4.33	***
7L11	2.71	1.73	8.96	13.57	8.39	8.20	6.88	14.09	11.65	6.76	7.28	8.88	4.84	***
7L12	4.05	1.99	9.41	4.74	7.29	4.24	4.84	12.79	8.98	6.11	3.94	7.63	4.75	***
7L13	4.64	2.05	8.95	4.59	9.16	4.44	5.40	13.86	8.57	5.73	3.94	8.15	4.07	***
7L14	3.31	0.88	8.92	3.80	6.64	3.67	4.57	11.79	10.64	6.77	4.17	7.08	3.02	***
7L15	3.76	1.73	8.14	3.79	5.95	3.98	5.03	10.78	10.15	5.82	3.40	6.18	3.75	***
7L16	2.88	0.60	6.19	2.05	5.97	3.34	4.31	9.98	0.00	8.23	3.00	7.62	2.62	***
7L17	3.54	1.08	7.17	2.46	6.34	3.69	4.54	10.46	0.00	8.76	2.84	8.11	3.26	***
7L18	1.50	0.07	5.99	8.22	5.36	6.09	3.26	9.97	6.27	6.39	7.33	6.21	4.43	***
8L1	1.97	0.46	9.16	7.00	6.78	9.78	8.02	13.84	9.54	6.68	6.09	7.76	11.60	***
8L2	0.97	1.34	8.59	8.95	5.95	5.72	11.60	11.78	8.84	6.86	5.56	8.44	7.42	***
8L3	1.31	2.62	8.63	5.06	5.91	8.79	7.42	12.49	6.73	5.73	6.20	9.76	7.70	***
8L4	2.02	0.19	8.45	7.57	6.39	8.72	7.70	11.80	9.84	8.94	6.05	8.08	6.37	***
8L5	0.82	0.28	8.42	5.05	7.33	2.13	6.37	13.00	7.32	6.13	7.96	9.22	4.99	***
8L6	2.41	0.95	8.02	3.79	5.54	3.03	4.99	11.60	7.70	5.56	3.57	7.42	3.01	***
8L7	2.38	1.15	8.87	8.51	6.31	5.49	10.12	12.45	9.18	5.92	6.04	7.98	6.85	***
8L8	2.07	1.37	8.14	3.65	6.26	3.76	6.85	11.91	8.85	6.58	6.68	7.99	4.25	***
8L9	2.73	0.56	8.91	2.93	7.52	3.51	4.25	13.72	10.12	7.18	3.18	7.21	3.05	***
8L10	2.25	1.64	8.80	6.13	7.62	2.56	6.82	13.90	9.21	7.97	5.64	8.93	4.72	***
8L11	3.52	1.26	8.54	4.22	7.77	4.15	4.72	11.92	10.18	5.99	4.39	7.46	3.84	***
8L12	2.85	0.10	8.22	2.20	7.71	3.37	3.59	13.57	8.63	6.69	3.46	9.42	3.43	***
8L13	1.88	3.29	7.85	8.27	6.35	8.85	9.55	12.10	8.87	5.88	7.62	7.63	13.43	***
8L14	2.79	3.40	8.30	8.73	7.84	9.07	13.43	14.11	10.18	7.20	7.05	7.06	7.89	***
8L15	2.39	3.85	8.33	9.40	7.30	7.54	7.89	13.91	10.87	4.72	7.78	6.86	9.31	***
8L16	2.41	2.59	9.00	7.17	6.21	6.72	9.31	12.75	8.20	5.65	5.86	9.27	6.67	***
8L17	2.35	3.81	8.59	7.45	7.30	9.63	6.67	12.74	13.72	6.58	6.66	7.33	5.71	***
8L18	4.09	2.02	9.55	4.44	8.37	4.80	5.71	13.43	9.31	7.05	3.36	7.89	3.94	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
8L19	1.14	0.47	8.40	2.09	8.94	10.76	8.72	15.33	7.64	8.34	8.27	10.28	12.79	***
9L1	2.57	3.52	10.09	5.03	6.83	3.99	4.21	10.43	10.80	9.22	4.65	9.01	4.35	***
9L2	2.10	3.82	8.68	3.89	6.48	2.90	2.81	9.90	14.63	4.87	5.12	8.45	4.28	***
9L3	2.44	2.48	8.11	4.10	6.55	3.35	4.67	7.93	10.25	9.56	3.69	8.34	3.31	***
9L4	2.74	1.55	8.89	4.14	5.93	3.44	3.14	8.84	9.80	11.04	3.59	8.36	3.27	***
9L5	2.55	1.08	8.91	5.14	5.85	4.16	4.55	9.30	10.51	10.04	6.78	8.15	4.69	***
9L6	2.58	1.16	8.46	3.62	6.09	3.55	3.55	7.27	9.49	10.97	4.22	7.65	3.38	***
9L7	2.37	3.93	8.93	3.41	5.79	3.43	2.77	8.79	9.09	11.34	4.33	7.17	4.09	***
9L8	2.35	2.04	7.78	3.95	6.55	3.34	4.00	8.62	11.33	9.97	4.66	6.98	3.41	***
9L9	2.40	3.33	8.02	3.16	5.25	3.69	2.94	8.01	9.63	10.47	3.40	6.76	4.81	***
9L10	2.77	3.24	8.65	4.22	4.82	3.04	3.72	8.32	10.93	9.85	4.35	6.93	3.64	***
9L11	2.35	1.12	7.84	3.40	5.12	3.18	3.03	7.58	8.77	10.92	4.70	7.82	3.89	***
9L12	2.67	1.00	8.16	3.87	5.53	3.29	3.87	7.81	9.76	10.62	4.21	7.98	4.37	***
10L1	2.88	1.59	7.30	3.51	6.36	3.27	3.49	8.93	7.72	7.62	3.27	8.05	3.35	***
10L2	2.45	1.40	8.04	3.96	6.63	2.66	3.95	9.15	8.49	9.06	3.50	7.35	3.01	***
10L3	2.36	0.70	7.12	3.26	4.79	2.39	3.99	6.97	8.39	9.51	2.48	6.71	2.42	***
10L4	2.12	0.66	6.83	2.16	4.96	2.30	3.02	7.69	6.77	8.88	2.36	7.18	2.57	***
10L5	0.95	0.48	7.06	2.85	4.80	2.22	3.07	7.30	7.46	8.81	3.55	7.42	2.56	***
10L6	1.24	0.16	7.26	3.12	4.20	3.05	3.47	6.10	8.78	8.79	3.16	5.84	3.05	***
10L7	2.32	0.74	7.19	2.87	4.43	2.89	3.69	7.10	7.51	9.39	3.20	6.83	2.76	***
10L8	2.25	0.39	5.05	2.48	7.27	2.77	2.84	9.20	9.50	6.57	2.87	7.21	3.40	***
10L9	0.63	0.51	6.47	1.92	4.77	2.16	2.71	7.04	7.46	9.37	2.49	6.82	2.84	***
10L10	1.95	0.87	5.99	2.33	4.31	1.94	2.31	6.69	7.70	7.21	2.06	6.27	2.36	***

\*\*\*> 10 bifurcating ridges

SUMMARY FHSM VP 335 *P. mortoni* Upper dentition

Medial														
N=34														
Minimum	2.99	0.64	7.15	2.13	9.13	1.20	4.04	14.98	4.71	3.29	3.53	9.41	2.94	>10
Maximum	5.13	1.72	10.20	5.53	12.90	5.75	9.35	20.59	13.93	12.80	6.41	17.11	7.85	
Arithmetic Mean	3.838	1.214	8.66	4.33	10.97	2.44	4.95	17.53	11.54	5.95	5.38	12.02	4.28	
Standard Deviation	0.472	0.26	0.60	0.68	0.94	0.83	0.89	1.18	1.54	1.65	0.58	1.41	0.85	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
RPM														
N=20														
Minimum	7.21	3.08	19.92	13.14	17.02	7.25	13.79	31.82	20.78	8.92	13.55	21.47	9.45	>10
Maximum	13.12	8.59	25.38	18.25	22.63	11.94	18.60	37.98	28.93	17.38	17.82	29.19	13.93	
Arithmetic Mean	9.571	5.559	21.85	14.74	19.91	8.69	15.55	34.92	24.57	12.62	15.60	23.50	12.26	
Standard Deviation	1.338	1.302	1.31	1.26	1.36	1.08	1.29	1.55	1.74	2.25	1.03	1.75	1.04	
R2														
N=21														
Minimum	1.94	0.84	14.93	8.90	9.99	5.31	9.53	11.41	12.51	9.83	8.65	12.89	6.63	>10
Maximum	14.12	4.95	21.19	14.76	15.92	14.29	12.37	27.60	33.41	21.36	31.44	25.54	13.75	
Arithmetic Mean	6.779	3.122	16.72	11.22	13.85	8.39	11.14	20.45	19.39	14.61	17.40	17.87	9.79	
Standard Deviation	2.563	1.317	1.62	1.31	2.36	2.99	0.85	6.84	3.88	4.36	9.00	3.39	2.25	
R3														
N=15														
Minimum	6.23	1.74	12.86	9.31	11.44	4.76	8.64	13.17	13.67	7.98	7.65	11.84	6.48	>10
Maximum	9.5	5.71	17.01	11.98	16.22	11.67	13.19	26.15	18.92	19.89	25.38	22.57	11.72	
Arithmetic Mean	8.141	4.702	14.95	10.68	14.70	7.13	11.09	22.66	16.63	10.73	11.46	17.21	8.61	
Standard Deviation	0.875	1.062	1.38	0.86	1.28	1.47	1.31	3.06	1.28	2.89	4.07	2.43	1.28	
R4														
N=20														
Minimum	1.26	1.44	6.54	3.47	8.88	4.34	5.28	8.56	12.77	8.76	4.95	10.29	5.85	>10
Maximum	5.94	3.66	13.94	9.95	14.08	6.49	11.25	22.62	23.46	17.68	9.89	17.04	11.49	
Arithmetic Mean	3.387	2.777	12.46	8.11	10.74	5.62	9.83	13.30	17.32	14.04	7.27	12.46	6.90	
Standard Deviation	1.692	0.585	1.80	1.50	1.84	0.49	1.34	5.26	2.33	3.09	1.17	1.79	1.18	
R5														
N=18														
Minimum	3.99	1.74	9.44	4.92	8.98	3.54	6.22	14.84	10.94	5.98	5.14	10.71	4.75	>10

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Maximum	6.59	3.37	12.49	9.08	13.29	6.26	10.58	20.91	14.53	10.14	8.19	18.45	6.93	
Arithmetic Mean	5.251	2.389	10.90	7.31	10.46	4.87	9.05	16.96	12.65	8.23	7.04	13.62	5.94	
Standard Deviation	0.689	0.47	0.89	1.05	1.33	0.61	1.22	1.72	1.00	1.13	0.83	2.29	0.60	
R6														
N=15														
Minimum	2.82	0.91	8.33	5.19	10.02	3.67	6.42	15.74	8.47	6.35	4.59	11.39	3.96	>10
Maximum	5.31	3.05	11.31	6.82	11.57	5.44	8.98	18.26	13.52	11.87	6.71	18.44	5.63	
Arithmetic Mean	4.613	2.25	9.79	6.08	10.86	4.76	7.80	16.31	12.07	8.79	5.54	13.78	5.06	
Standard Deviation	0.659	0.587	0.63	0.47	0.55	0.51	0.77	0.61	1.57	1.52	0.58	2.13	0.53	
R7														
N=14														
Minimum	2.98	0.64	6.87	3.09	7.31	3.23	4.86	11.44	6.45	5.51	2.67	10.51	3.23	>10
Maximum	5.13	1.72	9.26	4.86	8.94	4.46	7.04	13.72	11.76	9.77	5.03	16.74	4.72	
Arithmetic Mean	3.947	1.185	7.84	4.14	8.02	3.87	6.01	12.22	8.95	7.39	4.10	13.41	4.01	
Standard Deviation	0.573	0.293	0.75	0.51	0.49	0.43	0.70	0.69	1.61	1.29	0.74	1.51	0.38	
R8														
N=14														
Minimum	2.99	0.68	5.31	3.00	4.88	2.39	4.19	3.19	7.98	7.45	1.95	5.80	3.43	>10
Maximum	4.38	1.63	7.97	4.15	9.22	4.97	5.85	11.35	15.49	12.22	4.45	10.62	7.09	
Arithmetic Mean	3.81	1.206	6.28	3.53	6.28	3.10	4.93	4.60	11.00	10.19	3.30	7.02	4.16	
Standard Deviation	0.384	0.256	0.68	0.34	1.01	0.61	0.50	2.02	1.84	1.24	0.65	1.12	0.88	
R9														
N=19														
Minimum	1.67	0.24	4.32	2.63	5.19	1.05	0.00	2.91	4.08	5.88	0.00	0.00	0.00	>10
Maximum	3.64	1.44	6.77	377.09	14.67	377.09	373.33	14.03	376.05	11.99	373.33	380.81	376.49	
Arithmetic Mean	2.484	1.038	5.35	241.45	6.82	271.04	31.06	7.92	24.41	8.94	30.87	22.19	16.07	
Standard Deviation	0.499	0.304	0.58	182.39	1.89	170.81	103.02	2.66	73.34	1.59	103.07	74.87	75.11	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
R10														
N=7														
Minimum	1.42	0.44	3.56	3.17	4.42	1.68	0.00	7.47	5.05	5.31	0.00	0.00	0.00	>10
Maximum	2.46	1.1	4.93	377.36	6.36	377.36	3.45	9.39	11.36	8.18	2.86	10.66	3.24	
Arithmetic Mean	1.786	0.869	4.47	322.03	5.05	321.82	0.49	8.15	7.93	7.08	0.41	3.89	0.46	
Standard Deviation	0.36	0.262	0.47	140.61	0.69	141.17	1.31	0.67	2.59	1.16	1.08	4.93	1.22	
LPM														
N=17														
Minimum	0.58	0.1	15.86	6.23	21.86	12.23	13.37	30.07	19.26	4.77	9.94	9.26	10.33	>10
Maximum	8.74	4.95	23.30	18.40	28.86	19.72	29.83	40.58	25.36	28.96	14.24	29.25	16.44	
Arithmetic Mean	6.535	3.205	18.87	11.28	26.41	14.15	19.02	37.99	22.26	9.90	11.90	22.85	13.60	
Standard Deviation	2.366	1.497	1.98	4.00	1.49	1.93	5.01	2.67	1.72	6.64	1.18	4.95	1.45	
L2														
N=21														
Minimum	1.26	2.16	11.74	5.67	9.46	5.89	8.67	21.53	15.54	4.36	7.47	12.01	6.69	>10
Maximum	9.5	5.71	18.37	11.12	22.87	12.51	14.13	33.83	28.15	9.88	14.67	20.34	12.09	
Arithmetic Mean	6.711	4.234	15.08	6.88	20.83	10.05	11.70	31.22	18.72	6.22	9.17	17.88	9.41	
Standard Deviation	2.454	1.173	1.23	1.39	2.71	1.47	1.33	2.74	3.31	1.38	1.87	2.26	1.41	
L3														
N=19														
Minimum	1.3	1.44	12.77	5.78	16.75	7.25	8.63	24.83	14.68	4.03	6.07	12.42	5.70	>10
Maximum	6.59	3.66	15.76	7.98	20.84	10.69	11.60	30.53	19.57	7.65	9.91	18.64	11.05	
Arithmetic Mean	3.944	2.706	14.48	6.62	18.53	8.65	10.14	27.92	17.15	6.12	7.64	16.32	8.17	
Standard Deviation	1.8	0.62	1.00	0.59	1.01	0.91	0.77	1.29	1.38	1.02	1.05	1.46	1.32	
L4														
N=21														
Minimum	3.85	1.49	10.76	5.48	8.35	5.91	6.79	18.64	0.00	4.90	4.55	9.11	5.49	>10
Maximum	5.52	2.9	14.65	8.27	17.24	9.56	10.36	26.38	21.25	20.24	7.75	25.11	13.00	

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	r Crown Width F-G	r Tooth Width B-C	Tooth Width E-D	Tooth Length B-E	Crown Length F-I	Tooth Length C-D	Crown Length G-H	
Arithmetic Mean	4.821	2.201	13.14	6.48	15.51	7.49	8.71	23.92	13.73	7.76	6.30	14.36	7.48	
Standard Deviation	0.514	0.347	0.89	0.66	2.19	0.92	1.07	2.11	4.99	3.94	0.77	3.30	1.56	
L5 N=13														
Minimum	1.23	0.27	10.71	4.25	7.91	4.43	6.86	6.10	8.94	5.08	3.94	8.53	4.92	>10
Maximum	5.31	3.05	13.54	5.96	15.81	7.60	8.82	22.53	19.88	21.87	5.88	15.21	8.34	
Arithmetic Mean	3.622	1.867	11.65	5.30	11.66	6.12	7.49	14.24	14.06	12.43	5.27	12.42	6.44	
Standard Deviation	1.369	0.912	0.93	0.53	2.98	0.97	0.48	7.04	3.97	7.11	0.65	2.26	1.10	
L6 N=16														
Minimum	0.87	0.25	8.27	3.42	5.84	4.10	4.48	5.17	7.01	4.72	3.16	7.31	3.22	>10
Maximum	3.43	2.54	11.44	11.72	9.57	6.42	11.71	15.84	16.87	19.11	16.84	12.55	5.53	
Arithmetic Mean	2.376	1.301	9.44	5.95	7.57	4.91	6.31	9.06	10.74	12.39	8.03	9.81	4.57	
Standard Deviation	0.745	0.502	0.85	2.37	0.98	0.60	1.76	4.28	2.34	5.31	4.64	1.37	0.70	
L7 N=18														
Minimum	1.47	0.07	5.99	2.05	5.36	2.11	3.26	5.32	0	5.73	2.84	6.18	2.62	>10
Maximum	5.4	5.61	11.15	13.57	10.28	11.12	16.18	16.47	15.32	18.31	9.53	14.55	11.55	
Arithmetic Mean	3.533	1.848	9.202	5.924	7.779	5.271	6.269	11.437	8.691	7.561	5.218	9.332	4.955	
Standard Deviation	1.031	1.429	1.499	3.342	1.508	2.265	3.101	3.607	4.612	2.815	2.052	2.687	2.138	
L8 N=19														
Minimum	0.82	0.1	7.85	2.09	5.54	2.13	3.59	11.6	6.73	4.72	3.18	6.86	3.01	>10
Maximum	4.09	3.85	9.55	9.4	8.94	10.76	13.43	15.33	13.72	8.94	8.27	10.28	13.43	
Arithmetic Mean	2.229	1.65	8.567	5.927	7.021	6.231	7.565	12.966	9.207	6.613	5.864	8.21	6.683	
Standard Deviation	0.819	1.263	0.414	2.392	0.922	2.825	2.518	1.021	1.537	1.033	1.611	0.993	3.193	
L9														

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
N=12														
Minimum	2.1	1	7.78	3.16	4.82	2.9	2.77	7.27	8.77	4.87	3.4	6.76	3.27	>10
Maximum	2.77	3.93	10.09	5.14	6.83	4.16	4.67	10.43	14.63	11.34	6.78	9.01	4.81	
Arithmetic Mean	2.491	2.356	8.543	3.994	5.899	3.447	3.605	8.567	10.416	9.906	4.475	7.8	3.957	
Standard Deviation	0.193	1.164	0.641	0.605	0.635	0.364	0.671	0.95	1.531	1.714	0.883	0.712	0.551	
L10														
N=10														
Minimum	0.63	0.16	5.05	1.92	4.2	1.94	2.31	6.1	6.77	6.57	2.06	5.84	2.36	>10
Maximum	2.88	1.59	8.04	3.96	7.27	3.27	3.99	9.2	9.5	9.51	3.55	8.05	3.4	
Arithmetic Mean	1.915	0.75	6.831	2.846	5.252	2.565	3.254	7.617	7.978	8.521	2.894	6.968	2.832	
Standard Deviation	0.728	0.442	0.826	0.637	1.085	0.43	0.554	1.099	0.799	1.02	0.518	0.623	0.367	

\*\*\*ridges >10 and bifurcating

Specimen:	FHSM VP 335 <i>P. mortoni</i> Lower dentition													
M1	11.18	5.16	24.09	16.83	25.45	16.32	27.41	34.51	34.57	21.57	16.86	24.52	16.79	***
M2	11.13	5.58	25.35	17.42	24.43	14.56	25.51	32.92	30.86	22.27	15.62	26.51	17.75	***
M3	10.68	5.17	25.05	15.83	25.42	16.64	26.28	35.08	36.05	21.44	16.36	25.34	16.80	***
M4	13.48	8.62	26.76	17.85	26.74	17.70	26.14	34.55	25.91	19.85	15.39	34.37	17.49	***
M5	13.70	9.15	26.60	20.36	26.33	19.37	29.60	33.62	24.37	20.87	17.14	32.64	20.00	***
M6	15.23	9.68	28.86	20.34	30.06	20.22	29.37	38.64	30.29	10.21	16.07	34.66	18.11	***
RPM1	12.72	7.55	24.97	15.22	22.79	14.88	22.65	33.35	20.44	29.48	12.94	23.46	15.57	***
RPM2	12.16	6.24	23.72	14.62	21.41	11.29	20.29	32.56	28.85	19.33	12.06	23.24	13.04	***
RPM3	11.35	6.39	24.50	15.25	21.06	13.17	21.38	32.35	16.47	30.12	11.31	20.28	13.96	***
RPM4	9.52	7.26	25.66	15.67	20.18	13.06	22.34	33.29	23.90	28.94	12.82	5.58	14.47	***
RPM5	12.36	6.15	25.16	14.96	20.61	12.66	22.24	31.94	6.32	38.90	11.94	16.66	14.46	***
RPM6	11.73	5.03	23.40	12.68	20.45	13.59	21.52	32.26	23.46	29.36	12.50	7.64	13.89	***
RPM7	12.52	6.24	24.92	15.60	20.49	12.09	20.97	31.27	23.47	27.41	12.63	7.68	12.43	***
RPM8	12.91	5.95	23.89	14.24	21.48	13.89	21.41	32.92	22.93	29.63	13.66	10.52	14.15	***
RPM9	11.14	5.40	23.66	15.00	21.19	12.75	21.19	32.97	18.99	29.35	13.55	13.58	13.60	***
RPM10	5.82	5.54	20.29	11.98	18.28	12.76	19.37	24.43	19.54	32.25	10.90	5.44	12.58	***
RPM11	11.78	5.45	23.60	11.97	18.22	10.24	15.88	30.58	29.18	13.91	11.78	17.56	10.52	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
2R1	8.32	3.84	23.63	14.99	20.04	11.23	20.67	31.18	22.92	29.78	13.00	7.91	13.00	***
2R2	8.22	3.27	23.12	13.84	13.16	11.89	20.45	16.32	34.60	9.49	15.75	24.07	14.13	***
2R3	8.23	2.96	21.38	13.16	19.04	12.94	20.37	28.73	19.18	28.96	14.64	13.28	14.35	***
2R4	7.99	3.48	20.59	12.50	18.45	11.35	19.11	28.47	19.51	26.80	13.02	11.42	12.29	***
2R5	9.30	4.21	21.72	12.52	18.90	10.20	17.58	29.24	18.32	26.33	10.49	13.41	11.49	***
3R1	4.28	1.59	15.75	10.27	18.63	14.74	20.33	26.82	22.27	22.81	13.03	6.15	12.61	***
3R2	4.46	1.91	16.27	9.80	16.45	13.19	19.16	24.17	17.48	28.79	11.87	5.77	13.52	***
3R3	5.81	2.08	15.53	9.74	18.06	10.70	16.87	25.97	20.33	21.47	11.31	7.94	11.64	***
3R4	7.44	4.16	16.67	10.93	11.92	11.31	18.28	11.00	23.12	9.49	11.82	17.43	12.15	***
3R5	9.00	4.71	20.13	11.19	12.50	11.75	17.15	17.00	18.52	15.19	11.40	17.27	11.97	***
3R6	9.16	5.10	18.66	11.08	20.80	13.12	18.94	28.69	19.74	21.55	8.90	5.79	12.15	***
3R7	10.52	4.95	19.37	11.78	18.94	11.41	18.43	28.19	19.41	21.33	9.82	8.70	11.54	***
3R8	8.86	3.51	17.97	10.51	18.83	10.91	17.86	27.43	20.28	22.60	9.81	7.76	10.80	***
3R9	8.32	4.07	19.11	11.56	18.60	11.51	18.80	26.63	17.66	15.42	10.22	24.10	11.73	***
3R10	8.02	3.92	18.29	10.88	20.42	10.84	16.61	29.47	20.95	11.57	9.12	24.82	10.12	***
3R11	5.93	2.29	16.81	9.85	15.98	12.46	19.57	28.64	20.68	15.31	10.40	16.59	12.33	***
3R12	7.21	3.86	17.82	11.86	17.64	11.32	19.45	28.92	22.39	11.77	9.99	21.36	11.20	***
3R13	11.90	7.01	20.63	12.88	18.11	12.66	19.28	28.41	19.97	23.37	10.59	8.97	10.93	***
3R14	11.91	6.90	21.59	13.80	14.63	11.32	18.34	17.11	21.32	24.30	11.44	15.87	11.36	***
3R15	11.89	7.23	19.93	13.50	20.59	12.85	19.03	27.71	33.06	14.58	11.39	18.53	12.99	***
3R16	11.26	7.13	20.52	13.29	20.95	14.63	20.89	32.95	23.73	6.37	11.33	20.34	11.51	***
3R17	11.43	6.82	21.49	13.44	20.83	12.76	19.18	31.96	19.31	7.70	9.45	20.58	10.52	***
3R18	11.11	7.34	20.78	14.47	19.91	13.76	20.79	31.14	22.68	9.05	9.77	21.81	10.89	***
4R1	5.49	1.19	13.67	8.55	14.57	8.49	13.91	20.94	19.18	18.45	9.91	4.33	10.35	***
4R2	6.15	2.69	13.96	7.97	14.10	9.51	14.35	22.58	18.16	8.64	7.84	17.26	8.98	***
4R3	4.64	2.05	12.13	6.82	15.02	8.44	11.81	21.11	17.92	10.70	9.52	20.02	9.92	***
4R4	6.46	2.93	14.48	8.08	14.46	8.75	13.70	22.79	9.35	17.73	7.02	12.43	7.02	***
4R5	5.17	2.69	13.60	8.48	10.74	9.36	13.15	16.34	17.21	13.44	7.49	18.36	9.06	***
4R6	6.94	4.22	14.84	8.92	11.50	9.83	14.41	11.99	21.10	18.71	7.88	10.19	9.66	***
4R7	0.57	4.01	14.87	9.72	10.36	9.03	15.07	12.19	19.95	18.11	8.27	10.10	8.58	***
4R8	4.11	3.58	15.02	8.63	10.41	9.21	14.25	12.04	18.15	18.40	8.15	11.43	8.48	***
4R9	9.47	5.65	15.53	10.27	16.20	10.65	15.75	22.14	26.57	11.14	7.73	14.68	9.52	***



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges	
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Crown	Tooth	Crown	Tooth		Crown
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
		A-B	A-F	A-C	A-G										
4R10	7.88	2.43	16.58	10.44	15.22	9.26	14.14	23.95	18.17	8.43	7.99	18.34	11.96	***	
4R11	6.78	3.37	14.62	8.55	13.16	8.11	13.19	22.29	17.29	9.88	6.83	16.01	8.78	***	
4R12	8.79	5.59	16.76	10.83	15.27	10.05	14.57	24.80	16.89	10.41	8.06	17.86	9.79	***	
4R13	8.55	5.03	15.37	8.67	14.21	8.88	12.59	22.12	13.98	12.68	8.23	21.02	10.23	***	
4R14	7.74	4.66	15.52	10.76	14.79	9.38	15.16	23.84	15.90	9.52	7.28	16.89	8.44	***	
5R1	3.48	1.86	11.62	7.56	12.40	7.43	11.72	17.67	14.12	9.81	7.62	17.96	8.49	***	
5R2	4.99	1.37	11.05	6.57	14.16	7.52	10.78	16.53	13.86	7.89	7.32	18.98	9.44	***	
5R3	8.05	5.01	13.05	8.71	11.91	7.77	11.56	18.17	14.63	8.85	7.22	12.55	7.75	***	
5R4	6.74	3.58	11.54	7.21	11.26	7.35	11.22	17.69	12.71	8.78	6.90	13.53	7.43	***	
5R5	7.13	3.70	12.99	8.97	12.06	7.67	13.45	19.80	13.79	8.40	7.08	13.88	6.84	***	
5R6	6.33	3.81	11.01	6.90	11.83	6.93	9.97	15.51	15.30	7.66	7.20	16.16	7.38	***	
5R7	7.55	4.42	12.32	8.41	12.05	7.69	10.99	18.16	13.83	8.95	8.73	13.55	8.14	***	
5R8	7.16	2.61	13.37	9.43	10.85	8.04	13.27	18.62	14.11	7.57	6.29	12.95	13.58	***	
5R9	6.74	3.90	11.31	7.45	11.27	7.74	11.53	17.52	14.95	8.83	6.97	12.45	7.59	***	
5R10	7.08	4.70	12.15	8.14	13.25	7.71	11.09	18.62	14.76	9.21	7.03	18.35	8.01	***	
5R11	3.52	1.65	13.12	8.64	10.15	6.92	12.04	21.40	12.19	9.62	6.74	19.56	11.12	***	
5R12	2.40	0.84	12.83	8.45	11.54	8.00	12.78	18.93	22.87	8.14	6.04	0.00	7.92	***	
5R13	7.65	4.70	13.19	8.73	13.15	8.02	11.71	19.80	14.05	9.13	6.45	15.30	7.69	***	
5R14	6.94	3.79	12.86	8.10	11.77	7.00	11.47	19.52	13.12	7.55	5.22	13.10	6.95	***	
5R15	7.63	4.22	13.07	9.27	11.76	7.82	12.74	18.44	13.10	8.24	6.21	12.93	5.96	***	
5R16	7.27	4.20	12.25	8.40	12.19	6.97	10.82	18.01	13.48	8.02	6.06	13.87	6.28	***	
5R17	5.80	3.10	11.03	7.20	11.69	7.62	10.84	15.13	15.15	9.62	6.38	16.74	8.06	***	
5R18	8.74	4.76	12.37	7.54	10.89	7.03	11.42	17.73	13.26	9.09	5.88	13.12	7.99	***	
5R19	8.20	4.30	13.18	8.21	7.99	6.46	10.73	8.52	13.34	15.75	5.39	11.55	6.68	***	
5R20	8.31	4.95	11.05	5.63	10.27	5.56	8.28	17.96	11.04	6.36	5.29	15.39	5.45	***	
5R21	8.44	4.33	13.06	8.06	12.44	8.14	11.42	19.02	13.48	8.66	5.78	13.54	7.56	***	
6R1	8.21	1.74	9.89	5.14	13.75	6.36	8.68	16.16	9.15	10.98	6.58	18.32	7.78	***	
6R2	7.83	4.93	9.27	4.04	11.18	6.37	7.60	11.76	10.24	14.21	6.46	8.07	7.16	***	
6R3	7.67	4.37	8.48	5.48	9.01	6.00	9.29	15.73	9.99	8.24	5.09	13.00	5.59	***	
6R4	7.45	4.53	9.88	5.88	10.61	5.80	8.68	14.92	10.91	5.53	5.48	17.12	5.78	***	
6R5	9.09	5.71	10.75	6.91	10.63	7.46	9.55	15.90	12.07	7.95	5.45	14.16	7.70	***	
6R6	8.20	5.35	10.12	6.20	10.63	6.19	10.07	15.61	11.92	8.63	5.40	12.17	4.29	***	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
6R7	9.08	5.42	10.50	7.34	10.45	7.75	10.82	15.69	11.94	6.54	6.99	11.78	7.02	***
6R8	7.45	5.16	11.10	7.44	10.81	7.68	10.56	13.38	10.54	11.99	6.17	13.06	7.18	***
6R9	8.24	4.41	9.08	5.69	10.09	6.92	10.82	15.75	12.90	8.55	6.08	13.26	7.02	***
6R10	8.12	5.06	12.12	7.68	10.66	6.98	10.03	15.89	12.99	6.90	5.66	13.19	7.01	***
6R11	8.94	5.44	11.60	7.61	8.82	6.13	10.90	7.55	12.58	14.17	5.93	10.56	5.61	***
6R12	8.92	5.47	10.57	7.35	8.25	6.80	10.23	7.24	10.80	13.01	5.51	9.10	6.54	***
6R13	9.50	5.68	10.73	6.97	8.18	6.64	9.79	7.06	11.30	15.58	6.15	9.51	9.25	***
6R14	6.23	3.80	9.48	6.42	8.02	5.90	9.90	8.85	16.68	13.84	6.85	6.57	7.57	***
6R15	7.19	3.46	10.59	5.64	8.82	5.67	9.35	8.42	14.30	14.34	6.41	8.49	6.21	***
6R16	5.94	2.47	10.75	6.89	9.05	6.33	9.58	6.39	16.21	14.36	7.11	8.46	6.60	***
6R17	5.66	2.36	11.08	6.66	11.45	5.89	8.93	15.54	12.44	6.98	6.09	16.56	6.65	***
6R18	5.67	2.16	10.73	7.16	9.99	6.02	9.85	15.09	12.47	9.35	6.04	11.72	6.41	***
6R19	2.57	3.13	10.43	6.88	8.06	7.26	10.61	7.01	12.09	14.96	6.17	11.76	7.02	***
6R20	4.29	3.55	6.43	3.61	15.99	11.87	9.96	9.63	11.47	13.61	6.84	15.98	7.95	***
6R21	1.63	3.29	10.64	6.08	9.13	7.07	7.03	8.55	12.44	14.45	6.28	7.83	10.17	***
6R22	1.26	3.16	9.00	4.60	9.03	6.12	7.91	9.48	12.12	9.57	6.35	13.90	11.15	***
7R1	1.79	3.43	7.29	4.18	7.13	5.51	7.28	3.28	11.53	11.27	4.83	6.85	5.62	***
7R2	2.20	2.95	8.55	4.61	8.08	5.77	7.42	4.60	13.75	12.09	4.62	6.97	5.97	***
7R3	4.26	3.00	8.20	5.07	7.84	4.82	7.46	5.18	13.31	11.88	5.24	6.89	7.12	***
7R4	1.82	3.18	8.33	5.51	7.22	5.37	7.88	5.37	11.79	12.78	5.08	7.08	8.21	***
7R5	2.78	3.66	9.25	5.15	7.64	5.16	7.19	5.02	14.35	12.49	4.97	9.40	4.39	***
7R6	1.30	1.91	9.97	4.68	8.74	6.34	7.87	5.20	14.68	13.04	5.53	8.02	5.90	***
7R7	1.73	2.94	9.37	5.35	9.92	6.06	7.73	9.45	9.53	10.96	5.51	14.71	6.19	***
7R8	3.23	2.39	9.70	4.74	8.21	5.41	7.19	3.93	15.14	15.58	5.13	7.86	5.88	***
7R9	1.78	3.18	9.38	5.01	8.60	6.24	7.94	11.32	10.81	8.45	5.88	10.53	6.38	***
7R10	4.99	2.59	8.80	4.57	8.83	5.41	7.38	4.68	7.35	13.50	4.63	10.57	5.26	***
7R11	5.36	2.23	8.66	3.65	8.34	4.97	6.86	4.66	12.54	14.23	3.55	7.53	5.99	***
7R12	5.45	2.52	6.42	4.66	9.73	5.45	10.41	12.39	10.38	5.55	5.09	14.56	4.83	***
7R13	4.03	1.44	7.89	4.14	8.30	4.24	6.66	4.47	12.24	12.77	5.00	9.25	5.98	***
7R14	6.59	3.37	9.21	3.43	7.65	5.49	7.00	4.76	10.54	12.71	4.42	8.75	6.33	***
7R15	6.36	3.25	9.14	4.95	8.27	5.70	8.10	4.58	15.13	14.51	5.47	11.13	7.20	***
7R16	4.27	1.74	8.65	4.32	8.54	4.51	7.19	5.00	15.23	14.33	4.98	8.97	5.11	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
7R17	5.33	2.08	9.44	4.63	8.51	4.95	9.55	4.86	15.20	15.40	8.17	8.62	8.43	***
7R18	6.16	3.05	8.43	4.56	10.14	5.38	7.71	5.81	12.56	12.44	5.18	9.28	6.16	***
7R19	5.51	2.51	9.05	5.29	8.42	5.31	6.60	12.12	9.06	5.85	4.17	13.64	4.28	***
8R1	5.02	2.33	7.30	4.43	6.94	6.43	8.04	4.03	12.10	11.19	4.71	7.15	4.75	***
8R2	5.38	2.43	7.96	4.89	6.87	4.80	7.40	4.12	12.08	11.35	4.36	7.32	4.82	***
8R3	5.48	2.32	7.51	4.67	7.42	5.51	7.83	3.99	13.82	11.36	4.46	7.10	4.23	***
8R4	5.41	2.12	7.68	4.05	7.55	4.63	7.42	2.89	10.76	12.14	4.90	9.19	4.33	***
8R5	4.75	2.12	7.86	4.98	6.49	3.91	7.81	4.37	10.12	11.59	4.77	7.11	4.77	***
8R6	5.52	2.38	7.97	5.01	8.72	5.35	7.49	11.80	8.42	5.33	5.88	15.93	5.86	***
8R7	5.46	2.68	7.04	4.38	8.41	4.76	6.73	11.14	7.89	7.96	5.01	13.98	4.54	***
8R8	5.02	2.52	8.38	4.80	7.84	4.32	7.56	11.67	8.73	7.62	4.09	12.64	6.66	***
8R9	3.99	1.81	8.33	4.58	8.20	4.60	6.85	11.19	6.40	8.00	4.69	15.60	4.49	***
8R10	4.55	2.08	7.21	3.83	8.05	5.68	7.41	10.79	7.28	5.85	4.61	15.74	6.65	***
8R11	5.20	2.45	7.66	4.76	6.22	4.89	7.29	4.48	13.76	11.16	4.76	8.15	4.87	***
8R12	4.52	1.76	10.83	5.81	5.16	5.16	9.14	12.47	11.31	9.03	3.94	4.50	5.17	***
8R13	5.07	2.13	8.70	4.30	6.12	6.12	7.88	9.16	16.78	10.63	3.95	3.48	4.54	***
9R1	3.85	1.49	7.15	3.73	5.94	3.80	5.62	3.75	11.21	10.89	2.88	5.96	4.12	***
9R2	3.51	1.76	5.81	3.74	4.94	2.94	4.75	3.59	16.29	10.11	6.59	8.38	6.03	***
9R3	3.19	1.58	6.53	3.20	6.32	4.29	5.83	3.87	11.22	11.00	1.85	6.65	5.66	***
9R4	5.42	1.80	7.23	4.27	10.15	4.14	3.95	7.81	13.33	10.96	3.91	9.40	3.50	***
9R5	3.40	1.56	6.92	3.14	3.91	3.36	4.27	7.82	10.49	4.79	3.76	4.51	3.74	***
9R6	3.60	2.13	7.63	4.55	7.32	3.61	5.30	3.82	11.81	10.78	4.84	6.82	4.03	***
9R7	4.96	0.97	7.05	3.99	6.06	4.06	5.65	3.69	12.44	10.84	8.87	6.83	7.37	***
9R8	1.78	1.46	6.66	3.99	8.85	4.44	4.71	9.40	11.92	10.34	8.10	0.00	7.74	***
9R9	2.35	1.21	6.94	3.87	6.46	2.74	4.39	8.76	6.15	7.71	4.43	13.77	4.04	***
9R10	2.04	1.37	6.88	3.83	6.66	3.71	4.94	5.83	11.65	9.71	5.02	6.92	5.14	***
9R11	1.48	0.90	7.26	3.17	7.32	3.13	4.88	6.55	10.74	9.03	5.84	6.48	5.34	***
9R12	1.69	0.95	7.19	4.35	6.40	3.52	6.17	9.02	9.41	7.76	4.24	8.67	3.77	***
9R13	1.27	0.58	6.21	3.64	8.22	2.76	5.84	11.43	7.62	8.03	3.80	0.00	3.42	***
9R14	2.87	1.37	5.09	4.14	6.71	3.00	5.35	8.98	6.55	6.91	4.12	12.20	4.06	***
9R15	7.96	5.41	6.54	3.81	6.25	3.48	5.29	8.91	7.42	6.84	4.02	11.05	3.25	***
9R16	7.09	3.33	6.81	3.98	6.76	3.16	4.92	9.98	8.38	8.05	4.39	9.42	3.47	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
9R17	6.30	3.28	6.21	3.98	6.57	3.18	5.51	9.52	7.87	7.52	4.11	8.27	3.59	***
9R18	7.74	4.31	6.62	4.04	7.76	3.24	4.36	9.21	8.46	6.95	4.52	11.16	4.44	***
9R19	7.40	4.77	7.57	4.99	6.15	3.50	5.50	9.14	9.35	7.47	4.49	9.89	4.94	***
9R20	6.84	4.93	6.97	4.06	6.23	3.01	5.01	9.44	8.21	7.61	4.24	10.16	4.55	***
9R21	7.00	4.22	7.94	4.89	8.10	3.55	4.44	9.26	6.49	8.51	4.59	14.73	4.12	***
9R22	8.63	5.60	7.28	4.49	7.06	3.32	4.82	9.26	8.13	7.63	4.46	11.48	4.51	***
9R23	10.46	6.71	8.49	4.73	8.91	3.77	4.95	11.83	9.32	8.96	5.17	11.15	4.23	***
9R24	5.87	3.48	6.03	3.62	9.30	3.52	5.72	10.29	5.35	9.54	3.82	14.53	2.88	***
9R25	6.87	4.21	5.30	3.88	5.93	3.21	5.87	8.69	8.95	8.20	9.89	9.31	2.59	***
10R1	7.12	3.64	5.13	3.52	6.16	2.15	4.40	9.07	5.33	5.90	2.90	10.83	3.16	***
10R2	3.10	1.67	5.24	3.22	7.82	1.99	4.02	9.41	5.45	5.31	2.30	13.58	2.43	***
10R3	4.19	2.12	5.96	3.12	6.08	1.89	3.71	9.30	6.47	5.49	3.32	8.26	2.67	***
10R4	9.98	5.97	5.58	3.28	6.28	2.29	4.06	9.79	5.83	4.99	3.14	9.61	2.60	***
10R5	5.61	3.71	4.68	3.78	6.80	2.88	5.90	8.83	6.95	7.32	3.43	11.18	2.51	***
10R6	8.41	4.70	6.58	3.91	7.98	3.37	4.22	8.86	5.67	8.42	4.64	12.50	3.46	***
10R7	8.17	4.95	6.60	3.90	6.27	2.47	4.95	9.20	6.52	5.08	4.18	11.16	2.65	***
10R8	7.31	5.81	6.81	4.10	7.78	3.46	4.43	10.33	4.61	5.18	4.04	14.05	3.83	***
10R9	8.30	3.85	6.74	4.29	6.63	3.07	6.06	9.59	7.70	6.79	3.18	10.71	3.05	***
10R10	1.78	1.46	6.77	3.36	7.67	2.74	4.69	9.26	7.53	6.56	4.07	12.09	3.37	***
10R11	1.78	1.46	6.77	4.19	6.19	2.95	5.21	9.05	7.57	5.17	3.88	9.33	3.82	***
10R12	2.62	2.02	6.84	3.60	6.91	2.86	4.64	9.90	8.52	7.63	3.56	8.97	3.56	***
10R13	3.84	2.03	5.82	3.72	6.43	2.33	4.87	9.18	7.08	6.05	4.00	10.17	3.22	***
10R14	3.99	2.00	7.86	4.63	7.80	3.09	4.68	10.54	6.48	6.70	4.53	13.75	4.40	***
10R15	3.71	1.97	7.40	4.36	6.79	2.83	5.00	10.56	5.37	4.88	4.32	12.47	3.45	***
10R16	4.19	2.12	6.01	3.66	6.45	2.40	4.64	9.58	6.33	8.28	3.89	10.48	4.08	***
10R17	6.04	3.60	6.69	4.01	6.42	3.23	5.04	9.90	7.09	5.44	3.89	10.82	3.41	***
10R18	5.82	3.10	6.08	3.84	6.72	3.19	5.28	9.04	6.76	5.64	3.39	12.54	3.30	***
10R19	6.67	1.10	7.00	3.76	6.19	3.45	4.69	9.90	7.30	6.30	4.15	11.59	3.93	***
10R20	6.57	2.57	5.76	3.39	6.40	1.72	3.93	8.77	7.73	5.38	4.06	10.23	3.38	***
10R21	5.78	3.10	8.46	3.56	6.98	3.00	5.32	11.74	7.56	9.63	3.61	10.76	3.35	***
10R22	4.69	2.56	6.82	4.39	7.89	2.75	4.14	10.14	5.84	6.00	4.77	14.19	3.90	***
10R23	4.19	2.12	5.99	3.18	6.46	2.14	4.48	9.57	6.91	5.25	4.12	8.95	3.49	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
11R1	1.83	1.03	5.23	3.41	6.77	2.74	5.05	8.95	5.89	8.53	2.92	10.70	2.51	***
11R2	2.20	1.33	5.31	3.31	6.26	2.84	5.31	8.47	6.82	9.09	5.25	8.27	2.94	***
11R3	2.66	1.60	6.13	3.71	5.29	1.93	4.09	9.01	11.00	10.28	3.15	0.00	2.78	***
11R4	2.73	1.37	6.29	3.90	5.10	2.10	4.46	8.86	9.52	9.76	3.00	0.00	3.63	***
11R5	2.84	1.71	6.14	3.74	4.99	1.84	4.24	8.84	10.64	9.28	3.28	0.00	2.83	***
11R6	2.53	1.28	5.34	3.58	5.51	3.55	5.39	8.74	9.19	10.43	3.01	0.00	4.38	***
11R7	2.73	1.35	5.27	3.02	6.03	2.07	3.98	8.52	10.20	9.81	2.71	0.00	3.46	***
11R8	2.96	1.55	5.78	3.92	5.23	1.68	4.30	9.09	9.33	9.52	3.43	0.00	3.31	***
11R9	2.94	1.55	5.38	3.88	5.74	1.78	4.51	8.86	10.79	9.80	3.27	0.00	3.78	***
11R10	3.10	1.67	5.22	3.97	5.60	2.22	5.12	8.51	6.31	5.49	3.77	7.70	2.60	***
11R11	3.21	1.81	5.63	3.43	5.48	2.09	3.90	8.39	10.33	8.92	2.89	0.00	2.79	***
11R12	3.42	1.90	5.80	2.74	6.20	1.54	2.73	10.65	12.49	6.59	3.03	0.00	2.85	***
LPM1	9.58	6.08	21.09	14.71	22.63	12.31	22.05	32.47	33.16	11.09	12.75	21.35	13.52	***
LPM2	11.22	6.03	21.19	15.17	23.56	14.24	23.60	32.34	23.89	10.37	12.33	28.47	13.87	***
LPM3	10.99	6.39	20.35	14.24	24.43	15.07	23.82	32.90	21.18	11.86	12.90	29.01	13.76	***
LPM4	11.31	5.98	21.46	15.77	23.85	14.66	25.43	31.82	25.20	7.19	13.79	29.17	14.08	***
LPM5	10.57	6.35	21.23	14.56	23.82	14.34	21.52	31.72	25.23	5.66	12.33	28.64	13.67	***
LPM6	10.79	6.20	21.09	15.03	23.63	13.54	22.56	36.67	25.90	8.42	13.35	24.66	13.32	***
LPM7	12.07	6.86	21.46	14.65	24.69	15.00	21.93	36.37	24.98	10.60	13.22	25.59	13.15	***
LPM8	12.02	7.73	20.16	13.70	23.24	12.94	18.21	29.17	23.91	7.83	11.31	29.39	12.82	***
2L1	7.38	2.76	17.60	12.78	20.51	11.54	19.72	32.88	18.61	12.45	13.95	23.72	13.80	***
2L2	8.45	3.55	19.16	12.37	20.76	10.93	16.83	32.45	19.79	10.89	12.04	22.92	11.71	***
2L3	6.80	2.30	18.77	13.34	21.00	11.00	19.64	34.19	22.21	10.76	15.09	25.00	14.84	***
2L4	6.83	1.56	18.39	12.44	22.38	12.14	19.95	34.11	25.29	6.74	14.91	26.85	15.75	***
2L5	8.43	3.78	19.42	12.74	23.26	14.09	22.04	36.38	21.62	11.06	14.05	25.89	14.20	***
3L1	6.58	2.05	17.22	10.49	19.95	9.17	15.85	31.29	26.03	6.25	9.96	14.79	10.90	***
3L2	4.97	1.07	17.88	12.21	16.55	7.56	16.53	30.39	28.25	6.61	9.54	12.71	10.74	***
3L3	6.30	2.31	18.00	11.95	18.64	8.51	16.83	31.66	21.47	8.23	10.70	18.61	11.20	***
3L4	7.18	3.18	16.59	12.69	20.01	10.06	18.25	28.98	21.28	7.85	10.64	21.41	12.06	***
3L5	5.69	1.85	17.02	10.98	20.12	10.22	18.03	33.10	20.38	5.16	10.24	21.04	11.53	***
3L6	4.64	0.87	16.91	11.94	20.74	9.57	18.70	35.23	17.47	12.25	12.27	20.17	13.21	***
3L7	8.66	4.12	18.57	12.04	21.02	9.86	18.33	33.30	20.97	5.45	10.58	23.03	8.40	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
3L8	7.48	2.64	17.83	12.16	20.80	9.53	19.57	34.97	21.50	5.90	10.46	19.87	10.21	***
3L9	8.57	3.59	18.52	11.51	20.98	9.89	17.34	33.35	27.38	5.23	10.01	15.51	10.10	***
3L10	8.28	4.06	18.29	11.10	20.76	10.40	16.92	32.45	26.44	6.01	9.27	14.92	10.15	***
3L11	7.69	3.38	18.34	11.79	20.16	9.59	18.00	32.62	31.07	7.56	9.66	11.48	9.44	***
3L12	9.59	4.07	18.58	11.54	21.51	8.68	16.71	32.88	28.13	6.96	10.48	15.42	10.22	***
3L13	12.08	5.90	19.26	10.89	23.13	8.11	9.25	31.47	17.43	10.73	13.59	20.05	11.74	***
3L14	10.77	6.30	20.52	11.75	23.07	9.00	10.04	33.38	21.17	8.34	14.34	23.67	13.48	***
3L15	10.56	4.94	17.47	11.16	24.60	7.72	10.21	31.97	22.34	9.31	13.61	22.92	11.42	***
3L16	9.89	6.19	16.32	12.53	23.59	6.69	10.89	31.80	20.23	7.93	14.41	21.81	10.15	***
3L17	10.08	5.45	19.95	11.46	23.33	7.67	10.63	36.15	20.05	6.54	12.77	21.22	12.91	***
3L18	11.25	6.31	19.86	11.42	23.52	8.18	10.59	34.05	19.31	8.37	13.66	20.34	14.26	***
3L19	11.57	5.90	18.93	12.21	23.58	7.99	10.89	32.08	19.79	5.49	12.90	22.29	10.88	***
3L20	10.67	6.28	20.21	12.09	24.20	7.95	10.66	31.78	18.84	7.59	12.87	22.26	11.74	***
3L21	11.77	6.30	18.88	11.13	23.62	7.79	9.80	31.00	19.44	8.30	12.95	20.80	12.06	***
3L22	8.44	3.97	17.58	10.85	21.28	5.73	10.35	33.29	19.24	7.56	15.49	20.48	12.49	***
3L23	8.38	4.14	18.70	11.36	21.64	6.94	10.56	32.00	29.71	6.76	14.04	15.13	12.16	***
4L1	7.91	4.36	13.13	7.71	17.04	6.41	5.65	21.04	22.88	7.04	13.09	12.14	8.36	***
4L2	7.98	4.34	13.53	6.77	16.92	5.70	5.46	22.90	17.33	5.40	11.74	16.51	9.13	***
4L3	7.99	4.29	14.08	8.56	16.52	5.45	6.35	23.19	13.12	6.82	10.64	14.70	8.75	***
4L4	7.86	4.15	13.81	7.62	16.74	5.66	6.79	24.42	15.33	4.32	10.08	14.56	8.34	***
4L5	7.73	4.10	13.11	7.36	16.88	5.23	5.94	24.12	13.50	7.39	10.49	14.38	9.39	***
4L6	7.17	3.30	13.38	6.27	17.75	4.98	5.71	27.12	12.17	9.28	10.38	14.20	8.12	***
4L7	7.43	3.71	12.97	7.91	9.66	5.41	6.63	9.90	16.35	3.26	11.77	13.19	8.52	***
4L8	7.54	3.36	14.22	7.29	17.01	6.23	6.76	25.84	14.25	6.41	11.43	15.68	9.17	***
4L9	5.79	2.56	12.91	7.10	16.02	4.52	7.11	24.99	18.21	7.26	9.36	11.16	7.40	***
4L10	6.67	3.54	13.39	7.36	16.40	5.65	6.30	25.93	14.71	8.43	10.77	13.86	8.21	***
4L11	7.85	3.86	14.08	6.77	16.68	5.77	5.90	24.59	15.39	5.32	9.15	14.38	8.09	***
4L12	7.75	3.45	13.55	6.38	10.22	5.67	5.07	7.20	12.90	9.64	9.41	13.32	7.38	***
4L13	6.47	2.88	13.87	7.77	16.85	6.19	7.67	25.24	16.00	6.10	10.70	16.08	9.94	***
4L14	7.90	3.98	15.37	9.75	19.38	5.70	8.74	29.82	18.48	5.07	11.31	16.58	10.51	***
4L15	9.42	5.08	16.05	9.49	19.24	6.38	8.40	28.43	15.97	5.89	12.60	16.86	10.50	***
4L16	7.88	4.43	14.89	9.59	18.33	5.67	8.67	26.33	17.17	5.95	12.55	16.46	9.12	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
4L17	8.96	5.27	15.80	9.58	20.18	6.76	8.29	29.94	16.81	8.59	12.57	16.12	11.54	***
4L18	7.19	3.71	15.66	8.66	19.41	6.48	7.91	30.12	18.50	8.87	11.67	15.66	9.26	***
4L19	9.31	4.67	14.71	9.03	20.98	6.06	8.26	27.83	14.94	10.63	11.57	18.47	9.93	***
4L20	8.88	4.16	15.71	8.77	18.72	6.52	8.12	27.25	13.90	11.07	10.39	16.24	9.17	***
4L21	8.22	3.62	13.30	8.34	20.03	5.62	8.18	25.32	15.90	11.37	11.98	17.79	10.38	***
4L22	7.99	3.88	17.04	9.43	20.08	6.95	8.24	32.72	15.70	10.64	13.15	17.83	9.84	***
4L23	5.62	1.95	14.14	8.21	21.23	7.02	8.99	30.02	15.09	11.41	11.59	18.99	10.72	***
4L24	5.28	2.19	15.48	7.41	16.71	6.61	9.22	28.85	19.91	4.18	8.87	16.30	10.17	***
4L25	5.05	2.22	13.45	8.27	16.96	6.60	9.60	26.64	13.64	9.55	11.59	17.75	10.04	***
5L1	4.45	2.25	12.05	7.42	13.43	5.61	6.87	22.05	14.45	7.08	10.68	13.41	8.70	***
5L2	2.79	1.93	8.10	6.47	14.26	4.68	5.36	20.49	10.96	8.64	10.86	13.56	7.27	***
5L3	4.99	2.36	12.49	7.15	14.52	4.56	8.05	24.01	11.73	9.06	9.60	12.78	7.99	***
5L4	5.80	2.89	12.83	6.98	11.88	4.98	6.21	20.87	14.54	7.19	10.68	12.44	9.09	***
5L5	7.20	3.67	12.19	6.43	15.31	5.05	6.20	22.66	11.75	7.97	9.97	12.24	8.19	***
5L6	6.29	2.63	13.04	6.76	13.28	4.31	6.61	22.10	12.30	8.63	10.25	12.54	7.68	***
5L7	5.86	3.10	11.75	6.82	13.28	4.37	5.05	20.08	13.60	7.42	10.02	11.23	6.63	***
5L8	5.48	2.68	11.35	6.25	12.17	5.04	6.34	19.05	11.57	7.99	9.30	11.11	7.06	***
5L9	7.33	3.79	12.12	7.30	15.54	5.61	5.77	20.94	11.62	7.25	9.81	14.48	6.60	***
5L10	5.09	2.43	11.21	6.48	13.93	3.99	5.15	22.08	12.13	7.13	9.86	12.09	6.76	***
5L11	5.05	2.61	11.09	6.54	13.15	4.30	5.90	20.08	10.61	8.27	9.28	12.43	7.58	***
5L12	4.58	1.39	10.78	5.85	14.18	3.76	6.26	21.54	10.64	9.34	8.45	13.58	6.21	***
5L13	4.65	2.46	9.85	4.84	13.73	4.14	4.05	19.13	14.59	7.26	8.24	10.95	7.23	***
5L14	5.39	2.57	11.24	5.72	13.18	4.59	5.51	19.12	14.00	7.46	8.24	10.91	6.63	***
5L15	6.79	3.91	10.99	6.30	13.53	5.39	5.84	19.12	11.57	6.25	10.21	11.97	7.52	***
5L16	5.59	2.94	11.08	6.40	11.48	4.35	5.04	18.60	15.18	7.52	10.50	7.87	7.34	***
5L17	5.71	2.66	11.08	5.96	13.89	3.45	5.39	20.16	13.48	5.57	9.20	12.22	6.77	***
5L18	6.41	3.30	10.39	6.08	14.28	4.77	5.38	19.52	11.31	8.09	8.95	12.51	6.80	***
5L19	7.07	3.89	11.92	6.77	13.79	5.79	5.11	19.86	12.57	6.52	9.17	11.36	6.53	***
5L20	6.87	3.58	11.20	6.55	15.02	4.65	5.20	21.03	12.22	6.16	10.20	12.41	7.90	***
5L21	6.32	3.13	11.55	5.78	14.37	5.09	4.65	20.78	9.85	9.50	9.04	12.41	6.70	***
5L22	7.35	3.84	11.08	6.55	15.02	4.86	5.54	19.46	11.27	5.68	8.94	13.77	7.84	***
5L23	5.88	2.85	11.45	5.19	12.42	4.43	5.40	17.95	10.75	6.93	8.21	11.68	5.24	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
5L24	4.57	2.01	10.53	5.18	13.59	4.69	4.76	19.37	14.47	5.89	7.63	12.64	6.73	***
5L25	6.36	3.12	12.12	5.98	13.11	4.78	5.70	20.09	12.42	8.13	7.71	11.80	6.49	***
5L26	7.18	3.76	12.65	6.68	15.21	4.51	5.43	22.84	11.39	7.81	9.17	12.70	7.00	***
5L27	5.37	2.27	11.00	6.24	14.57	4.09	6.38	21.43	12.53	7.47	9.20	12.18	6.01	***
6L1	3.45	1.31	10.16	4.67	9.25	4.15	4.38	16.16	13.26	6.12	6.94	8.52	6.00	***
6L2	3.46	1.01	9.71	3.28	11.12	4.88	5.91	17.92	15.25	5.45	8.65	6.55	5.26	***
6L3	5.67	2.71	10.27	6.22	11.35	4.18	4.95	15.79	11.66	5.83	8.30	10.46	4.83	***
6L4	5.13	2.85	10.54	5.78	12.67	4.00	4.63	18.86	9.87	6.26	8.62	13.25	5.95	***
6L5	6.52	3.90	10.07	5.71	14.70	5.30	4.80	18.04	10.96	6.81	9.16	11.41	7.17	***
6L6	5.55	3.14	10.12	5.82	10.18	4.28	4.11	15.31	11.86	5.92	8.43	9.05	5.19	***
6L7	6.04	2.85	10.12	5.38	13.87	4.12	4.38	19.09	11.18	6.14	8.74	11.10	5.88	***
6L8	5.91	3.18	10.59	5.63	13.48	4.18	4.39	18.86	10.79	5.85	8.35	11.30	5.09	***
6L9	5.98	2.60	10.86	5.11	13.56	3.90	4.00	19.39	11.03	7.41	8.66	11.05	5.71	***
6L10	5.59	2.49	11.01	6.27	12.56	3.52	5.49	17.92	15.36	7.75	9.27	9.82	5.21	***
6L11	5.91	2.96	10.96	5.33	14.18	4.59	4.25	20.22	10.19	7.69	7.52	13.18	6.50	***
6L12	4.94	2.74	10.60	6.10	12.65	3.93	4.99	19.37	13.35	6.95	8.69	10.23	6.40	***
6L13	5.28	2.11	11.78	5.37	11.70	3.86	5.59	19.31	12.24	7.09	8.91	9.68	6.06	***
6L14	3.29	1.19	9.81	5.19	8.91	4.33	6.39	16.57	12.15	6.75	9.09	8.57	5.84	***
6L15	3.59	1.63	9.33	4.54	8.53	4.14	5.77	14.62	10.19	7.02	8.68	10.14	5.59	***
7L1	4.87	2.54	9.77	5.57	10.19	3.88	4.21	15.30	8.36	6.63	8.07	9.93	5.82	***
7L2	3.52	1.99	8.95	4.67	6.68	3.49	4.16	13.28	9.88	6.98	7.29	7.54	5.46	***
7L3	3.58	1.43	9.80	4.67	10.20	3.80	4.56	16.43	12.00	4.73	7.80	11.23	5.20	***
7L4	3.14	1.85	8.68	4.90	9.36	3.62	4.05	15.70	9.86	6.91	7.30	9.09	6.22	***
7L5	5.06	2.08	10.87	4.67	10.69	4.36	4.02	16.31	8.88	7.88	7.65	10.08	5.82	***
7L6	4.43	2.23	10.10	4.47	9.91	3.25	3.54	16.47	9.44	5.99	7.15	9.99	5.09	***
7L7	4.06	2.20	9.87	5.54	9.58	3.63	4.22	16.01	12.61	6.12	8.22	8.89	5.13	***
7L8	6.31	3.16	9.72	4.93	9.52	3.72	4.11	15.64	10.15	6.46	7.64	9.54	5.53	***
7L9	4.50	2.44	10.48	4.93	9.81	3.86	11.17	17.01	9.22	7.68	10.54	9.86	5.22	***
7L10	4.32	2.22	10.07	8.39	10.00	3.97	8.57	16.65	9.13	8.22	9.98	9.75	6.07	***
7L11	5.07	2.47	11.19	8.59	9.93	3.80	9.53	16.38	9.28	7.89	8.13	9.57	5.55	***
7L12	6.56	3.57	10.87	8.49	7.57	4.23	9.13	5.86	10.08	15.84	11.47	10.83	5.90	***
7L13	2.81	1.82	9.55	9.20	6.88	3.03	9.12	4.77	8.34	14.83	9.95	9.18	5.08	***



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
7L14	2.54	2.42	10.55	6.83	7.21	3.95	8.01	5.63	9.36	16.57	7.44	11.56	5.01	***
7L15	3.98	2.69	9.39	7.48	10.42	4.02	6.72	16.83	8.65	7.16	8.70	9.25	5.84	***
7L16	3.34	1.96	8.89	5.56	10.20	3.37	5.97	16.91	11.09	7.04	7.05	8.50	5.10	***
7L17	3.95	1.91	9.06	4.53	9.68	3.12	5.93	16.35	9.96	7.94	3.80	7.34	5.59	***
7L18	3.82	1.46	9.34	4.66	9.27	3.65	3.90	15.82	9.78	5.95	6.87	9.29	5.89	***
7L19	3.13	1.67	9.94	6.87	9.10	3.70	7.80	13.22	9.49	9.91	8.39	9.51	5.53	***
8L1	4.39	1.79	9.22	4.45	9.82	3.10	4.29	15.35	8.85	6.73	6.66	9.71	4.66	***
8L2	4.54	1.86	9.22	4.77	9.92	4.74	4.52	15.32	8.64	5.40	6.95	9.18	5.12	***
8L3	3.72	1.28	9.02	4.18	7.89	3.11	5.05	14.12	8.70	6.95	7.60	8.24	4.25	***
8L4	3.77	1.53	7.46	3.63	7.36	2.60	4.22	11.40	7.58	5.99	4.21	8.87	3.91	***
8L5	3.34	1.29	7.62	4.53	6.75	2.01	4.05	11.41	8.41	5.85	6.34	7.15	4.40	***
8L6	3.47	1.78	7.45	4.12	6.64	2.80	3.63	10.91	8.24	5.77	6.14	7.68	5.39	***
8L7	3.37	1.65	8.15	4.51	6.09	3.00	4.14	11.20	8.39	6.53	6.45	7.83	5.31	***
8L8	3.52	1.96	8.33	4.48	6.16	2.92	4.28	11.27	7.61	7.34	6.02	7.98	5.01	***
8L9	3.31	1.47	7.96	4.01	7.83	2.37	3.71	13.99	8.29	5.25	7.56	7.81	4.74	***
8L10	3.05	1.43	8.50	3.53	8.14	2.80	3.42	14.35	7.34	6.13	6.26	7.75	4.46	***
8L11	3.92	2.33	8.61	4.71	7.17	3.00	3.60	12.20	7.19	5.86	6.15	7.90	4.64	***
8L12	4.21	1.99	9.80	4.02	7.63	3.91	4.06	13.97	8.58	6.64	6.14	8.08	5.18	***
8L13	3.76	2.03	9.23	4.58	6.40	2.69	4.39	13.10	8.65	7.24	7.48	7.67	4.73	***
8L14	4.08	1.82	8.99	4.14	8.80	3.28	3.67	14.32	8.15	6.97	7.37	9.32	5.13	***
8L15	3.75	2.17	9.24	4.61	7.38	3.84	5.09	13.58	7.98	6.24	6.67	8.01	5.42	***
8L16	3.57	2.17	7.80	4.37	7.22	3.79	4.28	12.83	8.28	4.50	5.41	8.21	5.47	***
8L17	3.25	1.72	7.78	3.80	6.14	2.57	3.69	4.62	7.81	7.11	5.00	12.47	4.70	***
9L1	3.97	1.39	8.26	4.34	6.67	3.81	3.85	4.20	8.15	5.79	6.04	10.92	5.79	***
9L2	3.74	1.49	8.03	3.23	6.03	3.01	3.68	4.84	7.52	7.82	5.82	11.62	5.29	***
9L3	3.64	1.61	8.41	3.72	5.51	3.03	3.66	5.69	7.32	6.66	6.17	9.15	4.98	***
9L4	3.03	1.37	9.18	3.97	6.00	4.27	3.85	5.20	8.89	6.58	6.93	10.27	5.42	***
9L5	3.27	1.33	7.90	3.64	4.89	3.10	3.87	5.36	7.19	6.35	5.50	8.81	4.89	***
9L6	2.32	1.46	8.68	3.67	6.02	2.58	3.12	4.54	7.41	6.60	5.71	10.27	4.43	***
9L7	1.78	1.46	7.85	2.77	4.32	2.59	2.90	5.34	7.80	6.01	4.52	10.04	4.78	***
9L8	2.35	1.21	7.98	3.72	6.00	2.62	3.02	6.58	7.27	7.45	5.19	11.26	4.42	***
9L9	2.04	1.37	8.43	3.63	5.68	3.13	3.49	5.22	7.69	6.66	5.73	10.29	5.00	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
9L10	1.48	0.90	8.72	3.82	7.11	2.89	3.44	13.64	7.32	5.94	5.89	7.87	4.35	***
9L11	1.69	0.95	8.44	3.84	5.99	2.42	3.27	12.77	10.67	3.91	4.31	6.48	4.55	***
9L12	1.27	0.58	8.14	4.17	5.32	3.00	3.72	7.50	9.63	10.39	5.78	8.26	4.24	***
9L13	2.87	1.37	8.25	3.73	7.77	2.29	3.18	13.62	10.04	4.52	5.97	8.63	3.68	***
9L14	1.79	0.93	7.96	3.10	5.16	2.02	2.36	5.09	9.63	10.35	5.37	9.30	4.32	***
9L15	5.61	1.92	9.61	4.26	7.01	4.63	3.51	5.32	11.19	9.53	5.36	10.42	6.01	***
9L16	2.53	1.22	6.91	3.30	6.39	2.88	3.25	9.66	9.75	7.44	5.45	8.49	4.53	***
10L1	3.04	0.66	7.01	3.47	4.99	2.32	2.85	7.54	9.79	8.83	5.27	7.21	4.41	***
10L2	3.45	1.86	7.93	3.33	6.31	3.57	4.25	7.87	11.17	10.23	3.37	6.86	3.22	***
10L3	3.48	1.96	7.87	3.86	5.51	2.96	3.85	7.46	7.97	9.17	2.87	8.00	3.12	***
10L4	2.52	1.49	7.08	3.37	5.41	3.24	2.72	6.56	7.38	8.24	3.42	8.54	3.83	***
10L5	2.03	1.28	7.76	3.12	5.82	2.92	2.53	7.50	9.78	9.52	3.88	9.61	3.97	***
10L6	3.00	1.79	7.36	3.15	6.30	3.48	3.65	7.93	8.05	7.80	3.18	7.71	3.65	***
10L7	2.07	0.86	7.09	2.74	4.39	2.28	2.49	7.79	9.34	8.99	3.72	6.87	3.68	***
10L8	3.53	1.56	7.55	3.50	5.29	2.75	3.45	7.25	7.90	9.14	3.78	6.29	2.70	***
10L9	2.54	1.21	6.29	3.10	5.17	1.94	3.18	7.49	7.62	8.41	3.08	6.77	3.65	***
10L10	2.04	1.37	7.02	3.92	4.63	2.95	4.49	6.72	8.36	7.49	3.54	8.94	2.71	***
11L1	1.48	0.90	5.60	2.58	4.11	1.51	2.24	7.45	8.78	4.45	2.28	5.29	1.76	***
11L2	1.69	0.95	5.92	2.40	4.27	1.95	2.05	6.82	7.53	6.07	3.04	6.10	2.73	***
11L3	1.27	0.58	5.76	2.20	4.39	1.92	1.96	7.24	7.16	5.52	2.29	5.73	1.92	***
11L4	2.87	1.37	6.13	2.95	3.86	1.77	3.22	5.59	5.81	6.43	2.54	6.66	2.74	***
11L5	2.25	1.31	5.85	2.53	4.16	1.79	2.37	6.78	7.32	5.62	2.54	5.94	2.29	***

SUMMARY FHSM VP 335 *P. mortoni* Lower dentition

Medial

N=6

Minimum	10.68	5.16	24.09	15.83	24.43	14.56	25.51	32.92	24.37	10.21	15.39	24.52	16.79	>10
Maximum	15.23	9.68	28.86	20.36	30.06	20.22	29.60	38.64	36.05	22.27	17.14	34.66	20.00	
Arithmetic Mean	12.567	7.227	26.12	18.11	26.40	17.47	27.39	34.89	30.34	19.37	16.24	29.67	17.82	
Standard Deviation	1.831	2.139	1.67	1.87	1.97	2.08	1.74	1.99	4.60	4.56	0.68	4.71	1.19	

RPM

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
N=11														
Minimum	5.82	5.03	20.29	11.97	18.22	10.24	15.88	24.43	6.33	13.91	10.90	5.44	10.52	>10
Maximum	12.91	7.55	25.66	15.67	22.79	14.88	22.65	33.35	29.18	38.90	13.66	23.46	15.57	
Arithmetic Mean	11.274	6.109	23.98	14.29	20.56	12.76	20.84	31.63	21.23	28.06	12.37	13.79	13.52	
Standard Deviation	2.039	0.772	1.44	1.41	1.34	1.25	1.89	2.53	6.28	6.52	0.87	6.86	1.34	
R2														
N=5														
Minimum	7.99	2.96	20.59	12.50	13.16	10.20	17.58	16.32	18.32	9.49	10.49	7.91	11.49	>10
Maximum	9.3	4.21	23.63	14.99	20.04	12.94	20.67	31.18	34.60	29.78	15.75	24.07	14.35	
Arithmetic Mean	8.412	3.552	22.09	13.40	17.92	11.52	19.63	26.79	22.91	24.27	13.38	14.02	13.05	
Standard Deviation	0.511	0.488	1.26	1.04	2.72	1.00	1.30	5.94	6.77	8.39	1.99	6.04	1.21	
R3														
N=18														
Minimum	4.28	1.59	15.53	9.74	11.92	10.70	16.61	11.00	17.48	6.37	8.90	5.77	10.12	>10
Maximum	11.91	7.34	21.59	14.47	20.95	14.74	20.89	32.95	33.06	28.79	13.03	24.82	13.52	
Arithmetic Mean	8.806	4.699	18.74	11.71	17.99	12.29	18.83	26.23	21.27	16.82	10.65	14.99	11.67	
Standard Deviation	2.566	1.996	1.96	1.51	2.75	1.26	1.21	5.68	3.44	6.63	1.11	6.77	0.88	
R4														
N=14														
Minimum	0.57	1.19	12.13	6.82	10.36	8.11	11.81	11.99	9.35	8.43	6.84	4.33	7.02	>10
Maximum	9.47	5.65	16.76	10.83	16.20	10.65	15.75	24.80	26.57	18.71	9.91	21.02	11.96	
Arithmetic Mean	6.339	3.578	14.78	9.05	13.57	9.21	14.00	19.94	17.84	13.30	8.01	14.92	9.34	
Standard Deviation	2.302	1.348	1.21	1.18	1.99	0.68	1.06	4.69	3.78	4.08	0.85	4.66	1.16	
R5														
N=21														
Minimum	2.4	0.84	11.01	5.63	7.99	5.56	8.29	8.52	11.04	6.36	5.22	0.00	5.45	>10
Maximum	8.74	5.01	13.37	9.43	14.16	8.14	13.45	21.40	22.87	15.75	8.73	19.56	13.58	
Arithmetic Mean	6.674	3.61	12.31	7.98	11.66	7.40	11.42	17.75	14.15	8.86	6.56	14.07	7.92	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Standard Deviation	1.733	1.242	0.86	0.94	1.27	0.62	1.13	2.54	2.24	1.78	0.86	3.98	1.76	
R6														
N=22														
Minimum	1.26	1.74	6.43	3.61	8.02	5.67	7.03	6.39	9.15	5.53	5.09	6.57	4.29	>10
Maximum	9.5	5.71	12.12	7.68	15.99	11.87	10.90	16.16	16.68	15.58	7.11	18.32	11.15	
Arithmetic Mean	6.779	4.12	10.15	6.26	10.12	6.78	9.55	11.89	12.16	11.08	6.14	12.03	7.17	
Standard Deviation	2.417	1.262	1.20	1.15	1.90	1.30	1.06	3.81	1.80	3.29	0.55	3.24	1.52	
R7														
N=19														
Minimum	1.3	1.44	6.42	3.43	7.13	4.24	6.60	3.28	7.35	5.55	3.55	6.85	4.28	>10
Maximum	6.59	3.66	9.97	5.51	10.14	6.35	10.41	12.39	15.23	15.58	8.17	14.71	8.43	
Arithmetic Mean	3.944	2.706	8.72	4.66	8.43	5.37	7.65	6.14	12.37	12.10	5.13	9.51	6.06	
Standard Deviation	1.8	0.62	0.86	0.55	0.82	0.54	0.93	2.85	2.34	2.79	0.91	2.49	1.11	
R8														
N=13														
Minimum	3.99	1.76	7.04	3.83	5.16	3.91	6.73	2.89	6.40	5.33	3.94	3.48	4.23	>10
Maximum	5.52	2.68	10.83	5.81	8.72	6.43	9.14	12.47	16.78	12.14	5.88	15.93	6.66	
Arithmetic Mean	5.028	2.241	8.03	4.65	7.23	5.09	7.61	7.85	10.73	9.48	4.63	9.84	5.05	
Standard Deviation	0.463	0.269	0.97	0.50	1.04	0.72	0.60	3.82	3.00	2.31	0.51	4.39	0.82	
R9														
N=25														
Minimum	1.27	0.58	5.09	3.14	3.91	2.74	3.95	3.59	5.35	4.79	1.85	0.00	2.59	>10
Maximum	10.46	6.71	8.49	4.99	10.15	4.44	6.17	11.83	16.29	11.00	9.89	14.73	7.74	
Arithmetic Mean	4.943	2.775	6.81	4.00	6.97	3.46	5.12	7.99	9.55	8.65	4.88	8.71	4.42	
Standard Deviation	2.599	1.786	0.77	0.49	1.39	0.45	0.58	2.49	2.56	1.63	1.79	3.73	1.25	
R10														
N=23														

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Minimum	1.78	1.1	4.68	3.12	6.08	1.72	3.71	8.77	4.61	4.88	2.30	8.26	2.43	>10
Maximum	9.98	5.97	8.46	4.63	7.98	3.46	6.06	11.74	8.52	9.63	4.77	14.19	4.40	
Arithmetic Mean	5.385	2.94	6.42	3.77	6.83	2.71	4.71	9.63	6.63	6.23	3.80	11.23	3.35	
Standard Deviation	2.214	1.384	0.87	0.42	0.65	0.51	0.59	0.70	0.97	1.27	0.59	1.70	0.52	
R11														
N=12														
Minimum	1.83	1.03	5.22	2.74	4.99	1.54	2.73	8.39	5.89	5.49	2.71	0.00	2.52	>10
Maximum	3.42	1.9	6.29	3.97	6.77	3.55	5.39	10.65	12.49	10.43	5.25	10.70	4.39	
Arithmetic Mean	2.762	1.513	5.63	3.55	5.69	2.20	4.42	8.91	9.38	8.96	3.31	2.22	3.16	
Standard Deviation	0.434	0.249	0.40	0.39	0.54	0.58	0.75	0.59	2.04	1.49	0.67	4.08	0.56	
LPM														
N=8														
Minimum	9.58	5.98	20.16	13.70	22.63	12.31	18.21	29.17	21.18	5.66	11.31	21.35	12.82	>10
Maximum	12.07	7.73	21.46	15.77	24.69	15.07	25.43	36.67	33.16	11.86	13.79	29.39	14.08	
Arithmetic Mean	11.069	6.452	21.00	14.73	23.73	14.01	22.39	32.93	25.43	9.13	12.75	27.03	13.52	
Standard Deviation	0.805	0.588	0.49	0.62	0.65	0.99	2.12	2.49	3.45	2.17	0.77	2.90	0.41	
L2														
N=5														
Minimum	6.8	1.56	17.60	12.37	20.51	10.93	16.83	32.45	18.61	6.74	12.04	22.92	11.71	>10
Maximum	8.45	3.78	19.42	13.34	23.26	14.09	22.04	36.38	25.29	12.45	15.09	26.85	15.75	
Arithmetic Mean	7.578	2.79	18.67	12.74	21.58	11.94	19.64	34.00	21.50	10.38	14.01	24.88	14.06	
Standard Deviation	0.82	0.91	0.71	0.38	1.19	1.30	1.85	1.53	2.56	2.15	1.21	1.59	1.51	
L3														
N=23														
Minimum	4.64	0.87	16.32	10.49	16.55	5.73	9.25	28.98	17.43	5.16	9.27	11.48	8.40	>10
Maximum	12.08	6.31	20.52	12.69	24.60	10.40	19.57	36.15	31.07	12.25	15.49	23.67	14.26	
Arithmetic Mean	8.743	4.125	18.32	11.62	21.60	8.56	14.13	32.57	22.52	7.41	11.93	19.13	11.37	
Standard Deviation	2.197	1.765	1.15	0.58	1.97	1.24	3.79	1.60	4.09	1.74	1.89	3.56	1.39	

Distances in mm	Tooth Height	Crown Height	Apex to left posterior tooth edge	Apex to left posterior crown edge	Apex to right posterior tooth edge	Apex to right posterior crown edge	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
L4														
N=25														
Minimum	5.05	1.95	12.91	6.27	9.66	4.52	5.07	7.20	12.17	3.27	8.87	11.16	7.38	>10
Maximum	9.42	5.27	17.04	9.75	21.23	7.02	9.60	32.72	22.88	11.41	13.15	18.99	11.54	
Arithmetic Mean	7.514	3.722	14.31	8.06	17.44	5.97	7.36	25.19	15.93	7.60	11.15	15.57	9.28	
Standard Deviation	1.162	0.857	1.14	1.05	2.75	0.63	1.32	5.69	2.42	2.43	1.21	1.96	1.07	
L5														
N=27														
Minimum	2.79	1.39	8.10	4.84	11.48	3.45	4.05	17.95	9.85	5.57	7.63	7.87	5.24	>10
Maximum	7.35	3.91	13.04	7.42	15.54	5.79	8.05	24.01	15.18	9.50	10.86	14.48	9.09	
Arithmetic Mean	5.793	2.89	11.38	6.32	13.78	4.66	5.67	20.53	12.35	7.49	9.38	12.20	7.13	
Standard Deviation	1.092	0.67	1.01	0.63	1.04	0.56	0.80	1.45	1.45	1.06	0.91	1.23	0.83	
L6														
N=15														
Minimum	3.29	1.01	9.33	3.28	8.53	3.52	4.00	14.62	9.87	5.45	6.94	6.55	4.83	>10
Maximum	6.52	3.9	11.78	6.27	14.70	5.30	6.39	20.22	15.36	7.75	9.27	13.25	7.17	
Arithmetic Mean	5.087	2.445	10.40	5.36	11.91	4.23	4.94	17.83	11.96	6.60	8.53	10.29	5.78	
Standard Deviation	1.095	0.829	0.61	0.77	1.98	0.43	0.74	1.73	1.71	0.72	0.61	1.75	0.62	
L7														
N=19														
Minimum	2.54	1.43	8.68	4.48	6.68	3.03	3.54	4.77	8.34	4.73	3.80	7.34	5.01	>10
Maximum	6.56	3.57	11.19	9.20	10.69	4.36	11.17	17.01	12.61	16.57	11.47	11.56	6.22	
Arithmetic Mean	4.157	2.216	9.85	6.05	9.27	3.71	6.25	14.24	9.77	8.46	8.07	9.52	5.53	
Standard Deviation	1.078	0.538	0.71	1.64	1.24	0.35	2.42	4.06	1.12	3.43	1.65	1.06	0.37	
L8														
N=17														
Minimum	3.05	1.28	7.45	3.53	6.09	2.01	3.42	4.62	7.19	4.5	4.21	7.15	3.91	>10

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown	Posterior Tooth	Anterior Tooth	Labial Tooth	Labial Crown	Lingual Tooth	Lingual Crown	# of Ridges
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	r Crown Width F-G	r Tooth Width B-C	Tooth Width E-D	Tooth Length B-E	Crown Length F-I	Tooth Length C-D	Crown Length G-H	
Maximum	4.54	2.33	9.8	4.77	9.92	4.74	5.09	15.35	8.85	7.34	7.6	12.47	5.47	
Arithmetic Mean	3.707	1.781	8.493	4.261	7.491	3.09	4.123	12.585	8.158	6.265	6.377	8.462	4.854	
Standard Deviation	0.416	0.311	0.739	0.373	1.172	0.664	0.48	2.52	0.498	0.782	0.916	1.233	0.449	
L9 N=16														
Minimum	1.27	0.58	6.91	2.77	4.32	2.02	2.36	4.2	7.19	3.91	4.31	6.48	3.68	>10
Maximum	5.61	1.92	9.61	4.34	7.77	4.63	3.87	13.64	11.19	10.39	6.93	11.62	6.01	
Arithmetic Mean	2.711	1.285	8.297	3.682	5.992	3.017	3.386	7.161	8.592	7	5.609	9.505	4.792	
Standard Deviation	1.139	0.32	0.604	0.421	0.878	0.696	0.411	3.336	1.363	1.834	0.62	1.373	0.609	
L10 N=10														
Minimum	2.03	0.66	6.29	2.74	4.39	1.94	2.49	6.56	7.38	7.49	2.87	6.29	2.7	>10
Maximum	3.53	1.96	7.93	3.92	6.31	3.57	4.49	7.93	11.17	10.23	5.27	9.61	4.41	
Arithmetic Mean	2.77	1.404	7.296	3.356	5.382	2.841	3.346	7.411	8.736	8.782	3.611	7.68	3.494	
Standard Deviation	0.611	0.422	0.503	0.357	0.639	0.531	0.711	0.458	1.223	0.819	0.665	1.078	0.55	
L11 N=5														
Minimum	1.27	0.58	5.6	2.2	3.86	1.51	1.96	5.59	5.81	4.45	2.28	5.29	1.76	>10
Maximum	2.87	1.37	6.13	2.95	4.39	1.95	3.22	7.45	8.78	6.43	3.04	6.66	2.74	
Arithmetic Mean	1.912	1.022	5.852	2.532	4.158	1.788	2.368	6.776	7.32	5.618	2.538	5.944	2.288	
Standard Deviation	0.648	0.324	0.196	0.276	0.198	0.174	0.502	0.721	1.058	0.748	0.308	0.503	0.451	

Tooth File	FHSM VP 335 <i>P. mortoni</i> Extra teeth not associated with upper and lower dentitions													
Medials 3	2.23	0.66	5.98	422.22	6.83	422.22	0.00	9.37	8.59	6.66	0.00	6.78	0.00	0
	3.45	1.86	6.51	417.39	7.51	417.39	0.00	10.29	7.26	6.78	0.00	7.40	0.00	0
	3.48	1.96	4.12	412.86	5.14	412.86	0.00	3.47	7.43	7.43	0.00	2.92	0.00	0
Right PM 11 teeth	2.52	1.49	17.31	9.04	16.12	8.83	8.55	19.72	21.30	14.15	8.07	14.42	11.07	***
	2.03	1.28	17.03	9.08	17.32	11.05	11.11	20.10	21.21	14.29	9.77	16.62	11.53	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges	
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown		
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length		
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H			
		3.00	1.79	14.42	9.14	18.00	10.73	10.59	18.93	21.69	15.56	8.36	15.25	11.50	***
		2.07	0.86	15.04	8.10	18.59	9.82	8.85	18.16	20.98	14.67	7.52	12.91	11.59	***
		3.53	1.56	17.25	8.73	16.37	9.96	8.45	18.33	18.45	14.55	8.16	15.50	11.23	***
		2.54	1.21	16.15	8.38	15.51	9.00	8.84	17.56	21.44	15.62	6.85	11.14	10.63	***
		2.04	1.37	17.07	8.76	16.85	7.86	7.93	15.87	18.87	14.32	7.14	14.69	9.07	***
		1.48	0.90	15.20	9.20	17.38	8.72	7.54	17.81	19.48	13.48	7.66	13.54	10.90	***
2nd 3 teeth		1.69	0.95	15.95	9.56	14.93	7.19	7.23	17.99	19.17	14.59	8.10	7.44	9.97	***
		1.27	0.58	15.91	16.55	12.05	6.49	18.29	8.60	22.46	12.46	9.70	8.62	12.44	***
		6.58	2.05	16.18	7.35	13.52	5.65	5.55	14.71	14.45	12.96	6.26	11.92	7.11	***
3rd 4 teeth 2 broken teet		4.97	1.07	13.58	5.46	12.98	7.06	6.91	16.48	16.68	16.02	7.01	10.20	8.57	***
		6.30	2.31	14.89	7.21	14.56	6.64	5.53	16.65	7.95	16.22	7.39	15.71	7.41	***
		7.18	3.18	15.84	7.34	14.44	7.03	6.51	16.90	16.86	16.97	7.16	8.58	8.34	***
		5.69	1.85	15.05	7.51	12.71	5.82	6.28	18.24	14.39	16.57	7.26	11.98	9.27	***
4th 7 teeth		4.64	0.87	13.43	5.94	13.32	5.86	5.40	15.52	14.31	12.76	6.57	10.17	8.21	***
		8.66	4.12	13.91	5.81	12.83	5.12	5.25	13.80	10.97	14.24	6.77	11.73	6.54	***
		7.48	2.64	13.16	6.23	13.53	5.57	5.87	13.58	13.27	15.26	6.12	9.46	6.89	***
		8.57	3.59	12.24	7.90	12.07	6.66	7.56	16.11	10.69	10.17	7.37	15.29	7.56	***
		8.28	4.06	12.94	6.83	12.16	5.61	6.53	14.88	11.12	12.83	6.82	11.48	6.80	***
		7.69	3.38	13.59	5.35	10.64	5.72	6.52	14.88	16.91	8.36	7.16	10.10	7.92	***
		9.59	4.07	13.12	6.13	13.64	6.15	6.40	16.03	16.32	11.89	6.62	9.45	7.38	***
5th 5 teeth		12.08	5.90	9.86	6.14	10.44	5.25	5.26	10.96	13.33	9.02	6.14	10.32	6.65	***
		10.77	6.30	10.83	5.50	10.76	5.15	5.65	9.79	11.36	11.78	5.96	11.06	6.63	***
		10.56	4.94	10.37	5.93	10.31	4.94	5.24	11.82	12.29	10.75	6.84	9.89	6.22	***
		9.89	6.19	11.12	4.81	8.81	3.80	4.48	10.82	15.55	10.28	5.13	4.66	5.73	***
		10.08	5.45	10.87	6.27	11.52	5.05	4.67	12.20	9.39	11.43	6.18	10.92	6.21	***
Left PM 8teeth		11.25	6.31	17.32	9.30	17.73	9.10	7.76	15.34	21.32	15.35	8.66	13.90	9.83	***
		11.57	5.90	15.83	9.35	17.46	9.06	7.91	15.39	20.61	16.88	8.17	12.56	9.51	***
		10.67	6.28	15.74	8.21	17.57	8.20	6.91	17.48	21.75	14.76	6.68	11.94	9.72	***
		11.77	6.30	14.85	8.43	17.26	10.02	8.63	18.02	19.35	3.45	7.76	20.65	11.52	***
		8.44	3.97	15.27	8.40	17.60	9.15	7.45	18.44	14.49	13.55	7.17	18.42	10.49	***
		8.38	4.14	15.90	7.91	15.39	7.68	7.97	17.41	16.41	17.31	6.57	12.40	9.23	***
		7.91	4.36	14.25	7.43	16.42	7.70	7.42	17.47	20.44	14.27	6.95	12.92	9.52	***



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
2nd 10 teeth	7.98	4.34	15.87	7.82	17.22	9.45	8.45	17.21	20.89	13.20	7.45	11.24	9.90	***
	7.99	4.29	13.98	7.18	16.72	8.39	7.27	14.68	16.62	11.52	5.29	13.71	6.50	***
	7.86	4.15	13.26	6.41	14.02	8.17	8.65	15.74	15.55	12.66	6.18	11.73	7.21	***
	7.73	4.10	12.96	7.84	14.11	6.48	6.75	14.73	13.52	12.09	6.17	13.87	6.39	***
	7.17	3.30	13.77	7.35	14.77	7.24	6.55	15.53	21.12	9.23	5.55	8.88	6.57	***
	7.43	3.71	13.27	8.86	15.27	8.33	6.94	16.11	10.41	14.37	5.58	11.88	6.03	***
	7.54	3.36	12.13	6.21	13.06	6.01	6.89	15.75	16.59	12.45	5.86	9.49	5.47	***
	5.79	2.56	13.45	6.23	13.69	5.77	5.95	15.56	12.17	12.84	6.30	14.49	7.09	***
	6.67	3.54	13.41	8.20	15.91	7.54	7.04	15.51	13.78	10.26	6.86	14.68	7.83	***
	7.85	3.86	12.76	6.35	13.19	6.27	5.95	14.75	16.44	9.77	5.43	9.78	5.99	***
3rd 4 teeth	7.75	3.45	12.28	6.87	12.36	5.38	5.85	15.31	18.14	12.64	5.97	7.35	6.45	***
	6.47	2.88	11.91	6.39	14.71	6.64	6.88	15.88	16.38	10.42	6.37	8.75	6.29	***
	7.90	3.98	11.65	5.92	14.96	5.72	6.59	16.43	18.99	10.72	5.16	7.02	4.73	***
	9.42	5.08	11.77	6.68	12.76	6.39	6.86	13.55	17.47	11.09	6.04	7.97	6.33	***
4th four teeth	7.88	4.43	9.34	5.08	10.31	4.85	5.94	12.40	14.98	9.44	5.15	9.58	4.61	***
	8.96	5.27	10.87	5.58	12.59	6.47	6.43	13.92	10.34	11.33	4.69	10.69	5.70	***
	7.19	3.71	9.90	5.09	12.10	4.65	4.69	11.44	11.85	11.79	5.05	12.22	4.92	***
5th 2 teeth	9.31	4.67	11.13	5.67	13.35	6.60	7.15	14.27	15.12	11.40	6.18	7.46	7.58	***
	8.88	4.16	9.63	4.31	10.99	4.96	4.85	11.01	14.19	9.28	4.60	10.09	5.54	***
	8.22	3.62	9.75	4.49	10.82	4.76	4.57	13.97	13.81	7.04	3.53	8.37	4.47	***
Large left Para-medial	7.99	3.88	8.93	4.42	8.55	5.12	6.01	10.56	8.38	9.88	4.54	10.77	4.30	***
	5.62	1.95	24.32	10.79	21.84	11.80	11.11	27.78	18.99	21.62	11.96	21.35	13.04	#####
Left 2nd file? 1 tooth	5.28	2.19	18.81	8.03	16.48	9.00	9.33	21.33	17.27	21.51	13.08	16.14	12.28	#####
Left PM? 1 tooth	5.05	2.22	20.67	9.37	23.40	13.04	12.52	27.26	24.43	22.79	12.08	16.86	15.53	#####
Possible 2nd row 2 teeth	4.45	2.25	14.57	8.33	18.79	8.18	9.17	18.93	21.17	20.57	8.94	13.96	10.06	#####
Single lateral 4th file? to	2.79	1.93	18.50	5.95	15.77	7.63	8.72	17.24	16.71	18.62	6.72	17.11	7.99	#####
	4.99	2.36	14.19	6.38	16.44	7.96	7.20	20.12	22.47	13.00	6.80	11.14	9.41	#####
Lateral teeth possibly 6th	5.80	2.89	11.50	4.03	12.12	5.23	5.76	16.59	14.77	12.92	5.93	12.67	5.98	#####
	7.20	3.67	9.97	4.80	12.30	6.45	6.50	13.19	13.55	11.77	6.67	12.40	6.30	#####
	6.29	2.63	16.70	8.58	17.79	8.00	7.74	15.88	19.85	14.80	6.97	12.30	8.26	#####
	5.86	3.10	17.77	8.30	18.44	9.13	7.50	17.62	23.06	12.31	7.32	10.64	9.93	#####
	5.48	2.68	14.96	8.02	16.97	7.18	8.06	16.92	19.57	15.55	7.79	12.77	8.42	#####

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
	7.33	3.79	14.74	7.29	16.41	6.48	6.81	17.75	12.62	15.18	7.30	14.98	7.80	#####

### teeth do not belong to 336 dentitions

**SUMMARY 335 extra**

medials

N=3

Minimum	2.23	0.66	4.12	412.86	5.14	412.86	0.00	3.47	7.26	6.66	0.00	2.92	0.00	>10
Maximum	3.48	1.96	6.51	422.22	7.51	422.22	0.00	10.29	8.59	7.43	0.00	7.40	0.00	
Arithmetic Mean	3.053	1.493	5.54	417.49	6.49	417.49	0.00	7.71	7.76	6.96	0.00	5.70	0.00	
Standard Deviation	0.713	0.723	1.26	4.68	1.22	4.68	0.00	3.70	0.73	0.41	0.00	2.43	0.00	

RPM

N=8

Minimum	1.48	0.86	14.42	8.10	15.51	7.86	7.54	15.87	18.45	13.48	6.85	11.14	9.07	>10
Maximum	3.53	1.79	17.31	9.20	18.59	11.05	11.11	20.10	21.69	15.62	9.77	16.62	11.59	
Arithmetic Mean	2.401	1.307	16.18	8.80	17.02	9.50	8.98	18.31	20.43	14.58	7.94	14.26	10.94	
Standard Deviation	0.643	0.319	1.15	0.39	1.01	1.08	1.24	1.33	1.28	0.72	0.90	1.71	0.83	

R2

N=3

Minimum	1.27	0.58	15.91	7.35	12.05	5.65	5.55	8.60	14.45	12.46	6.26	7.44	7.11	>10
Maximum	6.58	2.05	16.18	16.55	14.93	7.19	18.29	17.99	22.46	14.59	9.71	11.92	12.44	
Arithmetic Mean	3.18	1.193	16.01	11.15	13.50	6.44	10.36	13.77	18.69	13.34	8.02	9.33	9.84	
Standard Deviation	2.952	0.765	0.15	4.80	1.44	0.77	6.92	4.77	4.03	1.11	1.72	2.32	2.67	

R3

N=4

Minimum	4.97	1.07	13.58	5.46	12.71	5.82	5.53	16.48	7.96	16.02	7.01	8.58	7.41	>10
Maximum	7.18	3.18	15.84	7.51	14.56	7.06	6.91	18.24	16.86	16.97	7.39	15.71	9.27	
Arithmetic Mean	6.035	2.103	14.84	6.88	13.67	6.64	6.31	17.07	13.97	16.45	7.20	11.62	8.40	
Standard Deviation	0.937	0.882	0.94	0.95	0.96	0.58	0.58	0.80	4.17	0.42	0.16	3.06	0.77	

Distances in mm	Tooth Height	Crown Height	Apex to left posterior tooth edge	Apex to left posterior crown edge	Apex to right posterior tooth edge	Apex to right posterior crown edge	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
<b>R4</b>														
N=7														
Minimum	4.64	0.87	12.24	5.35	10.64	5.12	5.25	13.58	10.69	8.36	6.12	9.45	6.54	>10
Maximum	9.59	4.12	13.91	7.90	13.64	6.67	7.56	16.11	16.91	15.26	7.37	15.29	8.21	
Arithmetic Mean	7.844	3.247	13.20	6.32	12.60	5.81	6.22	14.97	13.37	12.22	6.77	11.10	7.33	
Standard Deviation	1.573	1.173	0.54	0.83	1.07	0.49	0.79	1.01	2.59	2.35	0.41	2.06	0.62	
<b>R5</b>														
N=5														
Minimum	9.89	4.94	9.86	4.81	8.81	3.80	4.48	9.79	9.39	9.02	5.13	4.66	5.73	>10
Maximum	12.08	6.3	11.12	6.27	11.52	5.25	5.65	12.20	15.55	11.78	6.84	11.06	6.65	
Arithmetic Mean	10.676	5.756	10.61	5.73	10.37	4.84	5.06	11.12	12.38	10.65	6.05	9.37	6.29	
Standard Deviation	0.861	0.562	0.50	0.59	0.99	0.59	0.48	0.94	2.29	1.08	0.61	2.68	0.38	
<b>LPM</b>														
N=8														
Minimum	7.91	3.97	14.25	7.43	15.39	7.68	6.91	15.34	14.49	3.45	6.57	11.24	9.23	>10
Maximum	11.77	6.31	17.32	9.35	17.73	10.02	8.63	18.44	21.75	17.31	8.66	20.65	11.52	
Arithmetic Mean	9.746	5.2	15.63	8.36	17.08	8.80	7.82	17.09	19.41	13.60	7.43	14.25	9.97	
Standard Deviation	1.716	1.081	0.90	0.68	0.79	0.85	0.56	1.14	2.59	4.35	0.73	3.40	0.73	
<b>L2</b>														
N=10														
Minimum	5.79	2.56	12.13	6.21	12.36	5.38	5.85	14.68	10.41	9.23	5.29	7.35	5.47	>10
Maximum	7.99	4.29	13.98	8.86	16.72	8.39	8.65	16.11	21.12	14.37	6.86	14.68	7.83	
Arithmetic Mean	7.378	3.632	13.13	7.15	14.31	6.96	6.78	15.37	15.43	11.78	5.92	11.59	6.55	
Standard Deviation	0.682	0.511	0.60	0.92	1.36	1.12	0.82	0.49	3.09	1.59	0.48	2.60	0.68	
<b>L3</b>														
N=4														
Minimum	6.47	2.88	9.35	5.08	10.31	4.85	5.94	12.40	14.98	9.44	5.15	7.02	4.61	>10
Maximum	9.42	5.08	11.91	6.68	14.96	6.64	6.88	16.43	18.99	11.09	6.37	9.59	6.33	

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown	Posterior Tooth	Anterior Tooth	Labial Tooth	Labial Crown	Lingual Tooth	Lingual Crown	# of Ridges
			r tooth edge	r crown edge	r tooth edge	r crown edge	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Arithmetic Mean	7.918	4.093	11.17	6.02	13.18	5.90	6.57	14.56	16.96	10.42	5.68	8.33	5.49	
Standard Deviation	1.205	0.926	1.22	0.70	2.15	0.80	0.44	1.91	1.70	0.71	0.62	1.10	0.95	
L4														
N=4														
Minimum	7.19	3.71	9.63	4.31	10.99	4.66	4.69	11.01	10.34	9.28	4.60	7.46	4.92	>10
Maximum	9.31	5.27	11.13	5.67	13.35	6.60	7.15	14.27	15.12	11.79	6.18	12.22	7.58	
Arithmetic Mean	8.585	4.452	10.38	5.16	12.26	5.67	5.78	12.66	12.88	10.95	5.13	10.11	5.94	
Standard Deviation	0.949	0.671	0.73	0.62	0.99	1.01	1.21	1.67	2.18	1.13	0.73	1.99	1.15	
L5														
N=2														
Minimum	7.99	3.62	8.93	4.42	8.55	4.76	4.57	10.56	8.38	7.04	3.53	8.37	4.30	>10
Maximum	8.22	3.88	9.75	4.49	10.82	5.12	6.01	13.97	13.81	9.88	4.54	10.77	4.47	
Arithmetic Mean	8.105	3.75	9.34	4.46	9.68	4.94	5.29	12.26	11.10	8.46	4.04	9.57	4.39	
Standard Deviation	0.163	0.184	0.58	0.06	1.60	0.25	1.02	2.41	3.84	2.01	0.71	1.70	0.12	

\*\*\* ridges >10 and bifurcating

Tooth File	FHSM VP 2238 <i>P. mortoni</i> Upper dentition													
M1	0.18	0.17	6.86	4.83	4.41	3.64	7.17	6.46	12.88	5.06	2.81	7.58	4.70	***
M2	0.05	0.08	5.72	3.48	6.82	4.56	7.55	11.05	11.77	5.41	2.87	3.93	5.32	***
M3	2.10	1.28	5.69	4.05	6.56	3.53	6.37	8.46	9.62	7.47	2.78	5.39	4.58	***
RPM1	9.31	5.34	18.50	10.97	17.80	12.13	17.71	25.34	26.67	14.56	10.38	14.28	12.33	***
RPM2	9.73	5.87	17.45	11.71	17.04	11.32	16.72	22.45	24.73	16.15	9.70	15.75	8.91	cw
RPM3	10.93	6.29	17.93	11.79	17.39	10.63	17.77	23.47	25.70	16.54	9.68	15.69	10.01	cw
RPM4	12.99	8.65	18.64	13.56	19.18	13.34	16.97	22.30	25.31	14.49	8.89	15.83	9.91	***
RPM5	11.77	7.32	19.20	14.15	18.33	11.48	18.88	23.32	26.21	16.58	9.36	16.74	9.40	***
RPM6	11.50	7.30	18.83	13.29	19.64	11.58	18.45	24.92	27.02	17.27	8.45	17.30	9.87	***
RPM7	13.70	9.14	21.19	15.09	20.46	13.73	18.90	25.44	27.83	15.54	9.94	15.77	9.36	***
RPM8	11.61	7.71	20.03	13.24	21.54	13.11	17.84	26.33	24.33	17.95	10.36	18.40	11.77	***
2R1	7.09	3.64	17.08	11.88	15.24	9.24	17.58	24.44	23.33	13.11	8.90	12.76	8.18	cw

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
2R2	6.69	3.79	16.91	11.63	15.12	9.97	18.29	24.12	25.40	13.44	8.27	13.66	8.63	cw
2R3	8.11	4.49	16.84	10.92	16.61	9.15	16.56	23.73	25.21	13.22	7.77	13.98	8.11	cw
2R4	11.13	7.75	18.25	12.96	17.44	12.18	17.78	24.38	25.07	11.93	8.61	12.58	9.42	***
2R5	11.28	7.74	20.20	12.53	17.94	11.80	16.84	27.09	25.72	11.36	8.20	12.62	9.80	***
2R6	10.26	6.93	18.03	12.49	17.36	11.29	16.88	24.20	25.31	13.16	8.74	13.36	9.74	***
2R7	10.30	7.74	18.89	13.31	18.25	12.93	18.00	26.02	24.52	12.85	7.47	12.91	8.62	***
3R1	8.25	6.43	18.85	10.60	14.07	11.00	14.84	24.45	21.29	9.77	6.69	13.31	9.17	***
3R2	7.77	5.48	17.61	10.44	13.74	9.25	13.72	22.70	24.74	9.10	6.25	12.52	8.73	***
3R3	8.20	5.65	16.91	9.49	12.85	9.08	11.99	20.69	24.76	9.51	6.48	12.88	9.36	***
3R4	7.89	5.37	16.44	9.42	13.94	9.47	12.66	21.33	24.24	9.43	6.79	13.85	9.61	***
3R5	8.08	5.78	17.33	11.25	13.89	9.05	12.11	22.22	24.50	9.44	7.50	13.00	8.64	***
3R6	8.83	6.41	19.88	10.08	14.59	9.54	11.94	26.09	24.09	8.16	7.54	10.39	8.51	***
3R7	8.78	6.05	17.39	10.62	13.64	9.20	11.76	20.78	23.49	9.52	6.45	11.05	8.24	***
3R8	7.43	5.14	17.15	8.91	13.81	9.19	12.43	22.90	24.78	9.16	5.88	10.92	7.55	***
4R1	6.32	4.18	11.87	7.45	10.23	7.42	10.13	14.26	16.52	10.43	5.57	11.42	8.13	***
4R2	6.68	4.84	11.93	7.99	11.31	7.60	9.30	14.86	15.06	9.28	5.38	10.30	8.05	***
4R3	6.91	4.73	12.19	6.91	11.71	7.13	8.66	16.21	16.60	8.46	4.24	9.40	6.78	***
4R4	6.77	4.90	12.68	8.04	11.20	6.74	8.54	15.03	16.43	8.88	5.02	11.54	6.46	***
4R5	5.93	3.30	13.14	6.43	10.67	6.19	8.66	16.39	15.77	9.00	4.61	12.17	6.95	***
4R6	7.27	5.45	12.07	8.00	11.02	8.74	8.99	14.01	16.12	9.14	4.38	10.13	8.07	***
5R1	6.18	3.88	11.92	6.81	9.52	5.86	8.03	14.63	11.75	8.24	4.30	8.69	5.89	***
5R2	5.96	3.60	9.92	6.39	10.10	4.81	7.23	11.50	12.51	8.03	4.18	10.84	5.11	***
5R3	4.69	3.48	7.38	4.81	10.07	5.95	6.93	10.97	11.17	9.21	3.57	9.78	5.60	***
5R4	5.05	3.39	7.31	5.51	9.27	5.39	7.22	11.64	11.58	7.48	4.52	10.61	5.89	***
5R5	5.26	3.53	6.93	5.10	10.57	7.21	7.54	10.69	11.72	8.10	4.38	9.47	6.79	***
5R6	5.40	3.85	8.85	6.08	9.89	6.10	7.33	10.34	11.06	9.91	5.50	9.24	6.11	***
5R7	4.69	3.04	9.49	5.19	9.19	5.74	6.95	12.58	11.58	6.63	3.92	9.55	5.46	***
5R8	5.51	3.90	9.23	5.97	9.93	6.36	8.03	11.54	12.53	7.77	3.59	10.25	5.83	***
6R1	4.36	2.78	6.28	4.64	8.90	4.88	6.06	9.94	10.61	8.02	4.90	9.90	5.45	***
6R2	4.58	2.75	6.41	4.84	8.85	4.53	6.73	10.18	10.27	6.95	4.00	8.82	5.02	***
6R3	4.54	3.30	6.48	5.17	9.40	6.62	7.17	9.91	9.97	7.05	3.55	8.40	5.46	***
6R4	4.34	2.59	6.06	4.89	9.04	4.37	5.37	9.01	10.66	8.06	4.15	9.49	5.33	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
6R5	4.48	3.93	9.85	6.17	8.37	5.43	6.76	11.27	13.68	5.94	2.87	5.64	4.36	***
6R6	1.62	3.23	7.42	5.42	8.70	5.17	6.31	9.09	13.71	8.35	4.17	10.25	3.94	***
7R1	3.47	0.22	6.31	3.19	8.10	3.19	4.10	7.34	10.40	7.07	3.10	9.23	4.37	***
7R2	3.03	0.91	6.56	3.37	8.37	2.61	4.84	5.47	6.77	10.63	3.10	13.35	4.00	***
7R3	3.37	1.93	5.96	3.57	7.42	3.99	4.57	8.58	8.82	6.42	4.07	8.06	5.12	***
7R4	3.70	2.17	6.22	4.30	7.65	3.82	4.49	8.96	8.19	6.49	4.16	8.44	3.91	***
7R5	3.90	2.05	6.73	4.10	7.54	4.33	5.70	9.59	8.05	6.96	3.07	7.93	4.43	***
7R6	3.66	2.06	7.15	4.13	7.97	4.19	5.03	9.92	7.94	6.37	3.21	8.54	4.65	***
7R7	3.29	1.84	6.10	4.17	7.03	3.67	5.38	8.67	9.15	6.03	2.86	7.22	4.48	***
8R1	3.34	1.49	5.97	3.37	7.53	2.84	4.37	7.21	9.73	7.20	2.23	9.24	3.81	***
8R2	3.58	1.37	6.08	2.42	7.54	2.80	3.98	7.51	10.48	7.81	2.39	7.54	3.46	***
8R3	2.54	1.30	4.42	2.67	7.08	3.82	3.76	8.40	8.41	5.08	3.15	6.64	4.25	***
8R4	2.56	1.60	4.96	3.15	6.54	3.49	4.55	7.05	7.26	6.54	2.79	7.92	4.02	***
8R5	2.88	1.51	4.88	2.47	5.44	2.68	3.50	7.05	7.94	5.29	2.46	6.19	3.64	***
8R6	2.75	1.65	5.30	2.72	5.77	3.21	3.67	7.03	7.68	5.57	2.66	7.37	4.13	***
9R1	2.63	0.96	5.07	2.61	6.59	3.61	3.78	7.62	8.11	5.12	2.11	7.37	3.84	2
9R2	2.00	0.37	5.39	2.46	6.12	2.53	3.52	7.12	8.08	5.42	2.24	6.55	3.05	2
9R3	2.15	0.40	5.38	1.81	5.85	2.28	2.77	7.62	7.04	3.94	2.86	6.72	3.53	2
10R1	1.58	0.80	3.94	2.04	4.78	2.15	3.02	7.04	6.49	4.45	2.16	6.16	2.54	1
10R2	1.74	0.30	3.81	2.24	5.31	2.61	2.44	6.17	7.10	5.05	1.94	5.37	3.02	1
10R3	2.30	0.84	4.60	2.71	5.20	2.50	4.24	5.89	8.47	5.22	2.23	5.04	2.73	1
10R4	2.12	1.57	3.67	2.65	4.71	2.39	3.16	5.27	5.96	4.72	1.42	5.69	2.41	1
10R5	2.48	1.23	5.06	2.03	4.08	2.30	3.17	6.00	8.02	3.05	0.74	2.65	3.23	1
10R6	1.25	0.71	4.38	1.71	3.98	1.35	1.62	6.43	3.48	3.74	1.02	4.22	1.49	1
LPM1	11.76	6.88	19.75	11.52	20.47	11.76	16.99	25.08	27.11	16.34	9.05	15.61	10.21	***
LPM2	11.67	7.33	19.59	11.99	20.02	13.01	19.02	25.69	27.38	16.98	9.54	16.85	10.24	***
LPM3	11.78	7.00	19.74	11.23	19.74	12.22	17.82	25.61	27.77	17.43	10.90	16.15	9.28	***
LPM4	13.45	7.82	21.91	13.41	20.92	13.26	18.97	26.34	27.14	18.79	10.40	17.55	10.57	***
LPM5	13.85	8.39	20.38	12.60	20.31	14.04	17.87	23.98	27.77	15.33	8.12	15.71	10.41	***
LPM6	11.89	6.84	18.86	11.47	20.39	11.02	16.52	25.82	27.80	17.59	9.49	17.38	10.78	***
LPM7	13.58	8.50	20.81	12.93	20.80	13.88	17.80	23.77	27.01	18.15	8.28	17.76	9.32	***
2L1	10.56	6.97	15.39	10.00	17.77	12.34	15.44	19.58	21.57	13.85	7.40	13.77	8.97	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
2L2	11.22	7.26	16.92	10.96	18.88	11.76	15.68	21.57	21.48	16.09	8.75	14.68	9.52	***
2L3	10.50	6.88	16.76	10.69	18.11	11.78	14.82	22.16	21.49	13.66	7.06	13.25	8.61	***
2L4	9.89	6.82	15.71	10.13	18.20	12.27	15.37	21.35	22.80	14.06	8.45	12.90	9.53	***
2L5	10.35	6.69	16.67	10.10	18.72	12.30	15.71	21.41	22.72	14.85	9.13	14.32	9.62	***
2L6	11.22	6.85	17.23	10.40	18.58	10.08	13.57	22.09	22.54	16.05	8.72	14.46	8.52	***
2L7	11.44	7.65	17.28	11.27	19.40	12.64	15.74	22.73	25.43	12.95	8.04	12.26	8.28	***
3L1	6.59	4.35	12.59	8.60	15.62	8.92	12.57	19.95	23.11	12.89	7.06	10.52	6.57	***
3L2	9.17	4.60	13.83	8.07	17.17	8.73	11.69	21.29	22.95	14.61	5.87	10.05	6.21	***
3L3	6.96	4.53	12.07	7.23	16.26	8.69	11.66	19.80	24.26	11.11	6.66	9.01	5.94	***
3L4	7.69	4.53	12.64	7.84	15.29	9.69	13.36	19.30	24.41	13.06	6.04	9.88	6.35	***
3L5	9.11	4.45	13.53	8.03	19.40	9.72	12.60	25.30	22.34	13.91	6.13	10.45	5.70	***
3L6	7.50	4.60	12.33	7.13	16.26	9.24	10.76	19.26	22.68	13.66	6.44	8.87	6.37	***
3L7	9.82	4.56	14.38	7.06	18.29	8.97	10.13	23.66	22.00	12.40	5.75	9.91	5.77	***
3L8	9.81	4.61	14.07	6.94	15.90	8.29	10.10	21.09	22.26	13.21	5.87	10.52	6.34	***
3L9	8.33	5.02	12.72	8.09	15.51	8.46	10.68	18.76	23.35	13.15	7.06	10.14	5.23	***
3L10	8.24	4.12	13.24	6.68	17.00	8.65	10.23	21.75	25.28	12.09	5.54	8.22	5.33	***
4L1	6.71	2.62	10.75	6.05	12.20	6.66	9.31	15.60	16.92	11.80	5.24	8.31	4.86	***
4L2	6.98	2.69	11.07	6.60	12.49	5.91	9.12	15.57	18.39	10.28	5.90	7.60	5.25	***
4L3	7.57	3.87	11.42	7.13	11.81	7.34	9.24	14.59	18.29	9.96	5.48	9.02	4.43	***
4L4	6.08	4.15	11.40	7.28	9.28	7.03	9.02	13.05	15.64	9.00	5.43	8.61	4.75	***
4L5	5.96	3.25	11.00	5.09	8.84	7.05	8.01	12.94	12.87	10.80	4.98	8.28	4.74	***
4L6	4.91	3.05	9.12	5.33	6.72	5.04	7.60	11.51	13.22	10.32	4.68	9.66	4.48	***
4L7	7.38	3.41	11.15	6.68	11.24	7.02	9.03	14.89	17.69	10.47	6.15	6.85	4.08	***
4L8	7.65	3.26	10.19	6.39	12.25	6.88	8.29	14.31	16.87	9.19	5.13	8.48	4.70	***
5L1	5.08	1.88	9.81	5.35	10.07	5.45	7.64	14.51	12.84	11.58	5.86	6.55	4.32	***
5L2	5.57	2.40	8.82	4.92	8.23	5.34	7.27	11.04	12.42	10.47	5.18	8.69	3.95	***
5L3	6.26	4.01	9.88	6.16	7.99	6.18	7.42	11.49	13.37	9.44	13.03	8.31	7.83	***
5L4	5.07	3.42	9.94	5.57	8.84	5.62	7.04	11.93	11.06	10.19	4.31	8.76	4.89	***
5L5	5.73	2.45	10.47	4.74	8.06	4.56	5.34	10.72	10.21	11.82	4.52	9.88	4.53	***
5L6	4.52	2.54	9.76	5.32	11.56	6.04	7.42	12.77	14.09	7.49	3.82	6.88	3.88	***
5L7	6.84	2.58	9.64	4.72	9.14	5.31	6.49	11.27	12.17	9.94	4.20	6.84	4.32	***
5L8	6.78	2.84	10.08	4.68	9.28	6.10	5.31	10.03	12.80	8.80	4.15	7.28	4.03	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	Width F-G	Width B-C	Width E-D	Length B-E	Length F-I	Length C-D	Length G-H	
5L9	6.74	3.47	9.32	4.97	8.47	5.85	6.30	10.11	12.29	9.03	4.57	8.26	4.30	***
6L1	5.42	1.25	7.94	2.94	7.99	4.45	5.15	9.82	9.35	10.00	4.85	6.37	3.02	***
6L2	5.12	2.28	7.90	3.45	7.23	3.99	5.55	8.66	11.83	5.53	12.76	6.87	6.18	***
6L3	4.97	3.01	9.63	5.39	6.75	5.60	6.98	10.61	11.78	6.75	4.43	7.54	4.16	***
6L4	4.30	2.36	9.00	4.31	6.63	4.57	6.00	9.99	10.07	10.05	5.05	7.22	3.63	***
6L5	4.87	2.95	9.67	5.50	6.35	5.07	6.27	9.90	9.85	9.89	5.11	7.76	3.77	***
6L6	4.06	2.18	8.21	5.33	7.45	4.86	4.99	6.89	10.23	6.66	4.95	10.34	4.81	***
6L7	5.34	2.88	7.44	3.55	7.18	4.71	5.78	7.98	10.51	7.91	5.04	6.33	19.49	***
6L8	4.45	1.43	7.14	2.80	7.77	3.64	4.86	9.89	9.55	8.94	4.78	5.72	2.95	***
7L1	4.81	1.53	6.61	2.58	8.37	3.12	3.64	4.51	9.18	8.74	3.34	0.32	2.35	***
7L2	3.01	1.09	6.51	2.53	6.62	3.24	3.56	8.49	8.27	7.91	4.03	6.59	2.62	***
7L3	2.41	1.30	4.95	2.87	5.29	2.72	3.96	6.50	5.87	6.56	3.66	6.02	2.42	***
7L4	2.94	1.10	7.00	3.92	4.64	3.79	4.27	6.89	7.26	7.54	4.50	6.07	3.17	***
7L5	2.73	1.46	7.00	2.36	4.72	3.25	4.20	7.33	6.26	8.36	3.21	6.96	3.41	***
7L6	2.67	1.51	6.63	2.54	4.49	2.84	3.89	7.27	5.86	7.39	2.31	6.33	2.96	***
7L7	3.42	2.02	6.84	3.72	4.45	2.73	3.63	6.72	6.85	6.96	3.77	6.56	3.29	***
7L8	1.89	0.35	6.32	3.32	2.69	1.42	3.50	7.07	6.53	7.03	4.07	4.86	2.96	***
8L1	3.01	1.41	5.69	2.10	6.26	3.11	3.38	6.66	7.14	7.93	2.58	5.77	2.75	***
8L2	1.22	0.63	4.28	2.41	4.70	1.81	3.22	7.95	7.08	5.47	3.44	5.21	2.51	***
8L3	3.18	1.82	6.45	3.12	5.31	3.04	3.65	8.69	7.38	5.86	3.37	4.47	2.18	***
8L4	1.77	0.48	5.63	1.37	4.54	1.84	2.40	6.68	6.90	6.34	2.24	5.93	2.78	***
8L5	2.12	1.27	6.29	3.07	3.03	1.79	3.16	6.97	6.95	6.68	3.65	5.35	3.08	***
8L6	2.38	2.50	5.81	3.23	2.77	3.01	3.41	5.53	5.64	7.10	2.93	6.05	2.20	***
8L7	3.35	1.93	5.49	3.25	4.65	2.97	3.46	6.53	7.82	5.18	3.15	4.75	2.48	***
8L8	2.59	1.02	5.57	3.19	4.50	2.47	2.40	6.49	7.24	5.59	4.01	5.16	2.23	***
8L9	3.43	0.58	6.22	2.55	4.88	2.75	3.05	6.23	7.16	6.77	3.96	5.24	2.47	***
9L1	2.47	0.18	5.98	2.40	4.06	2.20	2.97	5.76	6.99	7.13	3.18	4.88	2.43	2
9L2	1.79	1.20	5.08	2.14	3.94	2.51	3.24	5.69	6.77	7.08	3.04	5.33	1.91	2
9L3	0.11	1.10	4.48	2.32	3.52	1.41	2.66	4.94	7.82	6.94	3.06	6.71	2.05	2
9L4	2.76	1.26	5.65	2.17	4.32	2.58	2.72	5.54	6.64	6.99	3.28	5.21	2.17	2
9L5	1.18	1.06	5.31	1.80	4.39	2.91	3.41	7.67	3.97	8.26	3.43	4.83	2.48	2
9L6	1.63	0.93	5.24	2.53	2.90	1.29	2.54	6.75	6.93	6.76	2.10	5.04	2.19	2



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
10L1	0.83	0.47	4.68	1.13	4.46	1.43	1.74	7.09	7.13	3.46	2.38	2.56	1.17	1
10L2	1.11	0.10	4.63	1.03	3.26	1.28	1.75	5.31	5.35	6.40	2.15	4.28	2.27	1
10L3	0.97	0.00	4.10	1.69	3.69	1.26	1.79	5.01	4.92	6.80	2.95	4.38	3.15	1
10L4	1.51	0.43	4.14	1.24	4.25	1.40	1.76	6.45	4.35	5.95	2.23	2.76	2.28	1

**SUMMARY FHSM VP 2238 *P. mortoni* Upper dentition**

Medial														
N=3														
Minimum	0.05	0.08	5.69	3.48	4.41	3.53	6.37	6.46	9.62	5.06	2.78	3.93	4.58	>10
Maximum	2.1	1.28	6.86	4.83	6.82	4.56	7.56	11.05	12.88	7.47	2.87	7.58	5.32	
Arithmetic Mean	0.777	0.51	6.09	4.12	5.93	3.91	7.03	8.66	11.43	5.98	2.82	5.63	4.87	
Standard Deviation	1.148	0.668	0.67	0.68	1.33	0.56	0.61	2.31	1.66	1.30	0.05	1.84	0.40	
R PM														
N=8														
Minimum	9.31	5.34	17.45	10.97	17.04	10.63	16.72	22.30	24.33	14.49	8.45	14.28	8.91	>10
Maximum	13.7	9.14	21.19	15.09	21.54	13.73	18.90	26.33	27.83	17.95	10.38	18.40	12.33	
Arithmetic Mean	11.443	7.203	18.97	12.98	18.92	12.16	17.91	24.20	25.98	16.13	9.59	16.22	10.19	
Standard Deviation	1.482	1.321	1.18	1.38	1.57	1.11	0.81	1.50	1.19	1.22	0.68	1.24	1.21	
R2														
N=7														
Minimum	6.69	3.64	16.84	10.92	15.12	9.15	16.56	23.73	23.33	11.36	7.47	12.58	8.11	>10
Maximum	11.28	7.75	20.20	13.31	18.25	12.93	18.29	27.09	25.72	13.44	8.90	13.98	9.80	
Arithmetic Mean	9.266	6.011	18.03	12.25	16.85	10.94	17.42	24.85	24.94	12.72	8.28	13.12	8.93	
Standard Deviation	1.928	1.946	1.23	0.82	1.25	1.49	0.66	1.23	0.80	0.78	0.52	0.55	0.72	
R3														
N=8														
Minimum	7.43	5.14	16.44	8.91	12.85	9.05	11.76	20.69	21.29	8.16	5.88	10.39	7.55	>10
Maximum	8.83	6.43	19.88	11.25	14.59	11.00	14.84	26.09	24.78	9.78	7.54	13.85	9.61	
Arithmetic Mean	8.154	5.789	17.70	10.10	13.82	9.47	12.68	22.65	23.99	9.26	6.70	12.24	8.73	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Standard Deviation	0.479	0.475	1.13	0.78	0.49	0.64	1.07	1.87	1.18	0.50	0.58	1.27	0.66	
R4														
N=6														
Minimum	5.93	3.3	11.87	6.43	10.23	6.19	8.54	14.01	15.06	8.46	4.24	9.40	6.46	>10
Maximum	7.27	5.45	13.14	8.04	11.71	8.74	10.13	16.39	16.60	10.43	5.57	12.17	8.13	
Arithmetic Mean	6.647	4.567	12.31	7.47	11.02	7.30	9.05	15.13	16.08	9.20	4.87	10.83	7.41	
Standard Deviation	0.468	0.741	0.50	0.68	0.52	0.87	0.60	0.98	0.59	0.66	0.55	1.04	0.76	
R5														
N=8														
Minimum	4.69	3.04	6.93	4.81	9.19	4.81	6.93	10.34	11.06	6.63	3.57	8.69	5.11	>10
Maximum	6.18	3.9	11.92	6.81	10.57	7.21	8.03	14.63	12.53	9.91	5.50	10.84	6.79	
Arithmetic Mean	5.343	3.584	8.88	5.73	9.82	5.93	7.41	11.74	11.74	8.17	4.25	9.80	5.83	
Standard Deviation	0.542	0.294	1.66	0.69	0.46	0.70	0.43	1.35	0.54	1.01	0.62	0.72	0.50	
R6														
N=6														
Minimum	1.62	2.59	6.06	4.64	8.37	4.37	5.37	9.01	9.97	5.94	2.87	5.64	3.94	>10
Maximum	4.58	3.93	9.85	6.17	9.41	6.62	7.17	11.27	13.71	8.35	4.90	10.25	5.46	
Arithmetic Mean	3.987	3.097	7.08	5.19	8.88	5.17	6.40	9.90	11.49	7.39	3.94	8.75	4.93	
Standard Deviation	1.163	0.496	1.43	0.55	0.35	0.82	0.64	0.83	1.73	0.92	0.68	1.67	0.64	
R7														
N=7														
Minimum	3.03	0.22	5.96	3.19	7.03	2.61	4.10	5.47	6.77	6.03	2.86	7.22	3.91	>10
Maximum	3.9	2.17	7.15	4.30	8.37	4.33	5.70	9.92	10.40	10.63	4.17	13.35	5.12	
Arithmetic Mean	3.489	1.597	6.43	3.83	7.73	3.69	4.87	8.36	8.48	7.14	3.37	8.97	4.42	
Standard Deviation	0.291	0.74	0.41	0.45	0.45	0.60	0.55	1.52	1.14	1.58	0.52	2.03	0.40	
R8														
N=6														

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Minimum	2.54	1.3	4.42	2.42	5.44	2.68	3.50	7.03	7.26	5.08	2.23	6.19	3.46	>10
Maximum	3.58	1.65	6.08	3.37	7.54	3.82	4.55	8.40	10.48	7.81	3.15	9.24	4.25	
Arithmetic Mean	2.942	1.487	5.27	2.80	6.65	3.14	3.97	7.37	8.58	6.25	2.61	7.48	3.89	
Standard Deviation	0.427	0.133	0.65	0.38	0.89	0.45	0.41	0.53	1.26	1.11	0.33	1.07	0.30	
R9														
N=3														
Minimum	2	0.37	5.07	1.81	5.85	2.28	2.77	7.12	7.04	3.94	2.11	6.55	3.05	2
Maximum	2.63	0.96	5.40	2.61	6.59	3.61	3.78	7.62	8.11	5.43	2.86	7.37	3.84	
Arithmetic Mean	2.26	0.577	5.28	2.29	6.19	2.80	3.36	7.46	7.74	4.83	2.41	6.88	3.47	
Standard Deviation	0.329	0.332	0.19	0.42	0.38	0.71	0.52	0.29	0.61	0.79	0.40	0.44	0.40	
R10														
N=6														
Minimum	1.25	0.3	3.67	1.71	3.98	1.35	1.62	5.27	3.48	3.05	0.74	2.66	1.49	1
Maximum	2.48	1.57	5.06	2.71	5.31	2.61	4.24	7.04	8.47	5.22	2.23	6.16	3.24	
Arithmetic Mean	1.912	0.908	4.24	2.23	4.68	2.21	2.94	6.13	6.59	4.37	1.59	4.86	2.57	
Standard Deviation	0.468	0.44	0.53	0.39	0.55	0.45	0.87	0.59	1.78	0.83	0.62	1.26	0.61	
LPM														
N=7														
Minimum	11.67	6.84	18.86	11.23	19.74	11.02	16.52	23.77	27.01	15.33	8.13	15.61	9.28	>10
Maximum	13.85	8.5	21.91	13.41	20.92	14.04	19.02	26.34	27.80	18.79	10.90	17.76	10.78	
Arithmetic Mean	12.569	7.537	20.15	12.17	20.38	12.74	17.86	25.18	27.42	17.23	9.40	16.72	10.12	
Standard Deviation	0.999	0.705	0.99	0.83	0.42	1.12	0.92	0.97	0.35	1.15	1.02	0.90	0.59	
L2														
N=7														
Minimum	9.89	6.69	15.39	10.00	17.77	10.08	13.57	19.58	21.48	12.95	7.06	12.26	8.28	>10
Maximum	11.44	7.65	17.28	11.27	19.40	12.64	15.74	22.73	25.43	16.09	9.13	14.68	9.62	
Arithmetic Mean	10.74	7.017	16.57	10.51	18.52	11.88	15.19	21.56	22.57	14.50	8.22	13.66	9.01	
Standard Deviation	0.565	0.33	0.73	0.48	0.55	0.86	0.78	1.00	1.39	1.21	0.76	0.90	0.56	

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
L3														
N=10														
Minimum	6.59	4.12	12.07	6.68	15.29	8.29	10.10	18.76	22.00	11.11	5.54	8.22	5.23	>10
Maximum	9.82	5.02	14.38	8.60	19.40	9.72	13.36	25.30	25.28	14.61	7.06	10.52	6.57	
Arithmetic Mean	8.322	4.537	13.14	7.57	16.67	8.94	11.38	21.01	23.26	13.01	6.24	9.76	5.98	
Standard Deviation	1.142	0.227	0.79	0.64	1.32	0.48	1.17	2.10	1.07	0.98	0.54	0.79	0.46	
L4														
N=8														
Minimum	4.91	2.62	9.12	5.09	6.72	5.04	7.60	11.51	12.87	9.00	4.68	6.85	4.09	>10
Maximum	7.65	4.15	11.42	7.28	12.49	7.34	9.31	15.60	18.39	11.80	6.15	9.66	5.25	
Arithmetic Mean	6.655	3.288	10.76	6.32	10.60	6.62	8.70	14.06	16.23	10.23	5.37	8.35	4.66	
Standard Deviation	0.95	0.529	0.77	0.79	2.09	0.77	0.64	1.44	2.16	0.89	0.48	0.85	0.34	
L5														
N=9														
Minimum	4.52	1.88	8.82	4.68	7.99	4.56	5.31	10.03	10.21	7.49	3.82	6.55	3.88	>10
Maximum	6.84	4.01	10.47	6.16	11.56	6.18	7.64	14.51	14.09	11.82	13.03	9.88	7.83	
Arithmetic Mean	5.843	2.843	9.75	5.16	9.07	5.61	6.69	11.54	12.36	9.86	5.52	7.94	4.67	
Standard Deviation	0.856	0.664	0.47	0.49	1.15	0.51	0.89	1.41	1.16	1.36	2.88	1.12	1.22	
L6														
N=8														
Minimum	4.06	1.25	7.14	2.80	6.35	3.64	4.86	6.89	9.35	5.53	4.43	5.72	2.96	>10
Maximum	5.42	3.01	9.67	5.51	7.99	5.60	6.99	10.61	11.83	10.05	12.76	10.34	19.49	
Arithmetic Mean	4.816	2.293	8.37	4.16	7.17	4.61	5.70	9.22	10.40	8.21	5.87	7.27	6.00	
Standard Deviation	0.497	0.67	0.96	1.13	0.57	0.61	0.72	1.26	0.94	1.76	2.79	1.42	5.55	
L7														
N=8														
Minimum	1.89	0.35	4.95	2.36	2.69	1.42	3.50	4.51	5.86	6.56	2.31	0.32	2.35	>10

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown	Posterior Tooth	Anterior Tooth	Labial Tooth	Labial Crown	Lingual Tooth	Lingual Crown	# of Ridges
			r tooth edge A-B	r crown edge A-F	r tooth edge A-C	r crown edge A-G	r Crown Width F-G	r Tooth Width B-C	Tooth Width E-D	Tooth Length B-E	Crown Length F-I	Tooth Length C-D	Crown Length G-H	
Maximum	4.81	2.02	7.00	3.92	8.37	3.79	4.28	8.49	9.18	8.74	4.50	6.96	3.41	
Arithmetic Mean	2.985	1.295	6.48	2.98	5.16	2.89	3.83	6.85	7.01	7.56	3.61	5.47	2.90	
Standard Deviation	0.863	0.482	0.66	0.60	1.69	0.69	0.30	1.12	1.18	0.74	0.67	2.17	0.40	
L8														
N=9														
Minimum	1.22	0.48	4.29	1.37	2.77	1.80	2.40	5.53	5.64	5.18	2.24	4.47	2.18	>10
Maximum	3.43	2.5	6.45	3.25	6.26	3.11	3.65	8.69	7.82	7.93	4.01	6.05	3.08	
Arithmetic Mean	2.561	1.293	5.71	2.70	4.52	2.53	3.13	6.86	7.04	6.33	3.26	5.33	2.52	
Standard Deviation	0.759	0.693	0.64	0.65	1.07	0.57	0.45	0.94	0.59	0.89	0.60	0.53	0.31	
L9														
N=6														
Minimum	0.11	0.18	4.48	1.80	2.90	1.29	2.54	4.94	3.97	6.76	2.10	4.83	1.91	2
Maximum	2.76	1.26	5.98	2.53	4.39	2.91	3.41	7.68	7.82	8.26	3.43	6.71	2.48	
Arithmetic Mean	1.657	0.955	5.29	2.23	3.86	2.15	2.92	6.06	6.52	7.20	3.01	5.33	2.21	
Standard Deviation	0.95	0.397	0.51	0.26	0.56	0.66	0.34	0.99	1.31	0.54	0.47	0.70	0.22	
L10														
N=4														
Minimum	0.83	0	4.10	1.03	3.26	1.26	1.74	5.01	4.35	3.46	2.15	2.56	1.17	1
Maximum	1.51	0.47	4.68	1.69	4.46	1.43	1.79	7.09	7.13	6.80	2.95	4.38	3.15	
Arithmetic Mean	1.105	0.25	4.39	1.27	3.91	1.34	1.76	5.97	5.44	5.65	2.43	3.50	2.22	
Standard Deviation	0.293	0.235	0.31	0.29	0.54	0.09	0.02	0.97	1.20	1.50	0.36	0.97	0.81	

\*\*\*ridges >10 and bifurcating

Tooth File	FHSM VP 15532 <i>P. mortoni</i> Lower dentition													
M1	9.33	4.40	14.27	7.52	15.31	8.66	10.16	18.50	19.73	11.35	5.51	12.56	7.53	10.00
M2	9.20	3.70	14.89	7.97	14.31	8.40	11.49	19.02	20.14	10.37	5.00	11.66	7.16	10.00
M3	9.75	4.52	14.58	7.74	14.81	8.53	11.80	18.39	19.68	11.63	6.06	11.85	6.06	10.00
M4	9.01	3.89	15.17	8.27	15.28	8.50	11.16	17.68	19.72	11.63	6.07	12.11	7.53	10.00
M5	9.50	5.37	15.77	8.77	16.19	8.93	12.27	18.86	19.41	12.68	5.79	11.12	7.08	10.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
M6	8.89	4.20	14.60	7.57	14.87	7.71	10.74	19.01	20.32	11.50	5.59	9.51	6.23	10.00
M7	3.48	4.95	15.15	8.48	14.77	8.87	12.36	19.62	19.44	11.27	7.08	11.66	6.12	10.00
M8	7.93	3.97	14.86	7.23	16.00	10.22	11.97	18.31	18.12	11.01	6.05	10.83	7.07	10.00
M9	8.31	4.50	15.13	7.90	14.73	8.96	12.06	20.92	19.40	8.86	5.60	9.27	6.49	10.00
M10	7.06	3.48	16.85	6.36	20.35	15.19	10.97	6.55	17.97	20.49	6.35	5.72	5.76	10.00
M11	7.42	3.53	12.62	7.42	12.93	6.52	9.89	15.85	17.15	8.53	5.08	11.85	5.01	10.00
RPM1	7.31	3.77	12.07	7.35	12.41	7.14	10.45	13.90	16.19	9.60	5.53	10.66	4.60	8.00
RPM2	7.54	3.25	11.12	6.28	12.58	6.68	8.54	13.96	17.70	6.05	4.81	6.23	4.82	8.00
2R1	7.70	3.01	12.26	7.45	11.73	5.91	9.07	15.01	14.31	10.59	4.97	11.15	5.38	8.00
2R2	7.06	3.09	13.92	7.94	11.35	5.63	9.08	15.46	13.27	11.21	5.98	10.28	5.22	8.00
2R3	5.94	3.03	13.18	6.28	11.95	5.06	7.77	15.90	13.71	11.32	5.41	11.19	4.63	8.00
2R4	6.62	2.67	13.57	6.21	11.50	5.11	8.27	15.52	13.90	12.95	5.04	11.13	5.02	8.00
2R5	7.76	3.53	12.38	5.55	11.84	5.96	8.74	15.19	13.74	12.63	5.00	10.67	5.36	8.00
3R1	5.21	2.21	11.53	6.76	10.20	5.11	8.30	11.28	9.89	16.18	5.06	10.45	4.76	8.00
3R2	6.13	2.73	11.04	7.13	9.55	4.93	8.14	10.39	14.58	20.22	5.47	10.78	4.05	8.00
3R3	5.97	2.47	12.03	6.40	10.86	5.29	8.47	12.17	9.58	12.14	4.30	11.98	4.11	8.00
3R4	5.48	2.91	12.86	5.59	11.92	5.64	8.70	17.64	14.92	9.77	4.67	10.77	4.91	8.00
3R5	5.98	1.46	14.32	6.77	11.56	6.38	9.21	17.87	19.24	5.78	4.10	9.58	4.55	8.00
3R6	5.61	1.86	11.66	7.91	10.65	5.58	7.21	13.07	15.06	6.31	4.20	11.23	4.86	8.00
3R7	5.67	2.14	11.66	8.22	13.51	5.10	7.38	14.72	15.87	6.18	3.50	9.91	4.15	8.00
3R8	6.29	2.35	12.61	7.49	12.65	5.63	6.89	12.39	16.52	9.37	5.00	7.73	4.52	8.00
4R1	5.50	2.08	10.26	4.80	9.37	4.14	6.28	11.74	10.62	5.10	3.41	12.94	2.93	8.00
4R2	5.93	2.17	10.62	4.94	9.89	4.16	5.48	14.06	11.18	4.41	3.71	11.47	4.23	8.00
4R3	5.11	1.51	10.44	4.87	9.63	4.15	5.66	13.24	9.82	9.97	3.84	8.62	3.48	8.00
4R4	4.63	1.75	9.65	4.85	10.08	4.25	5.97	11.64	10.37	4.26	3.82	15.34	3.95	8.00
4R5	5.08	2.17	10.79	5.58	9.54	3.77	6.06	11.68	13.62	7.24	4.73	9.10	3.55	8.00
4R6	5.86	2.37	10.33	4.57	9.23	3.28	7.17	11.74	11.97	10.14	3.17	9.91	1.99	8.00
4R7	5.39	2.31	9.68	4.13	8.98	4.31	5.98	4.75	9.70	15.76	4.40	5.94	3.28	8.00
4R8	4.43	1.53	11.29	5.34	8.89	3.86	7.03	12.98	12.63	11.02	6.76	6.77	5.75	8.00
4R9	5.78	2.31	9.81	4.69	9.43	4.19	7.05	12.27	12.51	10.35	3.94	9.25	2.94	8.00
4R10	4.49	1.79	10.11	4.27	9.66	3.60	5.22	11.08	10.36	10.68	4.22	7.90	3.08	8.00
4R11	5.34	1.66	10.20	4.72	8.97	3.34	6.54	10.57	8.92	9.99	4.59	9.55	3.89	8.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
		A-B	A-F	A-C	A-G									
4R12	4.40	1.95	9.50	3.37	8.34	4.11	5.17	10.53	9.42	7.23	4.54	12.04	3.34	8.00
4R13	5.52	2.75	8.95	3.88	7.88	3.71	5.03	9.59	5.56	10.45	4.13	10.93	5.80	8.00
4R14	4.31	1.83	10.24	4.52	8.90	3.74	6.60	12.67	8.94	9.86	3.17	8.20	2.59	8.00
4R15	4.53	1.27	10.24	4.67	10.32	3.56	6.01	11.37	9.30	10.17	3.85	9.85	3.83	8.00
5R1	4.26	1.75	9.97	4.26	8.24	3.83	5.47	12.20	8.97	9.78	4.19	8.18	3.67	7.00
5R2	3.94	1.43	10.55	4.28	7.82	2.99	5.60	12.74	4.89	10.06	3.05	10.40	5.20	7.00
5R3	4.33	2.09	10.26	4.27	8.03	3.41	6.08	11.44	9.89	5.93	3.21	10.54	2.76	7.00
5R4	4.83	1.98	9.98	4.34	8.53	3.86	5.45	9.63	7.01	11.59	4.78	9.67	3.25	7.00
5R5	3.73	1.49	9.24	3.97	7.54	3.47	5.41	10.18	5.48	6.78	3.86	13.54	5.34	7.00
5R6	4.59	1.93	8.62	4.48	7.86	2.43	5.58	10.07	11.40	9.79	3.00	6.11	5.70	7.00
5R7	4.92	1.09	10.25	4.33	7.57	3.73	6.16	11.61	5.07	8.78	2.45	10.23	5.68	7.00
5R8	4.49	1.64	8.01	5.34	8.37	3.77	6.49	8.77	11.99	8.49	3.27	8.26	5.00	7.00
5R9	3.25	1.35	8.55	4.01	6.63	3.04	5.62	10.26	6.28	7.35	3.62	8.96	2.59	7.00
6R1	4.46	1.64	10.02	3.19	7.34	2.80	3.76	11.65	10.72	5.46	7.23	8.30	2.61	6.00
6R2	4.34	1.07	7.72	3.39	7.49	3.11	4.90	8.57	7.48	6.82	2.57	11.31	4.82	6.00
6R3	4.69	1.67	6.76	3.05	7.39	2.77	4.64	8.71	8.72	5.46	2.81	8.98	3.16	6.00
6R4	4.37	1.42	8.29	3.58	7.01	3.56	4.53	8.82	10.25	9.40	3.51	5.60	3.05	6.00
6R5	4.19	1.75	8.20	3.30	7.31	3.06	5.64	8.75	7.30	9.42	1.27	6.31	4.72	6.00
6R6	3.90	0.53	9.11	3.48	8.03	4.57	6.67	10.52	6.93	9.02	2.45	9.19	4.74	6.00
6R7	4.20	1.30	8.59	3.95	7.44	3.04	5.15	8.44	9.49	6.75	1.77	8.47	5.16	6.00
6R8	3.61	0.65	7.66	3.87	7.29	3.32	4.82	8.86	6.89	9.08	3.91	8.23	3.33	6.00
6R9	3.17	1.32	8.08	9.21	7.35	3.71	5.60	8.27	6.61	9.61	8.51	2.98	6.16	6.00
6R10	3.39	1.97	8.51	4.11	7.54	3.57	5.47	9.24	6.93	8.14	3.42	9.12	5.21	6.00
6R11	3.63	1.62	5.54	3.72	6.57	3.21	4.80	7.35	6.61	8.55	2.57	6.12	4.40	6.00
6R12	3.56	0.50	7.74	3.17	7.31	3.25	4.35	9.02	5.99	8.56	2.72	7.80	5.24	6.00
6R13	4.70	0.92	7.53	3.26	7.71	3.46	2.14	8.47	10.90	9.01	5.90	4.48	3.65	6.00
7R1	3.99	1.19	6.80	3.38	6.24	3.48	1.85	6.62	11.09	8.86	5.93	2.73	4.58	5.00
7R2	3.43	1.52	7.18	2.99	6.70	2.92	2.48	7.51	9.85	7.60	5.65	4.23	3.32	5.00
7R3	4.50	1.17	7.21	3.56	6.90	2.82	2.56	7.29	9.02	8.37	5.68	4.15	3.07	5.00
7R4	2.58	2.32	7.86	2.79	6.41	3.32	1.91	9.17	7.41	7.45	5.94	5.88	3.67	5.00
7R5	2.92	1.08	6.87	2.50	5.23	3.11	2.13	6.95	11.29	9.08	5.32	2.40	3.84	5.00
7R6	2.83	1.54	6.37	2.30	7.15	3.42	1.73	8.43	7.08	7.93	5.28	7.41	4.26	5.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
7R7	3.86	1.31	8.64	3.78	6.40	3.34	4.63	9.42	6.51	6.88	2.84	8.53	4.91	5.00
7R8	3.00	1.38	5.33	3.75	6.73	2.43	4.35	7.50	6.78	7.92	4.91	6.46	2.09	5.00
7R9	3.19	1.29	6.13	3.07	6.85	3.15	4.61	7.11	6.87	8.63	4.16	6.17	1.91	5.00
7R10	3.26	1.54	7.66	8.60	7.44	3.64	5.02	6.54	6.09	9.05	9.89	3.15	3.64	5.00
7R11	3.18	1.21	7.68	2.89	7.42	3.61	2.14	8.00	11.19	9.47	5.49	2.96	4.09	5.00
7R12	3.80	1.75	6.37	3.80	6.73	3.66	2.30	7.49	9.14	6.40	6.46	7.00	3.78	5.00
7R13	2.90	1.24	6.36	3.05	6.75	3.27	3.63	8.38	6.47	8.12	4.18	7.10	1.51	5.00
8R1	2.68	1.55	6.39	2.94	6.82	3.75	2.06	6.86	10.62	7.57	4.76	3.68	4.15	4.00
8R2	2.37	0.34	4.02	3.66	5.47	3.11	4.06	5.51	10.34	6.19	3.61	3.92	1.84	4.00
8R3	3.39	1.46	5.35	1.67	5.93	2.15	2.65	6.34	7.90	7.44	2.97	5.17	1.34	4.00
8R4	3.06	0.84	5.61	3.00	5.53	2.44	3.74	6.19	7.55	6.29	4.57	7.05	1.77	4.00
8R5	3.37	0.28	5.98	2.15	6.13	2.37	3.49	7.22	7.80	5.98	3.99	6.13	2.01	4.00
8R6	2.31	0.74	5.09	2.74	5.57	2.22	3.67	6.39	9.27	6.43	2.34	2.65	1.23	4.00
8R7	3.19	1.29	6.16	2.36	5.75	3.87	5.51	8.55	6.75	4.01	4.92	6.25	4.63	4.00
8R8	3.26	1.54	6.41	2.56	5.91	3.59	4.45	7.97	4.82	7.21	5.77	6.81	5.01	4.00
8R9	3.18	1.21	6.91	2.32	5.66	3.17	4.91	8.30	5.17	7.45	5.10	5.81	4.36	4.00
8R10	3.80	1.75	6.36	2.82	6.12	3.52	5.09	7.70	6.38	6.61	4.85	2.41	4.21	4.00
9R1	2.90	1.24	6.07	2.73	6.98	2.43	4.51	5.40	11.57	8.89	2.22	2.01	3.04	2.00
9R2	3.73	0.80	6.03	2.56	6.02	3.41	5.11	6.53	6.38	8.79	3.20	6.95	3.72	2.00
9R3	2.94	1.36	4.79	2.12	6.12	2.52	3.67	7.18	7.40	5.74	2.71	4.84	3.25	2.00
9R4	2.68	1.55	5.03	2.86	6.55	2.61	4.41	5.65	8.15	7.48	3.03	3.35	3.69	2.00
9R5	2.37	0.34	4.63	2.04	6.34	2.09	2.23	5.15	4.79	6.14	2.56	6.32	1.73	2.00
9R6	2.91	0.99	4.90	2.35	5.47	2.26	3.53	7.41	4.82	4.92	2.80	6.65	3.03	2.00
9R7	3.39	1.46	4.95	1.81	5.26	1.98	2.24	6.54	6.74	5.66	1.85	4.09	1.80	2.00
9R8	2.73	1.64	5.41	3.01	5.65	3.23	3.96	5.75	6.13	5.54	2.74	5.58	3.66	2.00
9R9	2.61	0.99	5.32	2.26	5.19	2.47	3.77	6.00	8.24	5.99	2.78	2.39	3.28	2.00
9R10	2.50	1.08	4.66	2.38	5.95	2.80	3.68	5.59	4.61	5.93	2.30	5.50	3.42	2.00
10R1	2.80	1.29	5.60	2.31	6.19	2.59	3.95	9.81	8.61	4.57	2.38	3.50	3.82	1.00
10R2	3.06	0.84	4.54	2.32	6.22	2.64	4.49	6.01	4.75	6.27	2.73	2.68	3.28	1.00
10R3	3.37	0.28	4.51	2.01	6.94	5.19	5.38	5.69	7.99	7.78	2.03	5.28	4.37	1.00
10R4	2.31	0.22	5.70	0.93	6.10	2.52	3.41	9.88	7.98	3.57	2.69	4.80	3.82	1.00
10R5	2.14	1.07	4.87	2.46	5.48	2.17	3.96	7.53	6.44	4.92	1.37	5.44	3.82	1.00



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
10R6	4.11	1.86	4.72	2.69	6.50	2.99	4.28	6.41	9.73	5.41	2.23	1.57	3.82	1.00
10R7	2.24	1.27	4.24	2.44	5.44	2.52	4.07	5.63	7.48	6.40	2.28	3.09	3.82	1.00
10R8	3.37	0.45	5.30	1.71	6.41	4.20	3.83	6.88	5.06	5.69	2.46	5.48	3.07	1.00
11R1	2.31	0.74	4.19	2.14	6.15	4.05	4.55	4.39	6.80	6.18	2.48	4.57	3.52	1.00
11R2	1.99	0.63	3.65	1.57	5.79	2.24	3.59	6.74	4.97	4.99	1.31	6.63	3.30	1.00
11R3	2.12	1.37	4.74	2.27	4.55	2.05	3.28	6.67	5.59	2.46	2.60	5.62	3.02	1.00
11R4	1.46	0.73	3.08	1.82	4.93	2.29	3.77	4.86	5.59	4.60	2.88	3.32	4.75	1.00
11R5	2.12	0.58	3.61	1.32	4.55	2.53	3.64	5.75	7.03	4.43	2.71	2.60	4.17	1.00
11R6	0.81	0.27	3.97	1.72	5.16	1.57	2.72	4.95	6.02	4.64	2.49	2.98	3.51	1.00
11R7	1.27	0.67	2.44	1.51	4.59	2.27	3.52	5.04	6.86	4.28	2.84	2.74	3.45	1.00
LPM1	6.86	0.62	10.77	5.92	10.29	5.36	4.34	13.75	10.40	9.22	8.57	8.84	5.11	8.00
LPM2	7.25	1.78	11.91	6.64	12.74	6.63	5.18	14.17	18.38	8.35	10.09	10.91	5.30	8.00
LPM3	7.75	2.58	11.20	6.68	11.93	5.50	4.86	13.56	15.04	8.76	10.20	9.54	4.55	8.00
2L1	7.72	2.10	12.40	7.16	13.85	7.01	4.91	17.14	15.18	10.59	10.41	10.89	4.71	6.00
2L2	7.56	2.83	11.61	6.29	13.04	7.09	4.87	13.17	14.96	11.85	9.36	13.23	4.41	6.00
2L3	8.28	1.41	12.04	6.49	13.59	6.68	3.88	16.74	17.48	11.59	9.55	8.27	5.44	6.00
2L4	7.39	1.96	10.97	6.14	12.76	7.21	5.99	14.16	16.44	8.25	9.56	12.62	4.79	6.00
2L5	7.14	2.24	11.93	6.00	12.38	7.03	5.92	14.03	13.63	12.40	9.01	12.18	5.07	6.00
2L6	6.87	1.67	11.06	6.07	12.18	8.11	5.23	15.18	12.17	9.96	9.91	11.97	6.82	6.00
2L7	6.62	2.07	11.97	7.34	13.72	6.52	6.81	16.05	11.70	12.00	10.68	12.54	4.22	6.00
2L8	8.11	2.72	11.84	7.00	12.94	7.78	4.05	15.97	14.75	10.35	9.39	11.45	7.43	6.00
2L9	4.76	8.61	11.73	6.56	13.06	7.18	5.21	15.31	14.54	10.87	9.73	11.64	5.36	6.00
2L10	7.40	1.26	12.03	5.26	13.12	6.76	4.86	15.97	15.98	10.87	8.66	9.29	5.48	6.00
3L1	6.59	1.21	10.69	5.63	13.85	6.59	5.19	14.39	12.09	10.82	8.60	11.81	5.16	6.00
3L2	5.90	1.02	11.19	4.89	14.05	5.88	4.66	17.03	9.44	11.60	7.87	11.02	4.02	6.00
3L3	6.00	1.90	10.77	4.46	13.54	5.38	4.13	15.86	8.40	11.21	7.23	12.05	5.35	6.00
3L4	5.28	0.73	9.13	3.52	12.41	5.24	3.46	15.67	10.09	10.18	7.99	10.19	5.17	6.00
3L5	6.23	2.78	9.48	5.59	10.76	5.43	3.60	8.99	10.03	10.13	7.88	11.24	6.30	6.00
3L6	6.17	1.93	10.51	5.51	11.06	5.87	3.77	10.43	10.72	11.35	8.13	11.27	5.30	6.00
3L7	6.11	1.49	9.61	5.21	12.07	5.69	4.25	13.95	11.05	8.56	8.11	11.60	4.32	6.00
3L8	6.48	1.55	9.87	4.80	11.32	6.01	4.30	12.63	11.11	9.75	7.38	9.40	5.03	6.00
3L9	6.11	0.80	10.36	4.32	10.89	5.69	3.18	12.30	9.78	9.83	7.97	10.18	5.97	6.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
4L1	6.17	0.96	10.45	4.34	10.79	5.69	3.40	11.54	8.60	12.18	6.90	11.35	4.20	5.00
4L2	6.52	1.35	9.61	4.48	11.53	5.60	3.12	13.76	6.27	10.17	7.93	12.21	4.88	5.00
4L3	6.25	1.24	9.85	4.18	10.66	6.27	3.89	12.70	9.28	9.75	6.66	10.15	5.53	5.00
4L4	6.50	1.90	10.07	4.36	10.33	5.38	4.22	9.99	9.72	10.06	7.83	11.19	4.22	5.00
4L5	4.78	2.54	7.62	5.49	11.43	5.68	4.32	11.13	13.45	9.32	7.74	7.84	4.73	5.00
4L6	4.68	2.44	9.37	4.18	13.02	4.98	5.76	11.45	8.15	10.17	2.95	10.48	6.49	5.00
4L7	4.70	2.48	9.49	4.51	11.30	5.60	4.12	12.47	7.70	10.16	6.89	9.70	3.83	5.00
4L8	4.12	1.11	8.48	3.85	9.81	5.13	3.38	8.56	8.73	9.88	5.57	10.97	4.40	5.00
4L9	3.57	0.65	9.10	3.72	10.56	5.30	3.40	8.89	9.89	9.57	5.58	10.80	4.70	5.00
5L1	5.14	1.77	9.15	3.69	9.29	5.26	6.74	7.53	7.28	10.87	4.54	11.32	4.48	5.00
5L2	1.89	2.10	9.29	4.10	11.85	4.83	3.93	6.30	9.14	11.26	6.02	5.05	3.32	5.00
5L3	4.83	0.79	8.05	4.10	8.36	5.50	2.77	9.10	8.78	8.73	5.74	9.34	4.78	5.00
5L4	4.93	2.00	8.05	3.99	10.14	4.03	4.48	10.69	9.23	8.85	3.14	11.08	5.58	5.00
5L5	5.07	1.66	8.03	3.61	8.98	3.86	4.92	10.13	9.73	8.19	3.34	9.35	5.17	5.00
5L6	5.10	1.02	7.41	2.67	8.12	3.08	4.49	8.04	7.91	9.22	1.92	8.86	4.55	5.00
5L7	4.36	1.59	7.48	3.19	10.27	3.81	4.53	10.43	9.66	7.01	2.29	9.15	4.86	5.00
5L8	5.66	1.74	9.02	3.75	10.74	3.91	4.34	11.88	7.18	9.23	3.86	8.64	5.44	5.00
5L9	5.51	2.04	8.86	3.76	11.27	3.69	4.68	10.55	9.87	9.64	6.02	8.46	3.88	5.00
5L10	5.79	1.81	8.67	3.65	9.75	3.81	4.42	8.93	8.01	8.96	2.22	9.07	5.31	5.00
5L11	5.92	0.12	8.66	4.20	9.51	6.09	3.97	9.58	9.20	9.66	6.30	9.80	4.11	5.00
6L1	4.67	1.81	8.58	3.83	9.09	4.40	6.06	8.58	8.53	7.51	3.15	9.65	3.49	3.00
6L2	16.40	26.16	8.07	3.08	9.87	3.94	5.92	8.93	7.32	8.91	2.90	10.63	3.10	3.00
6L3	4.30	1.22	7.98	3.11	8.81	3.69	5.58	7.22	5.87	10.43	2.70	10.45	3.00	3.00
6L4	5.11	0.38	8.46	2.92	9.80	4.40	2.88	13.77	8.18	4.71	4.88	9.17	2.37	3.00
6L5	4.06	0.23	8.34	3.21	10.05	4.39	2.81	12.11	8.40	4.56	4.07	10.34	4.47	3.00
6L6	4.41	0.68	7.47	2.35	10.31	3.57	3.12	12.24	9.57	3.04	5.83	10.90	3.97	3.00
6L7	4.42	0.92	8.15	2.66	8.79	3.75	5.43	8.75	6.93	10.16	3.59	8.46	3.21	3.00
6L8	4.32	1.78	7.51	3.40	9.84	3.56	3.70	11.01	8.42	7.20	2.77	9.61	4.25	3.00
6L9	3.06	0.61	7.30	2.28	9.61	3.47	3.76	12.09	7.38	10.02	2.34	6.93	3.34	3.00
6L10	5.16	2.66	8.89	4.20	11.57	4.50	3.81	11.54	7.25	8.99	3.75	8.12	3.66	3.00
6L11	4.47	1.07	8.51	3.62	10.08	4.14	2.97	8.03	8.37	9.26	5.04	7.28	4.01	3.00
7L1	4.29	2.28	7.06	4.11	9.82	4.33	4.46	10.19	6.07	8.24	2.49	7.90	3.93	3.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
7L2	3.08	0.39	6.64	1.59	6.65	2.85	3.15	6.50	4.04	12.24	2.92	8.60	3.10	3.00
7L3	4.76	0.97	8.21	2.02	7.31	3.42	2.95	7.12	9.22	7.64	3.71	8.86	2.76	3.00
7L4	4.95	1.75	7.52	2.56	8.24	3.73	3.41	8.96	6.21	8.44	3.01	8.77	3.17	3.00
7L5	2.82	0.44	5.70	2.29	7.15	3.16	3.30	5.65	4.96	6.99	1.71	9.20	3.19	3.00
7L6	3.78	2.21	6.88	2.75	7.69	2.82	2.71	5.80	8.05	6.24	3.24	7.94	2.24	3.00
7L7	2.19	0.29	5.46	3.09	7.75	3.67	2.88	6.07	6.14	6.90	3.82	8.61	1.93	3.00
8L1	3.51	0.81	7.72	2.59	8.16	3.42	3.15	6.88	7.39	5.96	3.30	7.47	2.55	1.00
8L2	3.90	0.46	7.24	2.53	6.27	3.24	4.08	4.45	6.85	6.60	1.67	8.17	3.52	1.00
8L3	3.18	0.83	5.27	2.04	6.21	3.23	3.19	6.66	7.65	6.31	3.10	6.15	3.03	1.00
8L4	2.56	0.87	6.39	2.13	6.40	2.76	3.49	5.89	8.16	5.65	2.01	8.81	2.47	1.00
8L5	3.61	1.68	6.47	3.19	7.40	2.57	4.46	7.80	6.64	7.52	2.09	6.19	2.69	1.00
9L1	3.03	0.37	6.70	2.28	6.55	3.21	3.27	6.72	7.25	8.12	3.25	7.27	3.35	1.00
9L2	3.32	1.45	7.13	2.34	6.60	3.56	4.26	6.36	8.21	7.13	3.25	7.65	1.95	1.00
9L3	3.73	0.46	6.22	2.49	6.25	2.48	3.40	6.34	8.00	6.46	1.85	6.87	3.00	1.00
9L4	4.05	1.90	6.83	2.34	5.01	2.76	2.77	5.70	7.51	6.25	1.95	7.15	2.45	1.00
9L5	3.13	1.17	5.64	2.57	6.01	3.00	3.43	6.22	6.04	5.46	2.15	7.17	2.69	1.00
9L6	1.52	1.42	4.54	2.28	6.23	2.81	3.44	4.30	7.13	6.16	1.99	7.27	2.36	1.00
9L7	1.31	1.01	5.12	1.98	6.92	2.98	3.48	6.79	6.48	6.11	1.63	7.55	2.06	1.00
9L8	3.30	0.44	5.84	1.97	5.82	2.58	3.37	5.82	5.96	6.96	1.63	6.69	2.74	1.00
10L1	2.36	0.12	5.88	1.80	5.07	2.64	3.44	5.32	6.52	6.27	2.38	7.92	3.55	1.00
10L2	3.93	0.87	6.69	1.88	6.08	2.57	2.88	5.05	6.54	5.98	2.61	7.45	2.07	1.00
10L3	3.38	0.30	6.73	1.64	5.11	2.22	2.91	5.10	7.42	5.08	2.15	6.86	2.69	1.00
10L4	2.65	0.54	5.74	1.77	5.48	2.89	2.97	5.61	5.83	4.86	2.38	5.99	2.16	1.00
11L1	2.11	0.65	4.24	1.65	4.18	2.01	2.56	5.56	3.38	6.97	1.86	3.90	2.42	1.00
11L2	2.64	0.88	4.83	1.74	3.72	1.67	2.90	5.14	8.80	6.97	1.86	5.11	4.07	1.00
11L3	1.68	0.73	3.24	2.24	4.96	1.99	3.97	6.55	8.54	3.95	356.62	2.12	360.06	1.00
11L4	1.54	0.28	2.29	2.74	4.47	358.35	0.00	4.93	5.80	3.76	0.00	3.33	0.00	1.00
11L5	2.31	0.74	3.95	359.11	5.12	359.11	0.00	7.34	5.30	3.87	0.00	2.21	0.00	1.00
11L6	2.06	0.66	3.77	355.74	3.38	355.74	0.00	5.92	5.97	3.07	0.00	3.46	0.00	1.00

0, 200-300 values=missing data

Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			left posterior edge <i>A-B</i>	left posterior edge <i>A-F</i>	right posterior edge <i>A-C</i>	right posterior edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
Medial														
N=11														
Minimum	3.48	3.48	12.62	6.36	12.93	6.52	9.90	6.55	17.15	8.53	5.00	5.72	5.01	10.00
Maximum	9.75	5.37	16.85	8.77	20.35	15.19	12.36	20.92	20.32	20.49	7.08	12.56	7.54	10.00
Arithmetic Mean	8.171	4.228	14.90	7.75	15.42	9.14	11.35	17.52	19.19	11.76	5.83	10.74	6.55	10.00
Standard Deviation	1.782	0.593	1.03	0.66	1.85	2.20	0.84	3.84	1.00	3.14	0.59	1.96	0.80	0.00
RPM														
N=2														
Minimum	7.31	3.25	11.12	6.28	12.41	6.68	8.54	13.90	16.19	6.06	4.81	6.23	4.61	8.00
Maximum	7.54	3.77	12.07	7.35	12.58	7.14	10.45	13.96	17.70	9.60	5.53	10.66	4.82	8.00
Arithmetic Mean	7.425	3.51	11.60	6.81	12.50	6.91	9.50	13.93	16.95	7.83	5.17	8.44	4.71	8.00
Standard Deviation	0.163	0.368	0.67	0.76	0.12	0.33	1.35	0.04	1.07	2.51	0.51	3.13	0.15	0.00
R2														
N=5														
Minimum	5.94	2.67	12.26	5.55	11.35	5.06	7.77	15.01	13.27	10.59	4.97	10.28	4.63	8.00
Maximum	7.76	3.53	13.92	7.94	11.95	5.96	9.08	15.90	14.31	12.95	5.98	11.19	5.38	8.00
Arithmetic Mean	7.016	3.066	13.06	6.69	11.67	5.53	8.58	15.42	13.79	11.74	5.28	10.88	5.12	8.00
Standard Deviation	0.765	0.307	0.73	0.98	0.24	0.43	0.57	0.34	0.37	1.00	0.43	0.40	0.31	0.00
R3														
N=8														
Minimum	5.21	1.46	11.04	5.59	9.55	4.93	6.89	10.39	9.58	5.78	3.50	7.73	4.05	8.00
Maximum	6.29	2.91	14.32	8.22	13.51	6.38	9.21	17.87	19.24	20.22	5.47	11.98	4.91	8.00
Arithmetic Mean	5.792	2.266	12.21	7.03	11.36	5.46	8.04	13.69	14.46	10.74	4.54	10.30	4.49	8.00
Standard Deviation	0.361	0.465	1.04	0.85	1.31	0.46	0.80	2.81	3.26	5.20	0.63	1.28	0.35	0.00
R4														
N=15														
Minimum	4.31	1.27	8.95	3.37	7.88	3.29	5.03	4.75	5.56	4.26	3.17	5.94	1.99	8.00
Maximum	5.93	2.75	11.29	5.58	10.32	4.31	7.17	14.06	13.62	15.76	6.76	15.34	5.80	8.00

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown	Posterior Tooth	Anterior Tooth	Labial Tooth	Labial Crown	Lingual Tooth	Lingual Crown	# of Ridges
			r tooth edge	r crown edge	r tooth edge	r crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Arithmetic Mean	5.087	1.963	10.14	4.61	9.28	3.88	6.08	11.33	10.33	9.11	4.15	9.85	3.64	8.00
Standard Deviation	0.579	0.395	0.57	0.55	0.64	0.34	0.70	2.15	1.96	3.01	0.87	2.42	1.04	0.00
R5														
N=9														
Minimum	3.25	1.09	8.01	3.97	6.63	2.43	5.41	8.78	4.89	5.94	2.45	6.11	2.59	8.00
Maximum	4.92	2.09	10.55	5.34	8.53	3.86	6.49	12.74	11.99	11.59	4.78	13.54	5.70	8.00
Arithmetic Mean	4.26	1.639	9.49	4.36	7.84	3.39	5.76	10.77	7.89	8.73	3.49	9.54	4.36	8.00
Standard Deviation	0.54	0.329	0.91	0.40	0.57	0.49	0.38	1.30	2.75	1.79	0.70	2.06	1.28	0.00
R6														
N=13														
Minimum	3.17	0.5	5.54	3.05	6.57	2.77	2.14	7.35	5.99	5.46	1.27	2.98	2.61	8.00
Maximum	4.7	1.97	10.02	9.21	8.03	4.58	6.67	11.65	10.90	9.61	8.51	11.31	6.16	8.00
Arithmetic Mean	4.016	1.258	7.98	3.94	7.37	3.34	4.81	8.98	8.06	8.10	3.74	7.45	4.33	8.00
Standard Deviation	0.505	0.487	1.08	1.62	0.34	0.47	1.08	1.07	1.73	1.48	2.16	2.25	1.07	0.00
R7														
N=13														
Minimum	2.58	1.08	5.33	2.30	5.23	2.43	1.73	6.55	6.09	6.40	2.84	2.40	1.51	5.00
Maximum	4.5	2.32	8.64	8.60	7.44	3.66	5.02	9.42	11.29	9.47	9.89	8.53	4.91	5.00
Arithmetic Mean	3.342	1.426	6.96	3.57	6.69	3.25	3.03	7.73	8.37	8.13	5.52	5.24	3.44	5.00
Standard Deviation	0.55	0.329	0.88	1.58	0.57	0.36	1.23	0.91	1.97	0.90	1.63	2.06	1.04	0.00
R8														
N=10														
Minimum	2.31	0.28	4.02	1.67	5.47	2.15	2.06	5.51	4.82	4.01	2.34	2.41	1.23	4.00
Maximum	3.8	1.75	6.91	3.66	6.82	3.87	5.51	8.55	10.62	7.57	5.77	7.05	5.01	4.00
Arithmetic Mean	3.061	1.1	5.83	2.62	5.89	3.02	3.96	7.10	7.66	6.52	4.29	4.99	3.05	4.00
Standard Deviation	0.472	0.521	0.84	0.54	0.40	0.67	1.08	1.01	1.98	1.06	1.05	1.71	1.53	0.00
R9														

Distances in mm	Tooth Height	Crown Height	Apex to left posterior	Apex to left posterior	Apex to right posterior	Apex to right posterior	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			r tooth edge <i>A-B</i>	r crown edge <i>A-F</i>	r tooth edge <i>A-C</i>	r crown edge <i>A-G</i>	<i>F-G</i>	<i>B-C</i>	<i>E-D</i>	<i>B-E</i>	<i>F-I</i>	<i>C-D</i>	<i>G-H</i>	
N=10														
Minimum	2.37	0.34	4.63	1.81	5.19	1.98	2.23	5.15	4.61	4.92	1.85	2.01	1.73	2.00
Maximum	3.73	1.64	6.07	3.02	6.98	3.41	5.11	7.41	11.57	8.89	3.20	6.95	3.72	2.00
Arithmetic Mean	2.876	1.145	5.18	2.41	5.95	2.58	3.71	6.12	6.88	6.51	2.62	4.77	3.06	2.00
Standard Deviation	0.412	0.392	0.53	0.38	0.58	0.46	0.92	0.76	2.12	1.39	0.40	1.75	0.73	0.00
R10														
N=8														
Minimum	2.14	0.22	4.24	0.93	5.45	2.18	3.41	5.63	4.75	3.57	1.37	1.57	3.07	1.00
Maximum	4.11	1.86	5.70	2.69	6.94	5.19	5.38	9.88	9.74	7.78	2.73	5.48	4.37	1.00
Arithmetic Mean	2.925	0.91	4.94	2.11	6.16	3.10	4.17	7.23	7.26	5.58	2.27	3.98	3.73	1.00
Standard Deviation	0.686	0.572	0.54	0.56	0.50	1.04	0.58	1.73	1.73	1.28	0.43	1.48	0.39	0.00
R11														
N=7														
Minimum	0.81	0.27	2.45	1.32	4.55	1.57	2.72	4.39	4.97	2.46	1.31	2.60	3.02	1.00
Maximum	2.31	1.37	5.30	2.27	6.41	4.20	4.55	6.88	7.03	6.18	2.88	6.63	4.75	1.00
Arithmetic Mean	1.726	0.713	3.87	1.76	5.27	2.65	3.61	5.66	5.99	4.66	2.47	4.24	3.60	1.00
Standard Deviation	0.554	0.33	0.90	0.32	0.75	0.95	0.52	0.99	0.82	1.11	0.50	1.54	0.59	0.00
LPM														
N=3														
Minimum	6.86	0.62	10.77	5.92	10.29	5.36	4.34	13.56	10.40	8.35	8.57	8.84	4.55	8.00
Maximum	7.75	2.58	11.91	6.68	12.74	6.63	5.18	14.17	18.38	9.22	10.20	10.91	5.30	8.00
Arithmetic Mean	7.287	1.66	11.29	6.41	11.65	5.83	4.79	13.83	14.61	8.78	9.62	9.76	4.99	8.00
Standard Deviation	0.446	0.985	0.58	0.43	1.24	0.70	0.43	0.31	4.01	0.43	0.91	1.05	0.39	0.00
L2														
N=10														
Minimum	4.76	1.26	10.97	5.26	12.18	6.52	3.88	13.17	11.70	8.25	8.66	8.27	4.22	6.00
Maximum	8.28	8.61	12.40	7.34	13.85	8.12	6.81	17.14	17.48	12.40	10.68	13.23	7.44	6.00
Arithmetic Mean	7.185	2.687	11.76	6.43	13.06	7.14	5.17	15.37	14.68	10.87	9.63	11.41	5.38	6.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Standard Deviation	0.993	2.141	0.45	0.62	0.55	0.49	0.89	1.26	1.80	1.21	0.60	1.55	1.03	0.00
L3														
N=9														
Minimum	5.28	0.73	9.13	3.52	10.76	5.24	3.18	8.99	8.40	8.56	7.23	9.40	4.02	6.00
Maximum	6.59	2.78	11.19	5.63	14.05	6.59	5.19	17.03	12.09	11.60	8.60	12.05	6.30	6.00
Arithmetic Mean	6.097	1.49	10.18	4.88	12.22	5.75	4.06	13.47	10.30	10.38	7.91	10.97	5.18	6.00
Standard Deviation	0.376	0.65	0.69	0.70	1.32	0.41	0.63	2.64	1.08	0.96	0.41	0.88	0.71	0.00
L4														
N=9														
Minimum	3.57	0.65	7.62	3.72	9.81	4.98	3.13	8.56	6.27	9.32	2.95	7.84	3.83	5.00
Maximum	6.52	2.54	10.45	5.49	13.02	6.27	5.76	13.76	13.45	12.18	7.93	12.21	6.49	5.00
Arithmetic Mean	5.254	1.63	9.34	4.35	11.05	5.51	3.96	11.17	9.09	10.14	6.45	10.52	4.78	5.00
Standard Deviation	1.116	0.724	0.86	0.51	0.92	0.38	0.80	1.75	1.98	0.82	1.58	1.24	0.81	0.00
L5														
N=11														
Minimum	1.89	0.12	7.41	2.67	8.12	3.08	2.77	6.30	7.18	7.01	1.92	5.05	3.32	5.00
Maximum	5.92	2.1	9.29	4.20	11.85	6.09	6.74	11.88	9.87	11.26	6.30	11.32	5.58	5.00
Arithmetic Mean	4.927	1.513	8.43	3.70	9.84	4.35	4.48	9.38	8.73	9.24	4.13	9.10	4.68	5.00
Standard Deviation	1.107	0.616	0.66	0.45	1.16	0.93	0.94	1.61	0.97	1.17	1.68	1.63	0.70	0.00
L6														
N=11														
Minimum	3.06	0.23	7.30	2.28	8.79	3.47	2.81	7.22	5.87	3.04	2.34	6.93	2.37	3.00
Maximum	16.4	26.16	8.89	4.20	11.57	4.50	6.06	13.77	9.57	10.43	5.83	10.90	4.47	3.00
Arithmetic Mean	5.489	3.411	8.12	3.15	9.80	3.98	4.19	10.39	7.84	7.71	3.73	9.23	3.54	3.00
Standard Deviation	3.661	7.579	0.51	0.60	0.78	0.40	1.30	2.15	1.00	2.56	1.12	1.37	0.62	0.00
L7														
N=7														

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Minimum	2.19	0.29	5.46	1.59	6.65	2.82	2.71	5.65	4.04	6.24	1.71	7.90	1.93	3.00
Maximum	4.95	2.28	8.21	4.12	9.82	4.33	4.46	10.19	9.22	12.24	3.82	9.20	3.93	3.00
Arithmetic Mean	3.696	1.19	6.78	2.63	7.80	3.43	3.27	7.18	6.38	8.10	2.99	8.55	2.90	3.00
Standard Deviation	1.039	0.876	0.97	0.82	1.03	0.54	0.58	1.74	1.76	1.99	0.73	0.48	0.67	0.00
L8														
N=5														
Minimum	2.56	0.46	5.27	2.04	6.21	2.57	3.15	4.45	6.64	5.66	1.67	6.15	2.47	1.00
Maximum	3.9	1.68	7.72	3.19	8.16	3.42	4.46	7.80	8.16	7.52	3.30	8.82	3.52	1.00
Arithmetic Mean	3.352	0.93	6.62	2.50	6.89	3.04	3.67	6.34	7.34	6.41	2.44	7.36	2.85	1.00
Standard Deviation	0.512	0.45	0.94	0.46	0.86	0.36	0.58	1.25	0.61	0.72	0.72	1.19	0.43	0.00
L9														
N=8														
Minimum	1.31	0.37	4.54	1.97	5.01	2.48	2.77	4.30	5.97	5.46	1.63	6.69	1.95	1.00
Maximum	4.05	1.9	7.13	2.57	6.92	3.56	4.26	6.79	8.21	8.12	3.25	7.65	3.35	1.00
Arithmetic Mean	2.924	1.027	6.00	2.28	6.17	2.92	3.43	6.03	7.07	6.58	2.21	7.20	2.57	1.00
Standard Deviation	0.989	0.562	0.89	0.21	0.58	0.35	0.41	0.80	0.85	0.81	0.66	0.32	0.47	0.00
L10														
N=4														
Minimum	2.36	0.12	5.74	1.64	5.07	2.22	2.88	5.05	5.83	4.86	2.15	5.99	2.07	1.00
Maximum	3.93	0.87	6.73	1.88	6.08	2.89	3.44	5.61	7.42	6.27	2.61	7.92	3.55	1.00
Arithmetic Mean	3.08	0.458	6.26	1.77	5.44	2.58	3.05	5.27	6.58	5.55	2.38	7.05	2.62	1.00
Standard Deviation	0.711	0.324	0.52	0.10	0.47	0.28	0.26	0.26	0.65	0.68	0.19	0.83	0.68	0.00
L11														
N=6														
Minimum	1.54	0.28	2.29	1.65	3.38	1.67	0.00	4.93	3.38	3.07	0.00	2.12	0.00	1.00
Maximum	2.64	0.88	4.83	359.11	5.12	359.11	3.97	7.34	8.80	6.97	356.62	5.11	360.06	1.00
Arithmetic Mean	2.057	0.657	3.72	179.81	4.30	179.81	1.57	5.91	6.30	4.77	60.06	3.36	61.09	1.00
Standard Deviation	0.404	0.202	0.88	194.91	0.68	194.91	1.78	0.91	2.06	1.74	145.29	1.12	146.47	0.00



Distances in mm	Tooth Height	Crown Height	Apex to left posterior r tooth edge A-B	Apex to left posterior r crown edge A-F	Apex to right posterior r tooth edge A-C	Apex to right posterior r crown edge A-G	Posterior r Crown Width F-G	Posterior r Tooth Width B-C	Anterior Tooth Width E-D	Labial Tooth Length B-E	Labial Crown Length F-I	Lingual Tooth Length C-D	Lingual Crown Length G-H	# of Ridges
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\*\*\*ridges >10 and bifurcating  
0, 200-300 values=missing data

Tooth File														
FHSM VP 16684 <i>P. mortoni</i> Upper dentition														
M1	3.38	1.27	7.30	2.17	6.30	2.06	2.81	6.97	8.75	11.01	2.52	7.29	2.55	0.00
Right tooth series incomplete														7.00
5R1	7.72	6.46	11.78	9.06	10.99	9.49	10.26	13.43	15.35	10.81	5.60	6.81	7.20	7.00
6R1	5.29	4.22	9.01	5.76	9.69	6.97	7.55	11.51	10.51	8.90	3.81	8.83	5.97	7.00
8R1	3.63	2.73	6.23	4.14	6.50	4.36	6.02	9.39	9.52	6.18	3.13	5.15	4.45	4.00
8R2	3.82	2.54	5.90	4.76	6.26	3.61	4.44	9.06	9.68	5.84	7.30	3.99	4.34	4.00
8R3	3.56	2.60	5.82	3.86	7.04	2.82	3.16	8.87	8.34	6.63	7.69	6.87	4.07	4.00
8R4	3.11	1.88	5.63	3.21	6.78	4.15	4.67	7.80	8.16	6.55	2.53	6.25	3.99	4.00
9R1	3.19	2.08	4.69	2.51	5.46	2.92	3.68	6.77	8.38	5.16	1.31	4.54	2.46	4.00
9R2	2.74	1.61	5.08	2.73	5.51	2.65	3.48	6.31	7.97	5.92	1.59	4.99	1.79	4.00
LPM1	2.72	1.44	18.73	11.08	21.31	12.01	12.88	19.34	18.80	18.80	9.03	16.41	11.69	15.00
LPM2	13.26	6.54	18.28	13.99	21.45	15.21	16.29	21.17	18.11	18.77	10.29	18.43	12.51	15.00
LPM3	13.01	9.20	17.92	13.80	21.12	10.78	15.18	22.07	16.83	17.82	10.59	19.56	10.86	15.00
2L1	12.29	8.62	15.60	10.62	16.90	9.80	11.58	15.98	20.00	14.35	9.04	11.10	9.45	14.00
2L2	12.10	6.69	16.78	9.06	16.77	10.60	12.30	17.91	18.19	13.79	7.35	11.28	8.59	14.00
2L3	12.16	6.27	17.37	9.52	16.86	8.37	10.36	18.40	17.77	12.82	5.35	12.20	8.40	14.00
3L1	12.19	6.15	13.77	10.57	13.80	10.32	11.02	14.93	17.54	11.41	8.68	10.79	8.55	10.00
3L2	9.59	6.68	13.07	8.87	12.97	9.51	11.41	15.68	16.90	11.35	7.24	10.71	6.69	10.00
3L3	8.18	5.53	13.21	10.05	14.32	9.48	10.44	16.20	18.60	8.11	7.58	6.79	7.47	10.00
3L4	9.05	6.39	12.65	9.14	14.36	10.29	10.44	14.39	17.00	11.07	8.32	8.64	8.38	10.00
3L5	8.48	6.14	13.49	10.32	15.68	10.99	10.72	16.48	15.89	10.78	16.08	9.74	6.94	10.00
3L6	9.92	7.17	14.95	12.32	15.70	11.78	11.85	16.58	14.31	11.84	7.89	12.03	7.78	10.00
3L7	9.83	7.21	13.70	10.32	14.44	10.81	11.22	16.05	14.88	10.55	6.64	10.85	6.89	10.00
3L8	10.19	7.46	12.71	10.16	14.63	9.71	10.13	16.26	15.07	10.52	8.67	9.50	8.00	10.00
4L1	8.93	6.21	12.49	8.04	11.60	8.30	8.84	13.87	16.65	11.69	6.92	6.66	6.17	8.00
4L2	7.84	4.67	12.89	8.88	13.64	9.20	10.10	15.02	14.59	13.66	7.90	9.60	6.50	8.00
4L3	8.23	5.17	11.88	7.15	14.50	9.13	9.34	16.69	12.57	11.80	6.82	10.10	6.26	8.00
4L4	6.31	4.41	11.41	8.27	12.92	8.26	9.23	16.19	11.85	12.83	7.20	8.53	6.37	8.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
		A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H		
4L5	6.88	4.25	11.53	8.04	12.97	8.87	10.06	16.23	12.17	12.46	7.51	7.90	6.12	8.00
4L6	8.03	5.20	11.73	8.35	11.29	8.79	9.51	14.74	10.45	18.14	7.95	7.64	6.31	8.00
4L7	7.51	7.00	10.21	6.74	10.56	7.74	8.07	12.85	13.89	12.01	6.98	9.22	5.77	8.00
4L8	5.91	4.22	9.19	6.71	9.19	7.06	7.88	12.32	14.81	8.69	5.48	7.75	5.22	8.00
5L1	5.45	3.90	10.85	6.75	11.98	7.21	7.70	14.96	9.94	11.39	5.37	9.37	5.33	6.00
5L2	5.84	3.90	10.79	8.27	12.29	8.36	8.89	14.02	13.35	9.18	5.70	7.76	5.95	6.00
5L3	7.17	5.55	11.00	6.56	12.07	7.37	7.56	14.86	12.20	9.07	4.58	9.41	4.90	6.00
5L4	6.17	3.95	9.99	6.52	10.62	6.81	8.17	12.58	14.93	8.29	4.94	6.73	5.79	6.00
5L5	5.69	3.85	10.83	7.83	12.15	7.46	9.21	14.94	13.87	8.57	5.26	10.08	5.93	6.00
5L6	5.34	4.91	11.61	8.17	12.53	9.00	9.61	13.70	14.70	8.15	4.47	8.64	5.71	6.00
5L7	7.00	5.09	9.24	7.16	11.75	8.04	9.31	12.19	13.13	10.13	5.80	9.41	5.40	6.00
6L1	5.11	4.04	9.65	5.73	9.48	5.44	5.82	11.36	14.81	6.66	3.71	7.16	4.87	5.00
6L2	5.79	3.30	8.84	5.57	9.40	6.27	7.46	12.29	12.60	5.69	3.06	6.78	3.95	5.00
6L3	4.83	3.03	9.23	4.87	10.14	5.74	6.29	13.22	13.01	5.22	3.50	6.08	4.42	5.00
6L4	5.82	2.65	9.23	5.29	8.50	5.38	7.35	11.32	14.31	6.36	3.38	5.47	3.95	5.00
6L5	5.04	3.03	10.08	5.97	8.87	5.70	6.23	11.45	11.19	8.72	4.14	4.45	3.89	5.00
6L6	6.44	2.54	9.58	4.55	8.20	4.73	5.58	11.71	12.11	9.03	4.18	5.98	4.49	5.00
6L7	5.22	2.30	7.80	5.28	8.96	6.20	7.20	11.14	13.59	5.12	3.00	6.69	4.37	5.00
6L8	5.71	3.18	9.47	5.98	9.27	6.31	7.76	12.65	12.36	6.26	3.78	6.95	4.42	5.00
7L1	5.47	3.50	8.01	3.58	6.92	3.81	3.97	8.49	9.16	8.30	3.54	5.22	2.76	5.00
7L2	3.83	1.54	6.82	4.08	6.39	3.73	5.10	8.20	10.32	3.91	3.29	4.87	3.15	5.00
7L3	3.22	1.86	6.13	4.02	7.15	3.35	4.99	10.34	8.82	5.01	2.97	4.49	2.25	5.00
7L4	2.80	2.37	6.35	3.73	4.68	3.91	4.35	8.03	9.85	4.21	2.70	5.17	1.93	5.00
8L1	3.52	2.67	6.37	3.48	5.46	3.22	4.14	8.61	10.51	4.32	2.72	5.01	2.58	4.00
8L2	3.80	2.13	5.57	2.88	5.38	2.95	3.45	6.99	7.67	6.48	2.49	5.67	2.27	4.00
9L1	1.44	1.27	5.10	2.58	3.89	1.72	2.41	6.26	8.81	2.25	1.83	4.28	1.46	3.00
9L2	2.87	1.29	5.15	3.01	3.72	2.15	3.49	6.08	8.83	3.01	1.33	4.10	2.10	3.00
9L3	2.92	1.18	4.80	2.35	4.37	2.06	2.87	6.03	7.90	2.96	1.29	4.44	1.87	3.00
9L4	2.31	1.44	5.47	3.36	4.04	1.75	3.41	6.46	9.02	2.56	1.32	5.22	2.18	3.00
9L5	2.82	1.51	4.48	2.94	3.65	2.37	2.86	5.25	8.44	2.20	1.57	4.04	1.79	3.00
9L6	2.63	1.71	5.80	3.09	3.68	2.23	3.70	7.16	8.40	3.77	1.81	3.50	2.04	3.00

Distances in mm	Tooth Height	Crown Height	Apex to	Apex to	Apex to	Apex to	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			left posterior	left posterior	right posterior	right posterior								
			r tooth edge	r crown edge	r tooth edge	r crown edge								
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	

SUMMARY FHSM 16684 *P. mortoni* Upper dentition

Medial

N=1

Minimum	3.38	1.27	7.30	2.17	6.30	2.06	2.81	6.97	8.75	11.01	2.52	7.29	2.55	0.00
Maximum	3.38	1.27	7.30	2.17	6.30	2.06	2.81	6.97	8.75	11.01	2.52	7.29	2.55	
Arithmetic Mean	3.38	1.27	7.30	2.17	6.30	2.06	2.81	6.97	8.75	11.01	2.52	7.29	2.55	
Standard Deviation														

**Right tooth file series incomplete**

R5th?

N=1

Minimum	7.72	6.46	11.78	9.06	10.99	9.49	10.26	13.43	15.35	10.81	5.60	6.81	7.20	7.00
Maximum	7.72	6.46	11.78	9.06	10.99	9.49	10.26	13.43	15.35	10.81	5.60	6.81	7.20	7.00
Arithmetic Mean	7.72	6.46	11.78	9.06	10.99	9.49	10.26	13.43	15.35	10.81	5.60	6.81	7.20	7.00
Standard Deviation														0.00

R6th?

N=1

Minimum	5.29	4.22	9.01	5.77	9.69	6.97	7.55	11.51	10.51	8.90	3.81	8.83	5.97	4.00
Maximum	5.29	4.22	9.01	5.77	9.69	6.97	7.55	11.51	10.51	8.90	3.81	8.83	5.97	4.00
Arithmetic Mean	5.29	4.22	9.01	5.77	9.69	6.97	7.55	11.51	10.51	8.90	3.81	8.83	5.97	4.00
Standard Deviation														0.00

R8

N=4

Minimum	3.11	1.88	5.63	3.21	6.26	2.82	3.16	7.80	8.16	5.85	2.53	3.99	3.99	4.00
Maximum	3.82	2.73	6.23	4.76	7.04	4.36	6.02	9.39	9.68	6.63	7.69	6.87	4.45	4.00
Arithmetic Mean	3.53	2.438	5.90	3.99	6.65	3.74	4.57	8.78	8.93	6.30	5.17	5.57	4.21	4.00
Standard Deviation	0.301	0.38	0.25	0.64	0.34	0.69	1.17	0.69	0.79	0.36	2.71	1.27	0.22	0.00

R9

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
N=2														
Minimum	2.74	1.61	4.69	2.51	5.46	2.65	3.48	6.31	7.97	5.16	1.31	4.54	1.79	4.00
Maximum	3.19	2.08	5.08	2.73	5.51	2.93	3.68	6.77	8.38	5.92	1.59	4.99	2.46	4.00
Arithmetic Mean	2.965	1.845	4.88	2.62	5.48	2.79	3.58	6.54	8.17	5.54	1.45	4.76	2.13	4.00
Standard Deviation	0.318	0.332	0.28	0.15	0.04	0.19	0.14	0.32	0.30	0.54	0.20	0.32	0.47	0.00
LPM														
N=3														
Minimum	2.72	1.44	17.92	11.08	21.12	10.78	12.88	19.34	16.83	17.82	9.03	16.41	10.86	15.00
Maximum	13.26	9.2	18.73	13.99	21.45	15.21	16.29	22.07	18.80	18.80	10.59	19.56	12.51	15.00
Arithmetic Mean	9.663	5.727	18.31	12.96	21.29	12.67	14.78	20.86	17.91	18.46	9.97	18.13	11.69	15.00
Standard Deviation	6.014	3.943	0.41	1.63	0.17	2.29	1.74	1.39	1.00	0.56	0.83	1.60	0.82	0.00
L2														
N=3														
Minimum	12.1	6.27	15.60	9.06	16.77	8.37	10.36	15.98	17.77	12.82	5.35	11.10	8.40	14.00
Maximum	12.29	8.62	17.37	10.62	16.90	10.60	12.30	18.40	20.00	14.35	9.04	12.20	9.45	14.00
Arithmetic Mean	12.183	7.193	16.58	9.73	16.84	9.59	11.41	17.43	18.65	13.65	7.25	11.52	8.81	14.00
Standard Deviation	0.097	1.253	0.90	0.80	0.07	1.13	0.98	1.28	1.18	0.78	1.85	0.59	0.56	0.00
L3														
N=8														
Minimum	8.18	5.53	12.65	8.87	12.97	9.48	10.13	14.39	14.31	8.11	6.64	6.79	6.69	10.00
Maximum	12.19	7.46	14.95	12.32	15.70	11.78	11.85	16.58	18.60	11.84	16.08	12.03	8.55	10.00
Arithmetic Mean	9.679	6.591	13.44	10.22	14.49	10.36	10.90	15.82	16.27	10.70	8.89	9.88	7.59	10.00
Standard Deviation	1.238	0.66	0.74	1.04	0.91	0.81	0.58	0.78	1.48	1.14	2.99	1.62	0.70	0.00
L4														
N=8														
Minimum	5.91	4.22	9.19	6.71	9.19	7.06	7.88	12.32	10.45	8.69	5.48	6.66	5.22	8.00
Maximum	8.93	7	12.89	8.88	14.50	9.20	10.10	16.69	16.65	18.14	7.95	10.10	6.50	8.00
Arithmetic Mean	7.455	5.141	11.41	7.77	12.08	8.42	9.13	14.74	13.37	12.66	7.10	8.43	6.09	8.00

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge	posterior crown edge	posterior tooth edge	posterior crown edge	r Crown Width	r Tooth Width	Tooth Width	Tooth Length	Crown Length	Tooth Length	Crown Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Standard Deviation	1.02	1	1.20	0.80	1.74	0.74	0.83	1.62	1.98	2.64	0.78	1.15	0.41	0.00
L5														
N=7														
Minimum	5.34	3.85	9.24	6.52	10.62	6.81	7.56	12.19	9.94	8.15	4.47	6.73	4.90	6.00
Maximum	7.17	5.55	11.61	8.27	12.53	9.01	9.61	14.96	14.93	11.39	5.80	10.08	5.95	6.00
Arithmetic Mean	6.094	4.45	10.61	7.32	11.91	7.75	8.64	13.89	13.16	9.26	5.16	8.77	5.57	6.00
Standard Deviation	0.73	0.713	0.77	0.76	0.62	0.76	0.82	1.14	1.70	1.16	0.52	1.16	0.38	0.00
L6														
N=8														
Minimum	4.83	2.3	7.80	4.55	8.20	4.73	5.58	11.14	11.19	5.12	3.00	4.45	3.89	5.00
Maximum	6.44	4.04	10.08	5.98	10.14	6.31	7.76	13.22	14.81	9.03	4.18	7.16	4.87	5.00
Arithmetic Mean	5.495	3.009	9.23	5.41	9.10	5.72	6.71	11.89	13.00	6.63	3.59	6.19	4.30	5.00
Standard Deviation	0.535	0.538	0.68	0.51	0.61	0.54	0.83	0.75	1.19	1.49	0.44	0.90	0.34	0.00
L7														
N=4														
Minimum	2.8	1.54	6.13	3.58	4.68	3.35	3.97	8.03	8.82	3.91	2.70	4.49	1.93	5.00
Maximum	5.47	3.5	8.01	4.08	7.16	3.91	5.10	10.34	10.32	8.30	3.54	5.22	3.15	5.00
Arithmetic Mean	3.83	2.317	6.83	3.85	6.29	3.70	4.60	8.77	9.54	5.36	3.12	4.94	2.53	5.00
Standard Deviation	1.172	0.859	0.84	0.24	1.12	0.24	0.54	1.07	0.68	2.02	0.37	0.34	0.54	0.00
L8														
N=2														
Minimum	3.52	2.13	5.57	2.88	5.38	2.95	3.45	6.99	7.67	4.32	2.49	5.01	2.27	4.00
Maximum	3.8	2.67	6.37	3.49	5.46	3.22	4.14	8.61	10.51	6.48	2.72	5.67	2.58	4.00
Arithmetic Mean	3.66	2.4	5.97	3.18	5.42	3.08	3.80	7.80	9.09	5.40	2.61	5.34	2.43	4.00
Standard Deviation	0.198	0.382	0.56	0.43	0.06	0.19	0.49	1.15	2.00	1.53	0.16	0.47	0.22	0.00
L9														
N=6														

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Minimum	1.44	1.18	4.48	2.35	3.65	1.72	2.41	5.25	7.90	2.20	1.29	3.50	1.46	3.00
Maximum	2.92	1.71	5.80	3.36	4.37	2.37	3.70	7.16	9.02	3.77	1.83	5.22	2.18	3.00
Arithmetic Mean	2.498	1.4	5.13	2.89	3.89	2.05	3.12	6.21	8.57	2.79	1.53	4.26	1.91	3.00
Standard Deviation	0.564	0.193	0.47	0.36	0.27	0.26	0.49	0.62	0.41	0.59	0.25	0.57	0.26	0.00

**Tooth File KUVF 55269 *P. mortoni* Lower dentition**

Tooth Files labeled as positioned in mount

M1	13.40	8.21	22.37	14.40	22.62	14.26	17.68	27.57	27.94	18.43	13.20	19.30	11.65	***
M2	13.29	7.71	23.64	13.71	21.77	11.55	16.43	29.01	29.11	16.42	11.71	17.83	9.57	***
M3	12.99	6.68	23.08	13.13	20.97	12.51	17.85	29.20	29.43	16.88	10.57	16.67	11.61	***
M4	15.09	9.08	23.76	15.64	22.95	16.68	21.63	29.58	30.01	17.99	12.47	18.68	12.98	***
M5	15.50	9.09	25.52	16.93	22.78	15.94	19.85	28.68	32.35	19.16	12.32	17.59	13.09	***
M6	14.17	8.84	25.13	16.63	22.07	15.55	19.82	28.31	29.06	17.38	12.73	19.91	12.44	***
M7	16.04	9.62	24.21	17.10	23.53	16.31	20.17	27.38	29.16	17.65	13.09	17.95	12.84	***
RPM1	9.43	6.56	13.47	10.87	19.76	12.11	17.01	22.95	23.45	13.45	9.69	16.21	9.49	***
RPM2	9.29	6.24	15.88	10.96	20.78	12.28	15.67	25.72	24.70	16.37	9.34	15.05	9.48	***
RPM3	11.31	7.58	15.83	10.78	21.34	13.06	16.63	24.86	26.13	16.22	11.02	17.26	10.31	***
RPM4	10.61	8.04	19.59	13.25	22.57	16.41	19.13	25.13	26.29	18.64	10.95	19.48	12.39	***
RPM5	9.66	6.35	16.62	10.91	19.41	11.86	15.63	23.31	25.94	16.76	10.17	17.19	10.69	***
2R1	6.53	4.27	14.25	7.94	13.54	9.81	13.49	21.17	21.80	11.58	7.35	13.07	8.34	***
2R2	7.91	4.39	17.68	8.28	16.94	10.84	13.97	26.27	20.72	11.97	8.63	15.02	9.14	***
2R3	7.96	5.41	15.29	10.01	16.01	10.52	13.49	20.74	20.24	11.78	9.74	10.94	8.08	***
2R4	7.09	3.33	11.68	5.83	13.39	8.24	11.84	16.93	22.24	14.13	9.03	12.29	7.43	***
2R5	6.30	3.28	14.52	7.22	18.22	11.96	10.68	18.67	15.99	18.17	13.31	18.45	10.02	***
2R6	7.74	4.31	15.14	8.65	19.42	13.22	13.00	18.03	18.14	17.08	10.00	17.14	10.64	***
2R7	7.40	4.77	11.82	8.43	16.92	12.03	13.51	17.61	16.47	17.85	11.54	17.22	10.41	***
2R8	6.84	4.93	13.30	7.90	15.68	9.94	11.80	15.54	19.37	14.65	11.45	16.98	9.79	***
2R9	7.00	4.22	13.26	7.88	14.64	9.29	11.89	18.89	18.44	16.37	9.16	15.49	7.25	***
2R10	8.63	5.60	16.97	9.12	16.29	11.73	13.68	21.34	17.68	16.82	8.98	14.30	10.18	***
2R11	10.46	6.71	16.88	9.28	18.27	12.88	15.68	23.55	17.99	16.42	7.76	13.50	9.12	***
3R1	5.87	3.48	10.80	8.01	8.42	5.71	8.93	12.80	12.88	9.21	7.39	12.32	6.82	***
3R2	6.87	4.21	12.49	7.71	13.64	8.24	11.01	17.74	14.42	13.62	12.70	11.70	7.70	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
			A-B	A-F	A-C	A-G								
3R3	7.12	3.64	12.50	7.14	15.31	8.10	10.87	19.26	16.40	13.71	11.54	12.55	6.80	***
3R4	6.43	2.75	11.93	7.62	12.45	7.35	11.00	19.65	15.23	12.39	5.44	15.54	5.89	***
3R5	5.56	2.34	13.29	8.07	14.77	9.14	10.58	13.89	16.93	15.57	12.47	13.66	8.01	***
3R6	9.98	5.97	14.11	7.56	15.46	9.35	11.36	19.44	20.01	15.80	7.31	11.81	7.78	***
3R7	5.61	3.71	10.38	7.05	13.23	8.88	10.90	17.08	16.74	13.10	7.95	13.04	8.84	***
3R8	8.41	4.70	13.34	8.55	14.57	9.33	12.67	19.76	19.32	12.85	7.91	13.72	8.28	***
3R9	8.17	4.95	13.31	8.60	15.03	9.55	12.04	19.04	18.68	13.21	7.97	12.76	7.33	***
3R10	7.31	5.81	10.38	9.03	14.85	9.29	11.75	15.85	16.73	13.27	7.38	11.19	7.42	***
3R11	8.30	3.85	15.84	8.03	13.70	7.11	10.89	22.40	21.49	12.13	6.60	10.97	5.45	***
3R12	9.01	5.09	13.46	7.19	16.34	10.38	11.84	20.37	19.89	12.46	7.55	14.48	8.76	***
3R13	7.68	4.52	15.52	8.57	14.93	9.27	12.88	21.24	20.38	15.07	8.93	14.70	7.71	***
4R1	2.62	2.02	8.32	5.47	7.43	5.83	8.82	11.74	15.16	9.92	5.76	9.96	5.37	***
4R2	3.84	2.03	8.47	4.03	9.45	4.74	6.77	14.41	12.78	9.00	3.86	9.63	4.90	***
4R3	3.99	2.00	9.16	3.93	10.60	5.62	6.54	14.33	15.17	9.07	4.36	8.24	4.61	***
4R4	3.71	1.97	10.17	3.92	10.05	5.44	6.88	13.97	13.73	10.24	4.42	10.35	5.17	***
4R5	4.19	2.12	10.04	4.11	11.33	5.79	7.90	15.41	15.55	9.18	4.22	9.35	5.86	***
4R6	6.04	3.60	11.98	6.06	12.00	6.08	8.04	16.59	13.95	11.23	5.11	9.77	5.04	***
4R7	5.82	3.10	13.61	5.39	10.90	6.67	8.90	17.96	15.88	7.53	4.24	11.14	5.48	***
4R8	6.67	1.10	12.97	5.88	12.48	7.40	7.27	17.46	16.47	9.59	5.32	11.29	7.95	***
4R9	6.57	2.57	12.07	5.01	11.92	7.39	8.49	16.31	17.35	11.32	4.67	10.50	5.97	***
4R10	5.78	3.10	11.60	6.11	13.45	8.60	10.26	19.35	15.48	9.21	6.11	13.39	7.37	***
4R11	4.69	2.56	9.06	6.01	11.82	7.16	9.40	13.25	15.21	12.79	5.77	10.82	7.91	***
LPM1	16.03	12.45	26.22	18.56	22.02	16.00	19.50	27.78	27.14	17.72	11.07	17.81	11.20	***
LPM2	8.41	5.90	21.12	12.56	16.68	10.45	17.15	27.97	26.90	14.04	8.57	17.82	9.16	***
LPM3	10.71	7.28	20.60	13.37	16.75	11.53	16.74	25.07	26.46	14.80	11.48	14.44	10.41	***
LPM4	11.27	7.66	22.45	14.85	19.04	12.40	19.25	28.18	24.14	17.46	11.18	18.46	11.28	***
LPM5	10.42	6.48	20.19	13.87	18.78	12.34	18.35	26.29	26.38	15.67	10.41	17.43	10.84	***
2L1	6.58	1.91	13.52	10.43	13.16	6.98	12.53	17.91	23.95	10.01	9.14	15.83	9.19	***
2L2	8.51	7.11	14.19	12.22	16.58	9.47	13.72	19.41	22.19	13.51	9.30	12.06	7.50	***
2L3	6.93	4.17	15.47	10.37	14.95	7.74	12.60	21.78	19.63	14.17	8.69	12.56	6.80	***
2L4	6.90	4.99	13.89	11.74	15.38	7.64	14.22	19.49	17.20	14.03	11.32	14.93	9.74	***
2L5	6.73	3.97	14.82	11.35	13.03	6.18	12.28	19.25	20.22	13.43	10.04	12.20	8.46	***

Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior	posterior	posterior	posterior	r Crown	r Tooth	Tooth	Tooth	Crown	Tooth	Crown	
			r tooth edge	r crown edge	r tooth edge	r crown edge	Width	Width	Width	Length	Length	Length	Length	
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
2L6	9.11	5.71	14.18	10.16	13.79	7.93	11.98	17.48	17.42	14.56	9.51	14.89	7.82	***
2L7	7.50	4.30	15.47	9.38	17.46	8.57	12.99	23.84	22.05	12.98	8.12	13.12	6.58	***
2L8	6.81	3.50	12.53	7.41	12.73	6.08	10.46	17.47	18.17	15.47	8.60	13.56	7.56	***
3L1	7.62	4.84	13.93	9.17	12.63	8.32	13.63	19.40	17.92	12.23	6.22	13.56	7.24	***
3L2	8.89	5.33	14.35	9.16	13.36	7.23	11.59	18.23	19.59	13.04	8.05	10.22	7.01	***
3L3	8.58	4.26	14.21	9.84	14.16	7.94	12.23	19.31	21.11	11.98	8.39	9.37	7.40	***
3L4	5.38	3.38	13.96	8.29	10.38	5.48	9.90	17.20	15.11	11.55	6.62	13.59	6.53	***
3L5	9.65	6.09	14.51	9.67	15.30	7.85	11.11	19.02	16.63	13.36	7.12	12.44	7.61	***
4L1	5.08	2.50	12.79	7.34	8.51	5.29	9.09	15.65	16.41	11.62	7.01	8.91	5.19	***
4L2	5.77	3.20	12.76	8.04	12.43	6.65	10.41	19.51	16.08	11.09	6.39	10.04	5.77	***
4L3	9.28	4.00	11.75	5.44	14.96	8.73	8.92	17.82	17.30	11.83	7.44	9.53	5.15	***
4L4	4.97	2.90	11.97	6.88	10.77	7.08	10.01	17.01	16.74	10.88	5.38	10.31	6.54	***
4L5	3.70	3.51	10.74	7.58	13.48	6.49	8.64	16.69	14.79	13.00	8.78	10.78	6.24	***
4L6	4.55	3.00	11.57	8.09	13.11	6.66	10.58	16.52	15.62	11.47	7.81	10.31	5.73	***
4L7	4.92	2.12	12.08	8.12	12.09	6.79	10.11	17.49	16.45	11.23	5.68	10.23	6.42	***
4L8	3.33	2.19	12.22	7.54	12.37	5.96	9.70	19.01	16.16	11.63	6.37	9.88	6.36	***
4L9	4.49	1.37	11.86	8.75	11.27	6.43	10.60	16.27	15.97	13.59	8.24	10.13	6.30	***
4L10	1.71	1.94	8.61	8.46	11.87	5.80	10.12	16.27	19.13	12.63	6.40	7.75	7.17	***
4L11	5.56	3.15	14.30	8.89	12.48	6.27	9.56	19.21	19.80	12.21	7.55	9.81	6.86	***
4L12	4.73	2.54	12.35	6.90	13.89	5.89	8.62	19.35	20.10	12.12	4.81	9.17	6.20	***
4L13	2.00	1.39	10.33	5.52	10.16	3.05	6.36	15.06	17.12	11.23	4.31	9.98	3.76	***

ridges >10 and bifurcating

SUMMARY KUVV 55269 *P. mortoni* Lower dentition

Labeled as positioned in mount

Medial

N=7

Minimum	12.99	6.68	22.37	13.13	20.97	11.55	16.43	27.38	27.94	16.42	10.57	16.67	9.57	>10
Maximum	16.04	9.62	25.52	17.10	23.53	16.68	21.63	29.58	32.35	19.16	13.20	19.91	13.09	
Arithmetic Mean	14.354	8.461	23.96	15.36	22.39	14.69	19.06	28.53	29.58	17.70	12.30	18.27	12.03	
Standard Deviation	1.2	1.005	1.10	1.62	0.85	1.99	1.80	0.83	1.37	0.93	0.91	1.10	1.24	



Distances in mm	Tooth Height	Crown Height	Apex to left	Apex to left	Apex to right	Apex to right	Posterior	Posterior	Anterior	Labial	Labial	Lingual	Lingual	# of Ridges
			posterior tooth edge <i>A-B</i>	posterior crown edge <i>A-F</i>	posterior tooth edge <i>A-C</i>	posterior crown edge <i>A-G</i>	r Crown Width <i>F-G</i>	r Tooth Width <i>B-C</i>	Tooth Width <i>E-D</i>	Tooth Length <i>B-E</i>	Crown Length <i>F-I</i>	Tooth Length <i>C-D</i>	Crown Length <i>G-H</i>	
RPM														
N=5														
Minimum	9.29	6.24	13.47	10.78	19.41	11.86	15.63	22.95	23.45	13.45	9.34	15.05	9.48	>10
Maximum	11.31	8.04	19.59	13.25	22.57	16.41	19.13	25.72	26.29	18.64	11.02	19.48	12.39	
Arithmetic Mean	10.06	6.954	16.28	11.35	20.77	13.14	16.81	24.39	25.30	16.29	10.23	17.04	10.47	
Standard Deviation	0.868	0.806	2.20	1.06	1.27	1.88	1.43	1.20	1.21	1.86	0.75	1.64	1.19	
R2														
N=11														
Minimum	6.3	3.28	11.68	5.83	13.39	8.24	10.68	15.54	15.99	11.58	7.35	10.94	7.25	>10
Maximum	10.46	6.71	17.68	10.01	19.42	13.22	15.68	26.27	22.24	18.17	13.31	18.45	10.64	
Arithmetic Mean	7.624	4.656	14.62	8.23	16.30	10.95	13.00	19.89	19.01	15.17	9.72	14.94	9.13	
Standard Deviation	1.164	0.997	2.03	1.11	1.93	1.56	1.37	3.12	2.06	2.48	1.77	2.36	1.20	
R3														
N=13														
Minimum	5.61	3.48	10.38	7.05	8.42	5.71	8.93	12.80	12.88	9.21	5.44	10.97	5.45	>10
Maximum	335.56	105.75	15.84	9.03	16.34	10.38	12.88	22.40	21.49	15.80	12.70	15.54	8.84	
Arithmetic Mean	35.102	19.617	12.87	7.93	14.05	8.59	11.29	18.35	17.62	13.26	8.55	12.96	7.45	
Standard Deviation	90.634	36.836	1.74	0.63	1.98	1.26	1.01	2.80	2.57	1.70	2.26	1.41	1.01	
R4														
N=11														
Minimum	2.62	1.1	8.32	3.92	7.43	4.74	6.54	11.74	12.78	7.53	3.86	8.24	4.61	>10
Maximum	6.67	3.6	13.61	6.11	13.45	8.60	10.26	19.35	17.35	12.79	6.11	13.39	7.95	
Arithmetic Mean	4.902	2.379	10.68	5.08	11.04	6.43	8.12	15.52	15.16	9.92	4.90	10.40	5.97	
Standard Deviation	1.34	0.697	1.85	0.92	1.65	1.12	1.19	2.25	1.28	1.43	0.76	1.32	1.21	
LPM														
N=5														
Minimum	8.41	5.9	20.19	12.56	16.68	10.45	16.74	25.07	24.14	14.04	8.57	14.44	9.16	>10
Maximum	16.03	12.45	26.22	18.56	22.02	16.00	19.50	28.18	27.14	17.72	11.48	18.46	11.28	

Distances in mm	Tooth Height	Crown Height	Apex to left posterior tooth edge	Apex to left posterior crown edge	Apex to right posterior tooth edge	Apex to right posterior crown edge	Posterior Crown Width	Posterior Tooth Width	Anterior Tooth Width	Labial Tooth Length	Labial Crown Length	Lingual Tooth Length	Lingual Crown Length	# of Ridges
			A-B	A-F	A-C	A-G	F-G	B-C	E-D	B-E	F-I	C-D	G-H	
Arithmetic Mean	11.368	7.954	22.12	14.64	18.65	12.54	18.20	27.06	26.20	15.94	10.54	17.19	10.58	
Standard Deviation	2.821	2.605	2.45	2.34	2.18	2.09	1.23	1.34	1.19	1.62	1.17	1.58	0.87	
L2														
N=8														
Minimum	6.58	1.91	12.53	7.41	12.73	6.08	10.46	17.47	17.20	10.01	8.12	12.06	6.58	>10
Maximum	9.11	7.11	15.47	12.22	17.46	9.47	14.22	23.84	23.95	15.47	11.32	15.83	9.74	
Arithmetic Mean	7.384	4.457	14.26	10.38	14.63	7.57	12.60	19.58	20.10	13.52	9.34	13.64	7.96	
Standard Deviation	0.934	1.542	0.99	1.51	1.75	1.15	1.14	2.23	2.47	1.61	0.99	1.42	1.11	
L3														
N=5														
Minimum	5.38	3.38	13.93	8.29	10.38	5.48	9.90	17.20	15.11	11.55	6.22	9.37	6.53	>10
Maximum	9.65	6.09	14.51	9.84	15.30	8.32	13.63	19.40	21.11	13.36	8.39	13.59	7.61	
Arithmetic Mean	8.024	4.78	14.19	9.22	13.17	7.36	11.69	18.63	18.07	12.43	7.28	11.83	7.16	
Standard Deviation	1.647	1.031	0.25	0.60	1.85	1.12	1.38	0.93	2.37	0.75	0.92	1.94	0.42	
L4														
N=13														
Minimum	1.71	1.37	8.61	5.44	8.51	3.05	6.36	15.06	14.79	10.88	4.31	7.75	3.76	>10
Maximum	9.28	4	14.30	8.89	14.96	8.73	10.60	19.51	20.10	13.59	8.78	10.78	7.17	
Arithmetic Mean	4.622	2.601	11.80	7.50	12.11	6.24	9.44	17.37	17.05	11.89	6.63	9.76	5.98	
Standard Deviation	1.876	0.792	1.36	1.09	1.68	1.26	1.16	1.50	1.64	0.80	1.34	0.78	0.89	

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