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Erratum:

item 3(c) on page 2 should read:

"add a new codon to KGG 1 (p.48) --

3-4/3:3:3:3/2:3:3:3 ..... KGG 300

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NASOLAMIA, NEW GENUS, FOR THE SHARK *CARCHARHINUS VELOX* GILBERT, 1898 (ELASMOBRANCHII: CARCHARHINIDAE)

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ABSTRACT

Nasolamia differs externally from all other carcharhinids in having very wide, transversely oriented nostrils placed close together so that the internarial width is only slightly greater than the width of each nostril. Cranial differences, which are in the ethmoid region and separate *Nasolamia* from all other carcharhinid genera except *Prionace*, include not only a narrow space between the nasal apertures, thus reflecting the external condition, but also the long axes of the nasal capsules being nearly parallel to the longitudinal axis of the cranium rather than diagonal to transverse to it. In other features *Nasolamia* comes closer to *Carcharhinus* than to any other carcharhinid genus.

INTRODUCTION

Carcharhinus velox Gilbert, 1898, is a small (up to 1.5 m total length) carcharhinid from the Eastern Pacific that differs from all other members of its genus by several characters of cranial anatomy and external head morphology. Beginning with its describer (Gilbert, *in* Jordan and Evermann, 1898), all workers on Eastern Pacific sharks, including Beebe and Tee-Van (1941), Rosenblatt and Baldwin (1958), and Kato *et al.* (1967) have placed *velox* in *Carcharhinus* or one of its synonyms. However, we feel that the peculiarities of *C. velox* are sufficient to warrant its separation from *Carcharhinus* in a new genus, *Nasolamia*.

Nasolamia belongs to the generic group of "advanced carcharhinids" delimited by Compagno (1970): *Carcharhinus* (including *Hypoprion* and *Aprionodon*), *Negaprion, Prionace, Isogomphodon, Lamiopsis, Triaenodon, Scoliodon, Loxodon, Rhizoprionodon,* and *Galeocerdo*. Compagno (1970) discussed the familial systematics of carcharhinoids and merged the families Triakidae and Carcharhinidae because the characters (dentition and nictitating lower eyelid) traditionally used to separate these two families failed to do so. However, he noted that the conglomeration of genera in the expanded Carcharhinidae was heterogeneous and might be redivided when further data on their comparative morphology were obtained. Subsequent studies of higher carcharhinoids (Compagno 1973a, 1973b, 1979) have restricted the family Carcharhinidae to the "advanced carcharhinid" genera. A comprehensive definition of the family Carcharhinidae is presented in Compagno (1979), but because that account is not generally available, major characters defining the family are given in the next section below.

FAMILY CARCHARHINIDAE

DEFINITION: Head not expanded into a winglike blade. Eyes low on sides of head, situated on horizontal head rim, with subocular ridge absent. Eyes less than twice as long as high, often about as long as high. Nictitating lower eyelid internal in all growth stages from newborn to adult, with its edge more or less slanted. Edge of secondary lower eyelid strongly differentiated, continuous anteriorly and posteriorly with upper eyelid. Subocular pouch very deep, curving below eyeball, and lacking denticles on its outer surface. Spiracles absent, vestigial, or small, consistently present only in *Galeocerdo.* No nasoral grooves. Anterior nasal flaps not in the form of barbels. Large papillae absent from buccal cavity. Labial furrows more or less reduced; when upper ones are elongate, they are very shallow anteriorly. Labial cartilages usually present (absent in *Scoliodon,* in some species of *Rhizoprionodon,* and in *Galeocerdo*).

Disjunct monognathic heterodonty (as defined by Compagno, 1970, 1979) always present, with medials or alternates and usually lower symphysials being the tooth groups present. Upper symphysials, anteriors, laterals, and posteriors are also present in some genera. Tooth crown with basal ledge, basal groove, and transverse ridges reduced or absent; when present, transverse ridges never extend far onto tooth crown and cusp. Teeth more or less compressed, bladelike, sharp-edged, with strong primary cusp on most or all teeth. Teeth never in a pavement, except for posterior teeth of *Lamiopsis.* Tooth rows relatively few, less than 40/40 in most genera, but with *Isogomphodon* having up to 61/56 rows. Three or fewer tooth series functional in all genera except *Lamiopsis,* which has from 4 to 8 series of posteriors.

Upper precaudal pits always present, lower pits usually present but sometimes absent or indistinct. Denticles from dorsum below first dorsal fin with crowns usually about as wide as long or wider than long.

Pectoral fin plesodic, with its skeleton supporting distal web of fin and projecting at least 2/3 of pectoral anterior margin length into fin. Distal pectoral radials tapering, pointed, and elongated, the longest distal radials over twice as long as longest proximal radials.

Claspers without exorhipidia. Clasper siphons long, reaching at least to free rear tips of pectorals. Cover rhipidion very large, extending nearly or quite to clasper tip. Rhipidion present or absent, when present mostly or entirely concealed by cover rhipidion. Dorsal edges of clasper groove forming a short tube between hypopyle and apopyle, not fused dorsally. Pseudosiphons usually present and very large. Pseudoperae present or absent. Clasper denticles nodular, rounded, acuspidate, and acarinate (clasper terminology follows Compagno & Springer, 1971, and Compagno, 1979).

Midpoint of first dorsal base well anterior to midpoints of pelvic bases. First dorsal insertion usually well anterior to pelvic origins, but nearly or quite over them in *Scoliodon* and *Triaenodon.* First dorsal base less then half as long as dorsal caudal margin, not in the form of a low, rounded keel. Second dorsal not greatly larger than anal, but only slightly larger, subequal in size, or smaller.

Ventral lobe of caudal fin always present. Postventral caudal margin deeply notched and divided into upper and lower parts in all genera except *Scoliodon,* in which it is usually deeply concave and not subdivided. Lateral undulations or ripples present on dorsal caudal margin (absent in young specimens of a few genera). Caudal axis at an angle to body axis.

Cranium with rostral cartilages always fused together at their distal tips, forming a basinlike, platelike, or yokelike rostral node. Nasal capsules usually ovoid or elongated, with nasal apertures confined to their anteroventral surface (Fig. 1). Nasal capsules with ventral shelves separating ectethmoid chambers from exterior.

Posteroventral surface of each nasal capsule with an ectethmoid condyle that articulates with the orbital process of the palatoquadrate. Ectethmoid condyle always perforated medially by an ectethmoid foramen, which communicates with the ectethmoid chamber. A deep subethmoidal fossa present between ectethmoid condyles on the ventral surface of the cranium. No supraorbital crests connecting the separate preorbital and postorbital processes.

Levator palatoquadrati muscles greatly expanded, with their origins extending anterior to the postorbital processes into the orbits, and their bodies extending diagonally posterolaterally to their insertions on the palatoquadrates.

Vertebral centra with strong, solid, wedge-shaped intermedialia. Diagonal calcified lamellae present or absent. Notochordal canal restricted or blocked at apices of calcified double cones in vertebral centra of adults and subadults, at least.

Valvular intestine with a scroll valve.

Development usually viviparous as far as is known, but *Galeocerdo* apparently is ovoviviparous.

Nasolamia, NEW GENUS

TYPE SPECIES. *Carcharhinus velox* **Gilbert, 1898.**

Nasolamia is unique in the Carcharhinidae in having very large, transverse, close-set nostrils with very large, oval excurrent apertures and with the internarial space 1.1 to 1.3 times the nostril width. Other carcharhinid genera have smaller nostrils, with oblique apertures, narrow, slitlike excurrent apertures, and internarial spaces 3 to 4 or more times the nostril width. The narrow snout and peculiar nostrils of *Nasolamia velox* are very striking and conspicuous, as one of us (Compagno) noted while sorting hundreds of carcharhinid heads at a fishmeal plant at Guaymas, Sonora, Mexico.

Cranially *Nasolamia* differs from other carcharhinid genera by differences in the ethmoid region. The narrow external internarial space of *Nasolamia* is reflected by the narrow space between the nasal apertures of the cranium (Figs. 2-3), which is less than the nasal aperture width. In other carcharhinid genera (except *Prionace*), the space between the nasal apertures is equal to or greater than the nasal aperture width (Fig. 1). *Nasolamia* has the long axes of the nasal capsules nearly parallel to the longitudinal axis of the cranium, while in other carcharhinid genera they vary from diagonal to transverse to the cranial axis. The extreme anterioposterior elongation of the nasal capsules of *Nasolamia* is approached only by *Prionace* among other carcharhinids.

GENERIC DEFINITION: Head elongated, strikingly conical, not greatly depressed, its depth at eyes about ⅔ its width at eyes, its length about ¼ of total length. Eyes subcircular in shape, with their ventral edges at level of nostril or slightly above. No posterior eye notch. Spiracles absent. No gillrakers.

Nostrils wide, close together, nostril width 75-90% of internarial width (Fig. 4b). Long axis of nostrils transverse to body axis. Anterior nasal flap weakly developed as a low trianguar lobe, not tubular (Fig. 4c). Nostrils nearly equidistant between snout tip and mouth, but slightly closer to mouth. Excurrent aperture of nostril large, subquadrate, and revealing interior of olfactory organ in ventral view.

Labial furrows very short, virtually confined to mouth corners, uppers 0.3% to 1.0% of total length or ⅓ to 2/5 of nostril width; lower labial furrows about length of uppers and concealed by upper lip when mouth is closed. Anterior end of upper labial furrow posterior to eye about 1⅔ eye lengths. Upper and lower labial cartilages present.

Dignathic heterodonty strongly developed (Fig. 5). Upper teeth generally larger than opposite lowers, with thicker and more oblique cusps (except for the first one to two anteriors, which have erect cusps), postlateral blades only, and convex premedial edges (Fig. 5). Lowers with slenderer and more erect cusps than uppers opposite to them (however, all lower rows except the first few have slightly oblique cusps), with both premedial and postlateral blades present, and well-defined notches between cusps and blades. Lower teeth crowns proportionately lower relative to their root widths compared with upper teeth; and lower teeth roots slightly lower than those of uppers.

Tooth row groups present include distinct medials or alternates, lower symphysials, and poorly differentiated upper anteriors, the remaining parasymphysial teeth being lateroposteriors in the upper jaw and anteroposteriors in the lower jaw. Tooth rows relatively few, 27-30/24-28. Tooth formulae: 13-14 + 1-2 + 13-14/12-13 + 0-2 + 12-13; or alternates or medials 1-2, anteriors 2, lateroposteriors 11-12/medials 0-2, symphysials 1, anteroposteriors 11-12; 1 to 2 series of teeth functional in both jaws. No basal ledges, basal grooves, or transverse ridges on tooth crowns. Cusplets or coarse serrations absent from teeth, but teeth of both jaws finely serrated at all growth stages. Roots of teeth high, narrow, compressed. Strong transverse grooves and notches present on attachment surfaces of roots.

Trunk not greatly compressed. No interdorsal ridge, though preservation may give the appearance of a feeble ridge. Lateral dermal keels absent from the caudal peduncle. Both precaudal pits present, of crescentic type.

Denticles from dorsum below first dorsal fin with crowns as wide as long at all stages (Fig. 6). Denticle crowns lack cusps but have ragged posterior edges. Three to seven longitudinal ridges present on crown, with 1 medial ridge and 1-3 pairs of lateral ridges; lateral ridges fewer in young, more in large specimens. All ridges about equal in height, medial not greatly higher than laterals.

Pectoral fins moderately broad, their lengths from origins to free rear tips about 70-75% of their anterior margin lengths. Apex of adpressed pectoral slightly posterior to its free rear tip when pectoral inner margin is held parallel to body axis. Origin of pectorals under 3rd gill opening or below interspace between 3rd and 4th.

Pelvic fins relatively small, anterior margins only 32-37% of pectoral anterior margins.

Claspers with pseudosiphon and pseudopera well developed. Cover rhipidion very large, nearly reaching tip of clasper. Rhipidion present and very well-developed.

Midpoint of first dorsal base much closer to pectoral bases than to pelvic bases. Origin of first dorsal above middle of inner margin of pectoral. Fee rear tip of first dorsal slightly anterior to pelvic origins. Second dorsal much smaller than first, height 22-31% of first dorsal height. Second dorsal margin only weakly concave.

Anal fin slightly larger than second dorsal, anal height 120-170% of second dorsal height, anal base about 125% of second dorsal base. Posterior margin of anal deeply concave, anal apex and distal parts of anterior and posterior margins forming a distinct lobe. Anal origin slightly anterior to second dorsal origin or under it; anal insertion posterior to second dorsal insertion by 1/7 of anal base or less. Anal base without preanal ridges (paired extensions of the anal fin base anterior to the anal fin proper and best developed in *Rhizoprionodon* and *Loxodon).*

Postventral caudal margin deeply notched and divided into upper and lower parts. The lower postventral margin slants posterodorsally from the tip of the ventral caudal lobe to the notch and forms a right angle with the upper postventral margin. Lateral undulations on dorsal caudal margin well-developed.

Cranium with rostrum not encrusted by masses of dense, calcified cartilage. Nasal capsules subovate in shape, elongated anterioposteriorly (Fig. 2-3), very narrow relative to their length; greatest width of each nasal capsule only ⅔ of its length. Width of cranium across nasal capsules only 1¾ to 2 times in nasobasal length (distance from

base of medial rostral cartilage to fused vertebral half-centrum between occipital condyles). Long axis of nasal capsule nearly parallel with longitudinal cranial axis. Distance between nasal apertures 2/5 of greatest width of nasal apertures. Nasal fenestrae and lateral ectethmoid foramina absent, medial ectethmoid foramina present on posterodorsal surfaces of ectethmoid condyles. Epiphysial (pineal) foramen present. Basal plate slightly narrower than width of orbit above it at orbital notches. No suborbital ledge connecting suborbital shelf and nasal capsules. Stapedial arteries enter orbits through a pair of large fenestrae in the suborbital shelf. Internal carotid arteries enter cranium through ventral foramina in the basal plate. The internal carotid foramina are far apart from each other and close to the medial rim of each stapedial fenestra. Preorbital processes strong, bladelike; postorbital processes short. Otic capsule expanded, ovate, inflated, length about 2⅓ to 2½ in nasobasal length. Postorbital processes originating at mid-length of otic capsules.

Vertebrae moderately numerous, total counts 176-183 (N = 5, mean = 179.60, standard deviation = 3.36, coefficient of variation 1.87). Monospondylic precaudal centra 28.1-28.9%, diplospondylic precaudal centra 19.2-20.2%, and diplospondylic caudal centra 51.7-52.5% of total counts (N = 4). Division between monospondylic precaudal and diplospondylic precaudal centra occurs above or just below middle of pelvic bases and is well-defined. "A" ratios (length of penultimate monospondylic centrum/length of first diplospondylic centrum x 100) are 162-190, "B" ratios (length of penultimate monospondylic centrum/its width x 100) are 90-107. Last few monospondylic precaudal centra not greatly enlarged. No 'stutter zone' of alternating long and short centra in diplospondylic precaudal or caudal region.

Vertebral centra with short diagonal calcified lamellae.

Development viviparous.

RELATIONSHIPS OF *NASOLAMIA*: Revisions of the family Carcharhinidae and the genus *Carcharhinus* by Compagno (1979, and in press) and Garrick (1982) recognise 25 or 31 species in *Carcharhinus* depending on whether species of the nominal genera *Aprionodon* and *Hypoprion* and the species *Carcharhinus gangeticus* and *C. glyphis* are included (Compagno) or excluded (Garrick) from *Carcharhinus*. The removal of *Carcharhinus velox* Gilbert, 1898 from *Carcharhinus* and its placement in the genus *Nasolamia* are part of these revisions.

Aside from its narial and cranial pecularities, *Nasolamia* has little to distinguish it from *Carcharhinus* and probably is a specialised derivative of one of the species groups within *Carcharhinus*. In dentition, vertebral counts, and general external morphology *Nasolamia velox* seems closest to *Carcharhinus acronotus* (Poey, 1860).

NASOLAMIA VELOX (GILBERT, 1898)

Figs. 2-6

HOLOTYPE: SU 11893, 1200 mm (total length) female (now with trunk and tail skinned out), from Panama Market, January-February 1896, C. H. Gilbert and others.

Because only a few specimens of *Nasolamia velox* have been reported, we are listing all the specimens that we know of, and are providing data on the morphometrics, meristics and other features of a sample of these. This information, in conjunction with the characters given in the Generic Definition, should facilitate comparison of *N. velox* with similar species of *Carcharhinus*. The morphological and meristic data may also be important for study of intraspecific variation in *N. velox,* especially if this species is shown to range further south than presently recorded.

MATERIAL EXAMINED: The 40 specimens (including jaws and chondrocrania) listed below are from the collections of the American Museum of Natural History, New York (AMNH); Field Museum of Natural History, Chicago (FMNH), Los Angeles County Museum of Natural History (LACM); of one of us (LJVC); Scripps Institution of Oceanography, La Jolla, California (SIO); Division of Systematic Biology, Stanford University, Stanford, California (now housed at the California Academy of Sciences, San Francisco, California; SU); University of California at Los Angeles (UCLA); and U.S. National Museum of Natural History, Washington, D.C. (USNM).

MEXICO: UCLA 49-38, 1390 mm female, Baja California, Outer Gorda Bank, 23° 01' 30" N., 109° 26' W., October 7, 1949, P.M. Roedel and R. C. Wilson; SIO-65-183, 1060 mm male, Baja California, Cabo San Lucas Bay; UCLA W52-247, ca. 1370 mm (jaws only), Baja Californa, Santa Maria Bay, November 25-26, 1952, M.A. Newman and others; SIO H47-53, 1400 mm adult male, (with trunk and tail skinned out), Gulf of Californa near San Felipe; UCLA 60-51, 2 males, 653-915 mm, and 1 female, 883 mm, Gulf of California, Bahia Las Animas, January 25-26, 1960, L. Pinkas and others; LJVC-0268, 526 mm newborn or late embryo female (cranium dissected); LJVC-G-148, est. 49 cm, LJVC-G-179, est. 104 cm, LJVC-G-192, est. 106 cm, LJVC-G-193, est. 96 cm, LJVC-G-194, est. 101 cm, LJVC-G-203, est. 96 cm, LJVC-G-205, est. 101 cm, LJVC-G-206, est. 94 cm, LJVC-G-207, est. 102 cm, LJVC-G-208, est. 110 cm, LJVC-G-209, est. 119 cm, LJVC-G-210, est. 106 cm, LJVC-G-211, est. 98 cm, LJVC-G-212, est. 115 cm, LJVC-G-213, est. 110 cm, LJVC-G-214, est. 117 cm, LJVC-G-215, est. 100 cm, LJVC-G-216, est. 106 cm, LJVC-G-217, est. 65 cm, LJVC-G-218, est. 98 cm, LJVC-G-219, est. 94 cm, LJVC-G-220, est. 110 cm, LJVC-G-221, est. 110 cm, LJVC-G-222, est. 61 cm, LJVC-G-252, est. 133 cm. (LJVC-G numbered specimens collected as severed heads from fisheries offal, jaws only saved for all specimens except G-184, G-192, G-193, G-214 and G-252, from which chondrocrania were prepared), all from Gulf of California, Guaymas, Sonora, Mexico; UCLA 58-47, 1018 mm female, Gulf of California, Sinaloa, S. of Bahia Topolobampo, February 10-14, 1958, J. Stevens; LACM F-211, 1325 mm male (jaws ony), Sinaloa, Mazatlan.

COSTA RICA: AMNH, 720 mm female.

PANAMA, PANAMA MARKET: USNM 79305, 564 mm female, April 21, 1911, S.E. Meek and S.F. Hilderbrand; FMNH 8170, 570 mm female, April 19, 1911, S.E. Meek and S.F. Hilderbrand; SU-11893, 1200 mm female (trunk and tail skinned out, holotype of *Carcharhinus velox* Gilbert).

MORPHOMETRICS AND MERISTICS: Proportional dimensions, tooth formulae, and vertebral counts for five specimens of *Nasolamia velox* are listed in Table 1; total tooth row counts and statistics for 35 specimens of *N. velox* in Table 2; and cranial proportions for 8 *N. velox* in Table 3.

COLOUR: Colour in general, when fresh, was described by Gilbert (in Jordan and Everman, 1898) as "bluish above, whitish or grayish below; . . . " After preservation in alcohol the general colour is gray or brownish gray above, paler to white below; distal margins of pectoral fins, pelvic fins, and ventral lobe of caudal fin narrowly edged with white; apical half of second dorsal fin black or dusky; a narrow dusky edging on dorsal and terminal margins of caudal fin; and a small but distinct black spot on upper side of tip of snout.

SIZE AND MATURITY: The smallest specimen we have seen was 526 mm long, and appeared to be either a late embryo or newly born, while two others of 564 and 570 mm still showed umbilical scars, indicating that they were fairly recently born. Assuming that size at birth is about 535 mm, then this suggests that adult *Nasolamia velox* must reach a length of at least 1500 mm. The largest female that we are aware of was 1390 mm long, and the largest male 1400 mm. Of the four males examined, three of 653, 915 and 1060 mm were immature, with clasper lengths of 2.3%, 2.9% and 2.8% of total lengths respectively, while the fourth of 1400 mm was mature, with claspers of 8.4% of total length.

DISTRIBUTION (See also MATERIAL EXAMINED): According to present information *Nasolamia velox* has a limited distribution along the coastline of the Eastern Pacific. Specimens we have examined were from the Gulf of California coasts of Baja California and mainland Mexico, and from Costa Rica and Panama. Kato *et al.* (1967) note that it has been reported from Ecuador and Chirichigno (1980) lists it from as far south as Peru. During the early summer of 1974 the senior author and Dr Bruce Welton found that *N. velox* was commonly caught by fishermen using light bottom longlines in the Gulf of California at Guaymas, Sonora, Mexico (see Material Examined).

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In addition, Mr Stewart Springer (then of the National Marine Fisheries Service Systematics Laboratory, U.S. National Museum) gave Compagno a specimen of *Nasolamia velox* (LJVC-0268) that was used in anatomical investigations. Peter A. McCrery did the dentition illustrations of *N. velox*, and Dr Victor G. Springer of the Division of Fishes, U.S. National Museum allowed us to use these illustrations for this paper. Mrs Martha J. Mitchell of Kent Cambridge Scientific Instrument Co. and Stanford University permitted Compagno to use a Cambridge Stereoscan scanning electron microscope under her care.

Compagno's contribution to this paper was part of a Ph.D. thesis project on systematics of carcharhinoid sharks researched at the Division of Systematic Biology, Stanford University, under supervision of Professor George S. Myers. This work was funded by a National Defence Education Act Predoctoral Fellowship, National Science Foundation Predoctoral Fellowship, and Stanford Department of Biological Sciences Fellowship; all administered through the Department of Biological Sciences, Stanford University. Garrick's contribution was made possible through funds and facilities organised and administered by Dr Leonard P. Schultz of the U.S. National Museum. His work was supported by Atomic Energy Commission Contract AT(30-1) 2409 and by National Science Foundation Grant GB-245.

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TABLE 1. Nasolamia velox, proportional dimensions in percent of total length, and some meristic values.

	USNM 79305 564 mm female	UCLA 60-51 653 mm male	AMNH 15669 720 mm female	UCLA 60-51 883 mm female	UCLA 60-51 915 mm male
Snout tip to:					
outer nostrils	4.6	5.5	5.1	5.5	5.7
eye	9.2	10.4	9.9	10.3	10.6
mouth	10.1	11.3	10.5	11.4	11.5
1st gill opening	20.6	20.8	-	21.8	22.6
3rd gill opening	23.2	-	-	-	24.8
5th gill opening	25.7	25.1	25.5	24.8	26.7
pectoral origin	24.5	24.3	24.7	23.6	25.8
pelvic origin	47.9	49.0	49.0	50.3	49.0
1st dorsal origin	31.6	34.0	32.7	32.7	34.0
2nd dorsal origin	61.4	62.8	-	63.0	62.7
anal fin origin	61.4	62.8	-	61.7	62.6
upper caudal origin	72.4	73.5	73.6	73.2	73.1
lower caudal origin	71.9	73.2	73.0	72.5	72.7
Internarial space	2.5	2.5	2.2	2.4	2.4
Mouth:					
width	7.1	7.0	-	7.0	7.0
length	3.9	3.5	-	3.7	3.9
Labial furrow lengths:					
upper	0.9	0.3	1.0	0.5	0.4
lower	0.4	0.3	0.6	0.3	0.5
Gill opening lengths:					
1st	2.3	2.8	2.3	2.3	2.7
3rd	2.8	3.7	2.4	2.9	3.3
5th	2.5	2.8	2.1	2.6	2.6
Eye:					
horizontal diameter	2.1	2.1	2.2	1.9	2.0
1st dorsal fin:					
length of base	9.8	9.3	9.3	9.6	9.5
inner margin	3.9	3.5	3.6	3.7	3.4
height	8.3	8.9	9.0	9.4	9.1
2nd dorsal fin:					
length of base	3.5	3.8	-	3.6	3.9
inner margin	3.5	3.4	3.3	3.6	3.7
height	2.4	2.3	2.3	2.4	2.5
Anal fin:					
length of base	4.3	3.8	-	4.4	4.1
inner margin	3.5	3.5	3.5	3.7	3.2
height	3.0	3.1	2.8	3.5	3.3
Pectoral fin:					
length of base	5.7	4.9	5.3	6.1	5.7
length anterior margin	16.7	16.4	16.0	17.5	16.8
length posterior margin	11.7	13.0	13.0	14.3	14.0
Pelvic fin:					
length of base	5.3	4.9	5.0	5.1	5.0
length anterior margin	5.9	6.1	5.9	6.0	6.2
length posterior margin	4.9	4.9	5.0	5.1	5.1
length of claspers	-	2.3	-	-	2.9
Caudal:					
length of dorsal margin	27.8	27.1	26.9	27.2	27.3
length of preventral margin	11.3	11.6	11.4	12.0	11.9
Trunk at pectoral origin:					
width	10.4	10.7	11.1	11.5	11.7
height	11.2	11.9	-	-	12.2
Dental formula:	14-1-14 / 12-1-13	13-2-13 / 12-1-12	13-2-13 / 12-1-12	13-1-13 / 12-1-12	13-2-13 / 12-1-12
Vertebral counts:					
precaudal	85	-	-	-	86
caudal	92	-	-	-	90
total	177	-	-	-	176

TABLE 2. Total tooth row counts.

Frequency matrix for upper/lower tooth row counts

Upper Jaw	30	-	-	-	1	-
	29	-	-	-	2	-
	28	1	15	5	6	1
	27	-	2	-	2	-
		24	25	26	27	28
		Lower Jaw				

Number of specimens counted: 35

Statistics:	Range	Mean	Standard deviation	Coefficient of variation
Upper jaw	27-30	28.00	0.54	1.94
Lower jaw	24-28	25-83	1.01	3.93

Coefficient of correlation, upper vs. lower counts: 0.21

TABLE 3. Cranial proportional dimensions in percent of nasobasal length (distance from base of rostrum to posterior edge of occipital centrum).

	LJVC-0264	LJVC-G-93	LJVC-G-203	LJVC-G-179	LJVC-G-195	LJVC-G-192	LJVC-G-214	LJVC-G-252
Nasobasal length, mm (NB).	55	92	92	100	103	105	112	137
CRANIAL PROPORTIONS, % NB								
Medial rostral cartilage length:	60.0	56.5	59.8	59.0	58.3	55.2	56.3	53.3
Width between bases of lateral rostral cartilages:	23.6	18.5	18.5	18.0	15.5	20.0	20.5	19.7
Width across nasal capsules:	60.0	56.5	56.5	55.0	55.3	55.2	56.3	54.7
Nasal capsule length:	47.3	47.8	50.0	49.0	50.5	47.6	49.1	48.2
Nasal capsule width:	30.9	29.3	28.3	28.0	27.2	28.6	28.6	27.0
Nasal aperture width:	20.0	22.8	21.7	21.0	21.4	21.9	21.4	19.7
Width between nasal apertures:	16.4	14.1	17.4	16.0	16.5	16.2	17.0	15.3
Length from rostral base to dorsal lip of anterior fontanelle:	25.5	35.9	34.8	34.0	36.9	35.2	36.6	35.8
Anterior fontanelle height:	29.1	30.4	28.3	30.0	32.0	30.5	32.1	29.2
Anterior fontanelle width:	25.5	21.7	22.8	21.0	21.4	22.9	23.2	21.9
Cranial height:	47.3	43.5	42.4	44.0	44.0	40.8	40.0	41.6
Basal plate width at orbital notch:	23.6	23.9	23.9	24.0	24.3	22.9	25.0	24.1
Width across internal carotid foramina:	21.8	20.7	20.7	22.0	19.4	21.9	23.2	19.7
Width across stapedial fenestrae:	41.8	40.2	40.2	41.0	38.8	41.0	40.2	40.1
Stapedial fenestra length:	12.7	13.0	12.0	13.0	11.7	13.3	12.5	12.4
Width across preorbital processes:	74.5	-	73.9	74.0	71.8	76.2	72.3	74.5
Preorbital process length:	18.2	-	19.6	-	-	-	17.9	-
Orbit length:	50.9	52.2	53.3	55.0	56.3	55.2	56.3	56.2
Orbit height:	21.8	32.6	29.3	25.0	27.2	27.6	24.1	27.0
Width across postorbital processes:	81.8	-	-	-	-	-	82.1	-
Postorbital process length:	14.5	-	19.6	-	-	-	17.9	-
Width across suborbital shelves:	52.7	52.2	52.2	53.0	51.5	51.4	58.0	54.0
Otic capsule length:	43.6	39.1	42.4	40.0	38.8	38.1	43.8	37.2
Width across otic capsules:	58.2	57.6	57.6	58.0	56.3	55.2	52.7	55.8

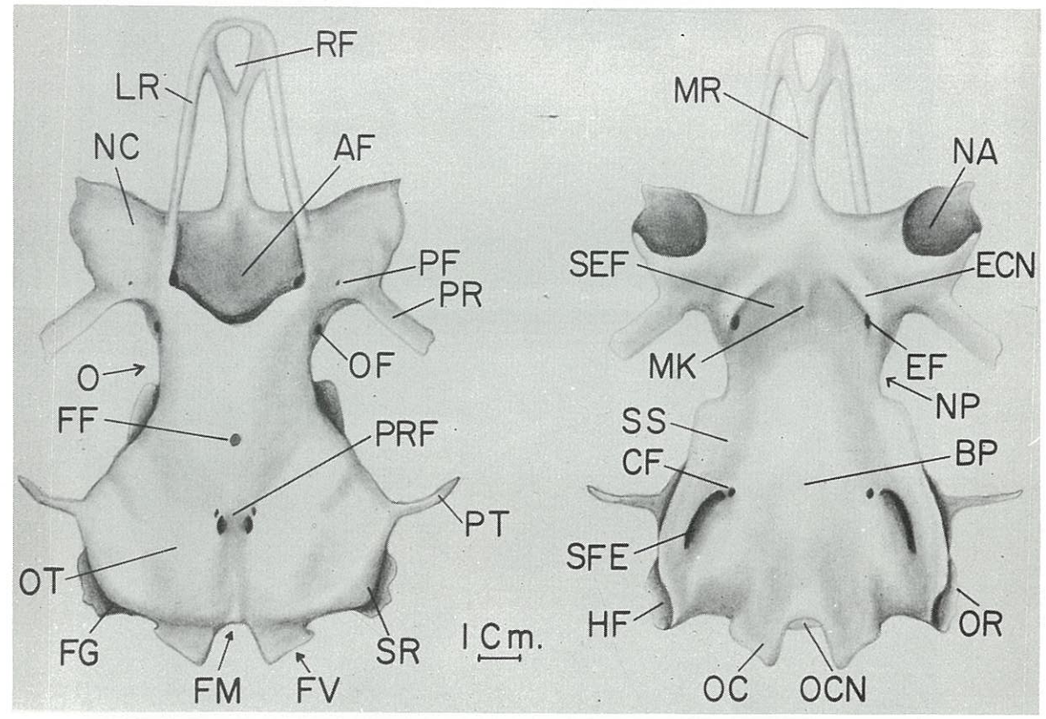

Figure 1. *Carcharhinus obscurus*, LJVC-0275, about 1400 mm: cranium in dorsal (left) and ventral (right) views. Del. L.J.V.C. Abbreviations: AF, anterior fontanelle; BP, basal plate; CF, foramen for internal carotid artery; ECN, ectethmoid condyle; EF, ectethmoid foramen; ES, ectethmoid shelf; FF, frontal fenestra; FG, foramen for glossopharyngeal nerve; FM, foramen magnum; FV, foramen for vagus nerve; HF, hyomandibular facet; LR, lateral rostral cartilage; MK, median keel in subethmoid fossa; MR, medial rostral cartilage; NA, nasal aperture; NC, nasal capsule; NP, notch for orbital process of palatoquadrate; O, orbit; OC, occipital condyle; OCN, occipital centrum; OF, foramen for orbitonasal vein; OR, opisthotic ridge; OT, otic capsule; PF, foramen for ophthalmicus profundus nerve; PR, preorbital process; PRF, parietal fossa; PT, postorbital process; RF, rostral fenestra; SEF, subethmoid fossa; SFE, fenestra for stapedial (orbital) artery; SR, sphenopterotic ridge; SS, suborbital shelf.

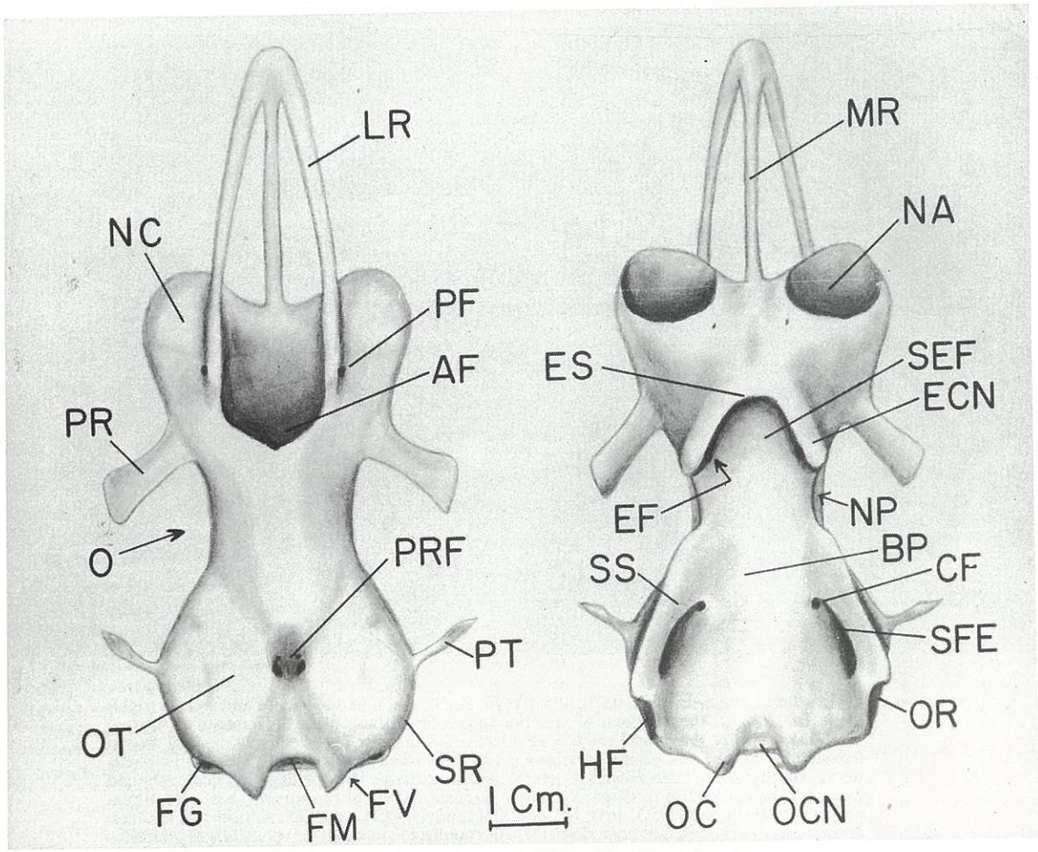

Figure 2. *Nasolamia velox*, LJVC-0268, 526 mm, newborn or later embryo female: cranium in dorsal (left) and ventral (right) views. Del. L.J.V.C. Abbreviations as in Fig. 1.

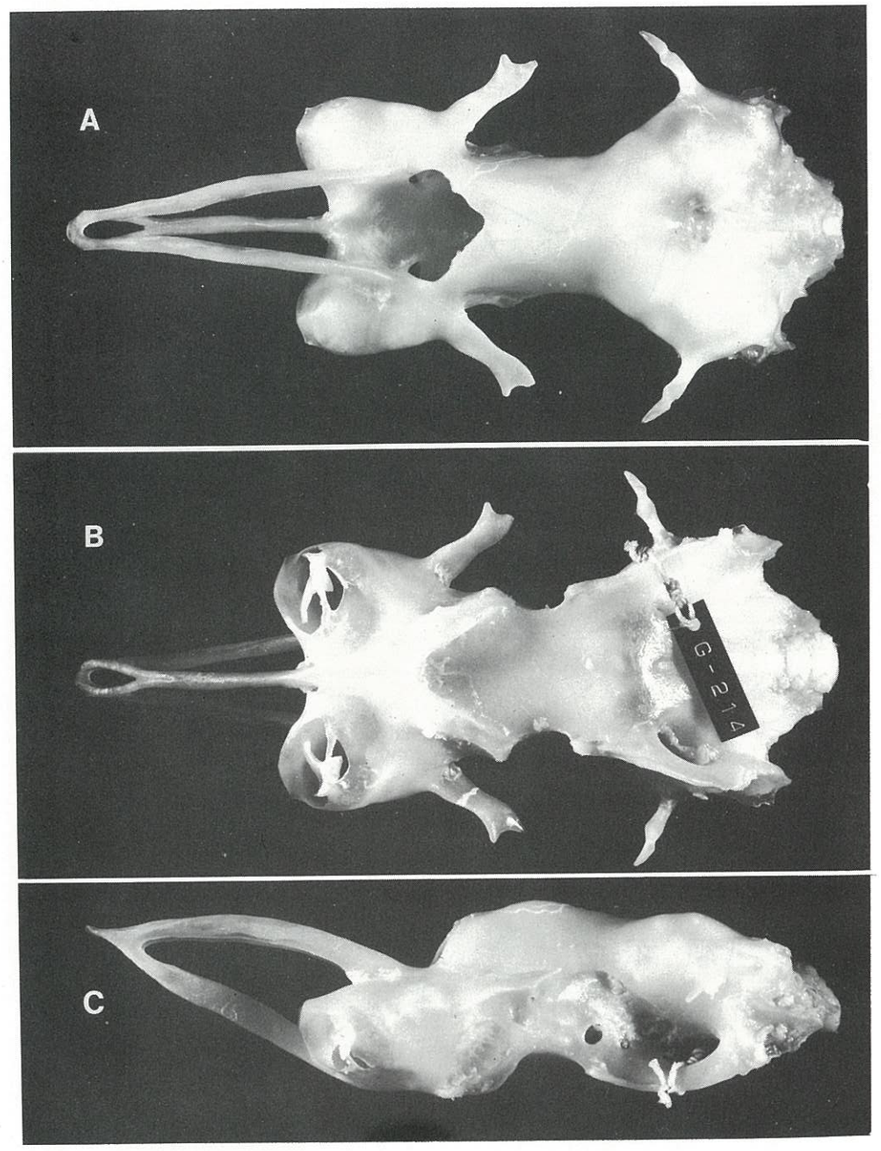

Figure 3. *Nasolamia velox* cranium, LJVC-G-214, 112 mm nasobasal length: A, dorsal view; B, ventral view; C, lateral view. Photograph by L.J.V.C.

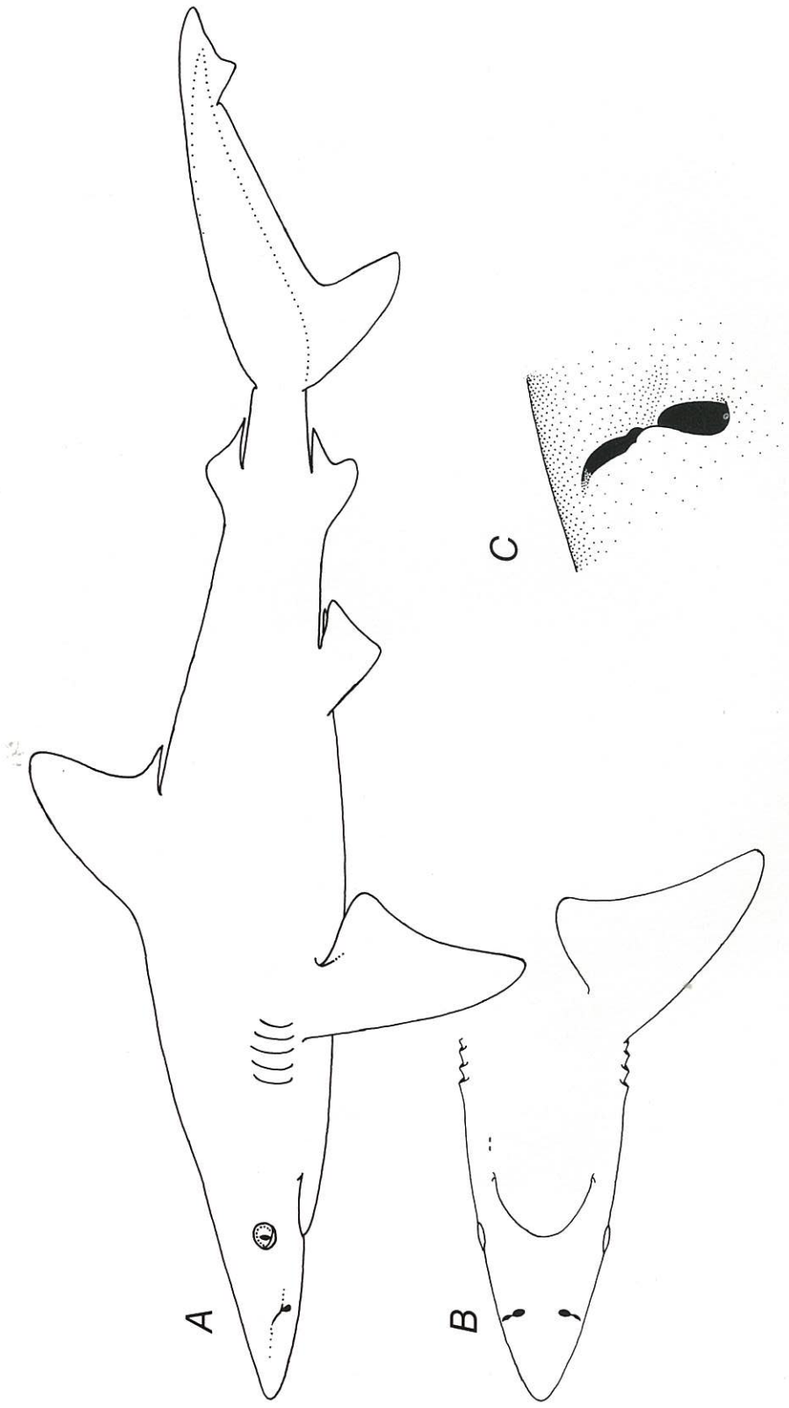

Figure 4. *Nasolamia velox*, UCLA 60-51, 915 mm, immature male: A, left side; B, underside of head; C, enlarged left nostril. Del. J.A.F.G.

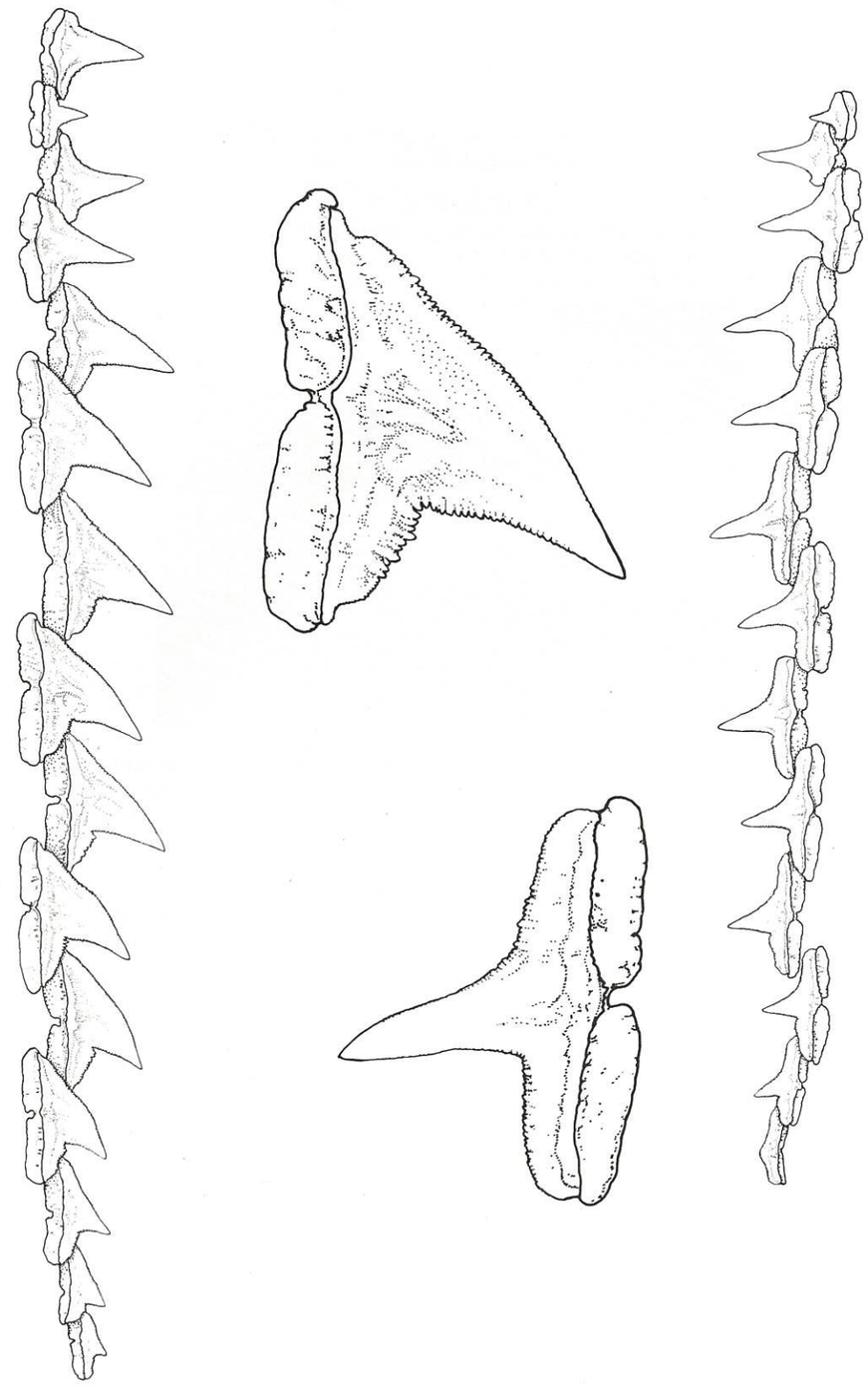

Figure 5. *Nasolamia velox*, UCLA W52-247, about 1370 mm: right upper and lower teeth (symphysis to the right); enlarged inset teeth are the second upper lateroposterior and the fourth lower anteroposterior. Del. Peter A. McCrery.

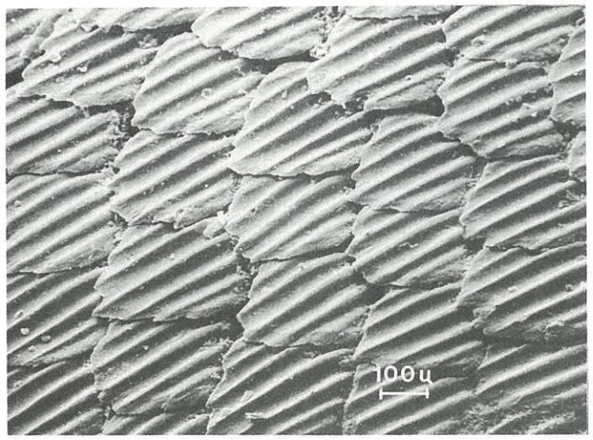

Figure 6. *Nasolamia velox*, S10-H47-53, 1400 mm, adult male: dermal denticles from dorsum below first dorsal fin. Scanning electron micrography by L.J.V.C., an oblique posterior photograph of denticle crowns.

KEYS TO AID IN THE IDENTIFICATION OF MARINE HARPACTICOID COPEPODS

Amendment Bulletin No. 4

by
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INTRODUCTION

This Bulletin deals with several important papers , but particularly notable are the revision of the Paramesochridae by Kunz (1981), the discussion of *Oniscopsis* by Becker & Kunz (1981) and the partial revision of *Tisbe* by Volkmann (1979c); all are major contributions to harpacticoid systematics. As in previous Amendment Bulletins (Wells, 1978, 1979, 1981) the page numbers in parentheses are those of the original Keys (Wells, 1976).

Family Longipediidae

Longipedia spinulosa Itô, 1981 is added to the genus (see p. 12 and Wells, 1981).

Family Cerviniidae

1. *Pontostratiotes minor* and *P. fontana,* new species by Dinet (1981), *P. pacificus* and *P. unisetosus,* new species by Itô (1982b), and *P. sixtorum mindanaoensis* Itô, 1982b, all to genus codon in KGG 1 (p. 21).
2. Montagna (1981) redescribes the male of *Cervinia magna,* discovering previously unknown sexual dimorphism. Brotskaya (1963) made *C. magna* the type of her new monotypic genus, *Pseudocervinia*. Montagna believes that this is not justified and proposes that *Pseudocervinia* sink as a synonym of *Cervinia*. As a consequence of Montagna's description —
   (a) amend the codon for *Pseudocervinia* in KGG 1 (p. 22) to read — d/d/u/3:3:3:3:/2:2:2:2 — *Cervinia magna* ♀,
   (b) note that *C. magna* ♂ has the same codon in KGG 100 (p. 23) as *C. bradyi.*
3. *Cervinia unisetosa* Montagna, 1981 to codon for *C. tenuiseta* in KGG 100 (p. 23).
4. *Expansicervinia glacieria* Montagna, 1981 to the codon for *Cervinia tenuicauda* in KGG 100 (p. 23).
5. *Pontostratiotes robustus* Itô, 1982b requires a new codon in KGG 200 (p. 24) — 8/?/6:7:7:8/5:5:6:5/>abd.
6. *Tonpostratiotes tenuipedalis* Itô, 1982b requires a new codon in KGG 200 (p. 24) — 7/5/6:7:7:7:/5:5:6:3/>abd.
7. Montagna (1981) synonymizes *Stratiopontotes* with *Ameliotes*. Itô (1982b) disagrees but synonymizes *Ameliotes* with *Herdmaniopsis.*

Family Ectinosomatidae

1. *Arenosetella panamensis* and *A. macronychospina*, new species by Mielke (1981b), to genus codon in KGG 1 (p. 28).
2. *Halectinosoma perforatum* Itô, 1981 to codon for *H. canaliculatum* and *H. inhacae* in KGG 100 (p. 29).
3. *Halectinosoma otakoua* and *H. hydrofuge*, new species by Wells, Hicks & Coull (1982), to genus codon in KGG 100 (p. 29).
4. *Noodtiella tabogensis* Mielke, 1981b to codon for *N. hoodensis* in KGG 500 (p. 35).

Family Harpacticidae

Harpacticus alevtinae Tschislenko, 1977 requires a new codon in KGG 100 (p. 45) — nor/9/1/?/4:5/0:5. Tschislenko does not state if there are modifications to the male P.2-P.4.

Family Tisbidae

1. *Tisbe japonica* Ho, 1982 and *T. coulli, T. ianthina, T. longipes* and *T. variana,* all new species by Volkmann, 1979a, to genus codon in KGG 100 (p. 49).
2. Volkmann (1979c) gives a partial revision of *Tisbe*, with keys to the species dealt with. In this revision she —
   (a) describes seven new species — *T. trisetosa, elanitica, rampighera, perplexa, gigantea, denticulata* and *maraensis;* all to genus codon in KGG 100 (p. 49).
   (b) synonymizes *T. wilsoni* with *T. gracilis* and *T. lancii* with *T. holothuriae,*
   (c) describes *T. inflatiseta* Volkmann, 1979 for the *nomen nudum, Tisbe inflatiseta* Fava & Volkman, 1975.
   (d) removes *T. compacta, cluthae, elongata* and *racovitzai* to species *incertae sedis* in the genus,
   (e) resurrects *Bathyidia* for *B. remota* Farran. This genus has the same codon in KGG 100 (p. 49) as *Tisbe.*
   As a consequence of this revision amend note b) to KGG 100 (p. 50) to read — "Care must be taken with these three genera. *Bathyidia* can be separated from most species of *Tisbe* by the form of the P.1 endopod (see Volkmann, 1979c). *Scutellidium* and *Tisbe* can be separated on the respective absence or presence of a seta on the A.2 basis".
3. Volkmann (1979b) revises *Tisbella.* As a consequence —
   (a) delete *Idyellopsis* and *Zosime* from KGG 1 (p. 48),
   (b) delete *Tisbella timsae* and *T. pulchella* from KGG 200 (p. 51),
   (c) describes *T. inflatiseta* Volkmann, 1979 for the *nomen nudum, Tisbe inflatiseta* Fava & Volkmann, 1975.
   (d) insert KGG as follows —
   KGG 300 — characters
   1. A.1♀
      n = number of segments.
   2. A.2 Exp.
      n = number of segments.
   3. P.2-P.4 Exp.3
      n:n:n = number of setae and/or spines on P.2, P.3 and P.4 respectively.
   4. P.2-P.4 Enp.3
      n:n:n = number of setae and/or spines on P.2, P.3 and P.4 respectively.
   5. P.2-P.4 Enp.2
      n:n:n = number of setae on inner border of P.2, P.3 and P.4 respectively.

KGG 300

A.1♀ segs.	A.2 Exp. segs.	P.2-P.4 Exp.3 setae	P.2-P.4 Enp.3 setae	P.2-P.4 Enp.2 setae	
8	4	7:8:8	5:6:5	2:1:1	*Idyellopsis*
7(-8?)	3	7:8:8	5:6:5	2:2:1	*Tisbella pulchella*
7	4	7:8:8	5:6:5	2:2:1	*Tisbella*[a)]
7	3	7:8:8	4:5:4	1:1:1	*Zosime*[b)]
7	3	7:8:8	4:4:4	1:1:1	*Z. reyssi*
7	3	7:7:7	4:4:4	1:1:1	*Zosime*[c)]
6	3	7:7:7	4:4:4	1:1:1	*Zosime*[d)]
6	3	6:6:6	4:3:3	1:1:1	*Z. bathyalis*

   a) *Tisbella timsae, rosea* Volkmann, 1979b, *alba* Volkmann, 1979b.
   b) *Zosime incrassata, bathybia.*
   c) *Zosime valida, atlantica, paratypica.*
   d) *Zosime typica, major, mediterranea, gisleni, bergensis, erythraea, paramajor.*
4. As a consequence of Kunz's (1981) revision of the Paramesochridae the following must be deleted from Tisbidae KGG 1 (p.48) —
   (a) codons for the two species of *Tisbisoma,*
   (b) codon for *Idyanthopsis psammophila,*
   (c) footnote c).

Family Porcellidiidae

Hicks (1982a) redescribes *Porcellidium tristanense* and describes three new species — *P. algoense, P. laurencium* and *P. ulvum.*

Family Peltidiidae

1. KGG 1 (p. 53): New codons are required for —
   Altheutha roeae Hicks, 1982a — 2/3/1:1:1/1:1:1/d:d
   Eupelte beckleyae Hicks, 1982a — 2/2/0:0:0/1:1:2/d:d
   Altheuthellopsis corallina Humes, 1981b — 1/2/0:0:0/1:1:1/f:f.
2. KGG 100 (p. 55): *Eupelte hexaseta* Hicks, 1982a has 6 setae.
3. *Altheutha langi* a synonym of *A. depressa* according to Hicks (1982a).

Family Tegastidae

1. *Tegastes acroporanus* Humes, 1981a and *T. cnidicus* Humes, 1981b to genus codon in KGG 1 (p. 56).
2. *Parategastes coetzeei* Kunz, 1980 to genus codon in KGG 1 (p. 56).
3. Kunz (1980) follows Monard (1935) in raising *Parategastes sphaericus* var. *similis* Sewell, 1924 to full species status. This species is included in the genus codon in KGG 1 (p. 56).

Family Parastenheliidae

Parastenhelia megarostrum Wells, Hicks & Coull, 1982 is added to the genus (see p. 12); a key to the genus is given.

Family Diosaccidae

1. *Amphiascoides golikovi* Tschislenko, 1977 to codon for *A. littoralis* in KGG 1100 (p. 74).
2. *Miscegenus heretaunga* Wells, Hicks & Coull, 1982: Because the A.2 exopod can have two or three segments this new genus and species requires new codons as follows —
   in KGG 110 (p. 74) — <Exp/se/7/5:5/2:5
   in KGG 600 (p. 89) — 5:6:7/0:0:0/2:5/5:5/m.
3. *Robertsonia curtisii* Greenwood & Tucker, 1982 to codon for *R. diademata* and *R. angolensis* in KGG 200 (p. 77).
4. *Stenhelia (D.) latioperculata* Itô, 1981 requires a new codon in KGG 400 (p. 86) — 4/7:8:7/7/d:d/lss.
5. KGG 600 (p. 89): New codons are required for —
   Amphiascoides koltuni Tschislenko, 1977 — 5?:6:7/0?:0:0/2:4/5:5/?
   Diosaccus aff. *dentatus* Itô, 1982a — 7:8:8/0:0:0/1:4/6?/?
6. *Schizopera elatensis* Kahan & Bar-El, 1982 to genus codon in KGG 800 (p. 93).

Family Ameiridae

1. *Parapseudoleptomesochra italica* Pesce & Petkovski, 1980 to codon for *Parapseudoleptomesochra*d) in KGG 1 (p. 102 as *Nitocrella,* but see Wells, 1978 p. 5).
2. *Praeleptomesochra phreatica* Pesce, 1981 requires a new codon in KGG 1 (p. 101) — 3:3/2:3:3/2:2:2/4/1 — and a note that the existing genus codon now applies only to *P. africana, P. pygmaea* and *P. similis.*
3. *Ameira parascotti* Tschislenko, 1977 requires a new codon in KGG 400 (p. 114) — 0:0:0/1:1:1/1:1:1/4:5:5/4:5/?
4. *Nitocrella petkovskii* and *N. paceae,* both new species by Pesce (1980), require new codons in KGG 700 (p. 120) —
   4:4:5/1:1:1/1:2:1/3:4/? — *N. petkovskii*
   4:4:6/1:1:1/1:1:1/3:4/? — *N. paceae.*

Family Paramesochridae

1. Becker & Kunz (1981) transfer *Oniscopsis* to family Tetragonicipitidae; as a consequence —
   (a) delete codons to *O. robinsoni* (p. 124) and *O. pauliani* (p. 125) in KGG 1,
   (b) character 5 in KGG 1 is now redundant.
2. Kunz (1981) describes several new taxa —
   (a) *Diarthrodella secunda pacifica* to species codon in KGG 1 (p. 124),
   (b) *Paramesochra acutata hawaiiensis* requires a new codon in KGG 100 (p. 126) — 4/4:4:2/0:0:0/1:3/0:3,
   (c) *Kliopsyllus insularis* requires a new codon in KGG 200 (p. 127) — 4:4:2/1:1:1/2:3/1:4,
   (d) *Kliopsyllus debilis* to codon for *K. enalius* in KGG 200 (p. 127),
   (e) *Kliopsyllus californicus* to codon for *Kliopsyllus*c) in KGG 200 (p. 127),
   (f) *Kliopsyllus spiniger ornatus* to species codon in KGG 200 (p. 127).
3. Kunz (1981) revises the family. As a consequence changes to KGG 1 (p. 124) are necessary to accommodate —
   (a) the reduction of *Paraleptopsyllus* to a subgenus of *Leptopsyllus,* and *Intermedopsyllus* to a subgenus of *Scottopsyllus,*
   (b) the placement of *Kliopsyllus runtzi, K. abyssalis* and *K. gigas* in *Wellsopsyllus,* a new subgenus of *Scottopsyllus,*
   (c) Kunz's formal proposal that *Idyanthopsis psammophila* be transferred to *Diarthrodella,*
   (d) the transfer of *Tisbisoma* to this family; add a new codon — 2-3:3:3:3/3/5/8/nf.
4. *Paramesochra borealis* Geddes, 1981a requires a new codon in KGG 100 (p. 126) — 4/4:4:2/0:1:1/2:3/2:4.
5. Amend the codons in KGG 100 (p. 126) for these species to read —
   4/4:4:2/0:0:1/2:4/0:2 *Paramesochra longicaudata*
   4/4:4:2/0:0:1/2:3/0:3 *P. helgolandica*
   4/4:3:2/0:0:0/1:3/0:3 *P. acutata* s.str.
6. Amend the codon in KGG 300 (p. 129) for *Apodopsyllus camptus* to read — 1/5/0:4/0:4. On further examination it is clear to me that the "inner seta" of the P.5 basendopod is only a remnant of the inner lobe.

Family Tetragonicipitidae

1. Three new species of *Phyllopodopsyllus* by Kitazima (1981) need to be added to KGG 1 (p. 131) —
   (a) *P. simplex:* female to codon for *P. danielae;* male to codon for *P. bahamaensis* and *P. opisthoceratus*♀.

   (b) *P. punctatus:* female to codon for *P. mossmani* and *P. laspalmensis;* male to codon for *P. paramossmani*♂.
   (c) *P. setouchensis:* female to codon for *P. bermudae* et. al.; male requires a new codon — a/2vr/2/3:3:2/5:6:6.
2. *Phyllopodopsyllus borutzkyi:* Codon in KGG 1 (p. 132) refers to female only; add a new codon for the male — a/2wd/2/3:2:2/4:4:6.
3. Add a new codon to KGG 1 (p. 133) — a/a/2/2-3:1:1/3:2:1 — *Oniscopsis.*

Family Canthocamptidae

In KGG 100 (p. 138) amend the codon for *Mesochra paranaensis* to read — 6/3/7:7:7/5:5/5:5/?

Family Cylindropsyllidae

1. *Boreopontia heipi* Willems, 1981 to codon for *Arenopontia australis* in KGG 1 (p. 141).
2. *Syrticola flandricus* Willems & Claeys, 1982 requires a new codon in KGG 1 (p. 141) — s/2:na/f/1:1:1/p.
3. Geddes (1981a) redescribes the female of *Leptastacus rostratus* (the male remains unknown). As a consequence amend the species codon in KGG 300 (p. 144) to read — p/2/0:0:1/3:4:5/1:1:0/1:2:2.
4. Geddes (1981a) raises *Leptastacus rostratus taurica* to species status; it has the same codon in KGG 300 (p. 144) as *L. rostratus.*

Family Cletodidae

1. Thistle (1980) describes two new species of *Enhydrosoma,* reviews the genus, comments on several species and provides a key; as a consequence —
   (a) *Enhydrosoma franklini* Thistle, 1980: Because segments 1-2 of P.2-P.4 exopod are fused together this species has the same codon in KGG 1 (p. 155) as *Enhydrosomella,* but the line of fusion is obvious and *E. franklini* cannot be confused with any species of *Enhydrosomella,*
   (b) *Enhydrosoma woodini* Thistle, 1980 requires a new codon in KGG 500 (p. 165) — 2:3/a/d:3:2/d:2:2/♀,
   (c) amendments to several codons in KGG 500 (p. 165) are required —
   2:3/a/d:3:4/d:2-3:4/s — *E. curticauda*
   2:2-3/a/d:3:5/d:2-3:5/m — *E. curvirostre*
   2:2-3/a/d:3:4-5/d:2:2/♀— *E. propinquum*
   2:3/a/d:3:4/d:3:4/m-s —*E. sarsi*
2. *Heteropsyllus pseudonunni* Coull & Palmer, 1980 to codon for *H. confluens* in KGG 1 (p. 158).
3. New codons are required in KGG 1 (p. 154) for two new monotypic genera described by Apostolov (1980) —
   3:2/3:3:3/2:2/5:5:6/3:3 — *Pontocletodes ponticus*
   2:1/3:3:3/2:2/5:6:6/4:4 — *Miroslavia longicaudata*
4. *Enhydrosoma variabile* Wells, Hicks & Coull, 1982 requires a new codon in KGG 500 (p. 165) — 2:3/a/d:2:3-4/d:2:2/s.

Family Laophontidae

1. *Heterolaophonte serratula* Mielke, 1981a requires new codons —
   in KGG 1-♀♀ (p. 172) — 3:3:2/2:2:1/5:6/2/7
   in KGG 1-♂♂ (p. 188) — 3:3:2/2:1/5b)/2/2.
2. *Stygolaophonte arenophila:* Amend the codon in KGG 1-♀♀ (p. 173) to read — 3:3:2/2:2:1/4:2/2/7.

3. *Esola longicauda galapagoensis* Mielke, 1981a: As the outer seta of ♀P.5 Benp. is very reduced and spinule-like it would be advisable to add a new codon in KGG 1-♀♀ (p. 172) — 3:3:3/2:2:2/2(3?):6/2/6. Note also that the species codon in KGG 900-♀♀ refers only to the nominate subspecies. The male of this new subspecies keys out with the species codon in KGG 600-♂♂ (p. 195).
4. *Afrolaophonte schmidti* Mielke, 1981a requires new codons —
   in KGG 1-♀♀ (p. 172) — 1:3:3/0:1:1/4:4/1/5
   in KGG 1-♂♂ (p. 188) — 1:3:3/0:1s/0:3/1/2.
5. *Klieonychocamptoides arganoi* Cottarelli & Mura, 1980 and *K. itoi* Mielke, 1981a both require the same new codons —
   in KGG 1-♀♀ (p. 172) — 1:1:1/0:0:0/3:4/1/6
   in KGG 1-♂♂ (p. 188) — 1:1:1/0:0/7[b])/1/1.
6. *Klieonychocamptoides remanei:* Amend codon in KGG 1-♀♀ (p. 172) to read — 1:1:1/0:0:0/3:4/1/7.
7. *Mexicolaophonte arganoi* Cottarelli, 1977 requires new codons —
   in KGG 1-♀♀ (p. 172) — 2:2:2/0:2:2/5:5/1/6
   in KGG 1-♂♂ (p. 188) — 2s:1s:2/0:1/0:4/1/2.
8. Geddes (1982) redescribes *Laophontina dubia;* amend present codons to read —
   KGG 1-♀♀ (p. 172) — 2s:1:3/0:0:1/4:5/1/6
   KGG 1-♂♂ (p. 188) — 2s:1:3/0:1/0:3/1/0.
9. Mielke (1981a) describes *Galapalaophonte pacifica* n.gen., n.sp. but later (1982) synonymizes the species with *Laophontina triarticulata.* As a consequence amend the codon in KGG 1-♀♀ (p. 172) to read —
   1s-2s:3:3/2:2:1/4:5/1/6.
10. *Paralaophonte aenigmaticum* Wells, Hicks & Coull, 1982: Male to codon for *Arenolaophonte stygia* in KGG 1-♂♂(p. 190). Variability in the P.5♀ causes this species to
    (a) key out to *Esola rosei* in KGG 1-♀♀ (p. 173),
    (b) require a new codon in KGG 500-♀♀ (p. 179)
    — 6:5-6:4/1:1:1/0:0:0/4:5:3/0:0:0.
11. *Quinquelaophonte* Wells, Hicks & Coull, 1982 is erected for the *quinquespinosa*-group of *Heterolaophonte.* As a consequence name changes are required to *Heterolaophonte* in KGG 1400-♀♀ (p. 183) and KGG 1800-♀♀ (p. 185), and to *H. parasigmoides, H. quinquespinosa, H. capillata, H. longifurcata* and *H. wellsi* in footnotes h and i of KGG 1-♂♂ (p. 191).
12. *Quinquelaophonte candelabrum* Wells, Hicks & Coull, 1982 requires new codons
    in KGG 1-♀♀ (p. 172) — 3:3:3/2:2:2/5:5/2/5
    in KGG 1-♂♂ (p. 188) — 3:3:3/2:2/4[b])/2/2.
13. Wells, Hicks & Coull (1982) give keys to *Paralaophonte* and *Quinquelaophonte.*
14. *Loureirophonte isabelensis* Mielke, 1981a requires new codons —
    in KGG 100-♀♀ (p. 177) — 5:5:4/1:1:0/0:0:0/3:3:2/0:0:na
    in KGG 1-♂♂ (p. 188) — 3:3:3/2:1/1:5/2/2.
    The present genus codon in KGG 1-♂♂ now applies only to *L. catharinensis* and *L. paranaensis.*
15. *Echinolaophonte tetracheir* Mielke: Female to codon for *E. horrida* and *E. brevispinosa* in KGG 300-♀♀ (p. 177). Male requires a new codon in KGG 200-♂♂ (p. 193) — 6:7:6/1:1:1/3:4:3/0:0/a.
16. *Paralaophonte panamensis* Mielke, 1982 requires new codons —
    in KGG 500-♀♀ (p. 179) — 6:7:6/1:1:1/0:0:0/4:6:4/0:0:0
    in KGG 1200-♂♂ (p. 197) — 6:5:5/1:1:1/4:4:4/0:0/p.
17. *Paralaophonte innae* Tschislenko, 1977 requires new codons —
    in KGG 600-♀♀ (p. 179) — 6:7:7/0:0:0/4:5:4/0:0:0
    in KGG 600-♂♂ p. 195) — 6:7:7/1:1:1/4:5:4/0:0/a.

18. *Paralaophonte pacifica galapagoensis* Mielke, 1981a to species codons in KGG 700-♀♀ (p. 180) and KGG 1100-♂♂ (p. 197).
19. *Paralaophonte problematica* Mielke, 1981a: Male to codon for *Paralaophonte*[a)] in KGG 1100-♂♂ (p. 197). Female requires a new codon in KGG 700-♀♀ (p. 180) — 6:7:7/1:1:1/0:0:0/4:5:4/0:0:0.
20. *Laophonte galapagoensis* Mielke, 1981a: Male to codon for *Paronychocamptus*[e)] in KGG 1-♂♂ (p. 189). Female requires a new codon in KGG 1200-♀♀(p. 182) — 6:7:7/1:1:1/0:0:0/4:6:4/0:0:1.
21. KGG 1600-♂♂ (p. 184): Delete the last codon in this KGG. The codon 6:7:7/1:1:1/0:1:1/7:6:6/1:1:1 now leads to *Pseudocletopsyllus spiniger* and four species of *Cletopsyllus (bacescui, secundus, sakagamii* and *brattstroemi* Geddes, 1981b). Male of *C. brattstroemi* to genus codon in KGG 1-♂♂ (p. 190).
22. *Laophontina* sp.♂ Mielke, 1982 requires a new codon in KGG 1-♂♂ (p. 188) - 1:2:3/0:2/0:5/1/2.
23. Hicks (1982b) describes the true male of *Laophonte danversae.* As a consequence
    (a) add a new codon to KGG 1-♂♂ (p. 188) — 3:3:3/2:2/2:5/3/2,
    (b) delete the codon for this species in KGG 1500-♂♂ (p. 198).

Family Ancorabolidae

Paralaophontodes exopoditus Mielke, 1981a requires a new codon in KGG 1 (p. 202) — 2:2/0:0/4-5/5:5:5/na:na. Note that the existing genus codon now applies only to *P. echinatus* and *P. robustus.*

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