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Aplacophore Mollusks of the 2003 Regional Monitoring Survey of the Southern California Bight

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and presented at a SCAMIT meeting on 11 April 2005.

Introduction

Examination of the material was a joint effort performed sequentially by the two authors. An initial examination and identification was performed by Don Cadien using only external characters. Kelvin Barwick subsequently and independently identified the animals using both external and internal characters. We then met to resolve discrepancies between the two sets of identifications and produced a final set for data submission.

The text is largely the work of Don Cadien, with editorial corrections, and additional material on radulae and polarized light examination of spicules by Kelvin Barwick. Kelvin captured all the images used here, and assembled the plates which accompany the voucher sheets in Appendix D. This attempt at a key is Don Cadien's: complaints about it, and suggestions for improvement, should be directed to him

Both the authors wish to acknowledge the support of their agencies in permiting them to pursue this project through their workplace. Without that support much less would have been accomplished. We also acknowledge assistance from Dr. Amelie Scheltema in identifying and/or verifying specimens submitted to her by Kelvin Barwick over the past few years.

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Aplacophore Mollusks of the 2003 Regional Monitoring Survey of the Southern California Bight - Kelvin Barwick (CSDMWWD) and Don Cadien (CSDLAC)

Survey design of the benthic infaunal portion of the Bight'03 Coastal Ecology program (B'03) included sighting of sampling stations below 200m. Previous regional programs have not extended much beyond 200m depths. In consequence members of the molluscan class Aplacophora were very infrequently encountered. Their infrequency was reflected in a lack of interest in their specific level identification. Only one aplacophore species level taxon could be reliably identified by Bight'98 program (B'98) participants, *Limifossor fratula*. All other taxa were lumped under Chaetodermatidae.

The group is more difficult to work with than most mollusks because its members lack a shell. These are the "worm-mollusks", elongate animals which possess a radula and bear spicules of aragonite rather than a shell. Since they have encountered so few, not many local taxonomists have expended much effort on them. It was our goal to produce a tool to provide reliable and definitive identifications based on external features. Hopefully we have succeeded, although radular examination remains necessary in some cases to provide confirmation of identifications based on external body features.

I. Composition of the Aplacophora

The higher level taxonomy of these animals has remained in flux for many years. Traditionally the Aplacophora were divided into two major groups; the chaetodermomorphs with no ventral pedal groove (the vestiges of the foot), and the neomeniomorphs which retain a ventral pedal groove (Figure 1).

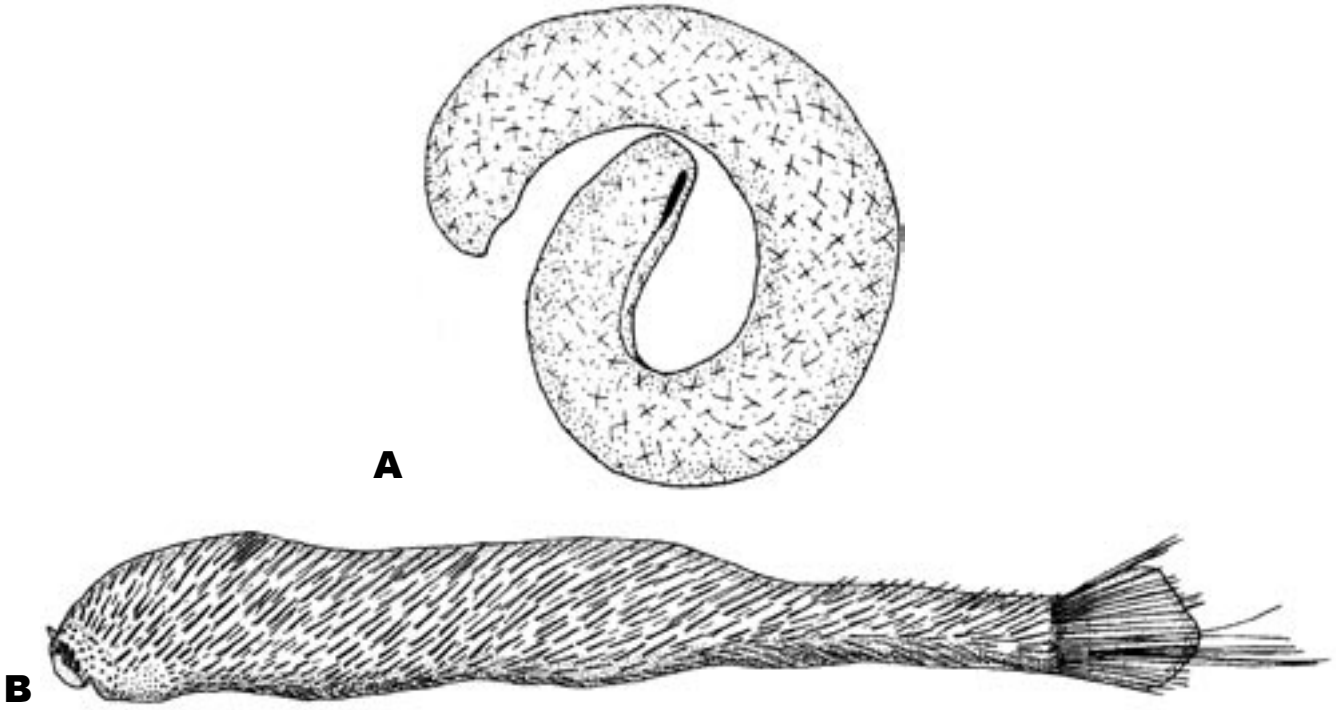

Figure 1. Aplacophore body form A) neomeniomorph (from Scheltema & Schander 2000), B) chaetodermomorph (from Scheltema 1993)

The differences between these two body plans have long seemed highly significant to many, and aplacophorans were viewed as poly- or paraphyletic (Salvini-Plawen 1968, Haszprunar 2000) united only by the synplesiomorphy of lacking a shell. Subsequent organizations of the mollusks have

grouped the "aplacophores" together (i.e. Scheltema 1978), or with the polyplacophores into a larger group Aculifera (Scheltema 1993) separate from the main molluscan line (Conchifera – the shell bearers). Other proposals have been tendered by biologists who are not in agreement with the above concepts. Cladistic methodology has helped provide support for some proposals while reducing it for others. Haszprunar's analysis yielded solenogasters (or neomeniomorphs) as the sister group to all other mollusks, and primitive rather than secondarily reduced or paedomorphic. The chaetodermatid "aplacs" group with the chitons in his analysis, but remain the sister taxon for all other mollusks except the solenogasters. This renders the concept of Aculifera, as used in the present SCAMIT Taxonomic Listing obsolete. Our use of "Aplacophora" is thus no longer reflective of current systematics (Salvini-Plawen 2003). For simplicity, we will retain it and use it in a general sense.

Within the solenogasters there is so much diversity that Salvini-Plawen (1978) introduced four separate orders for them. The last two decades have produced a flurry of description of new forms and a proliferation of families to receive them. Only a few specimens of this group were taken in B'03 samples, so we won't spend more time going into details of the group taxonomy. Any interested parties with time on their hands can contact Don Cadien for further information.

II. Previous Investigations in the Bight

Earlier work on the Southern California Bight aplacophoran mollusks was done by Heath (1911), Schwabl (1961a, b; 1963), and Scheltema (1998). The work of Scheltema in the Santa Maria Basin Taxonomic Atlas series (1998) corrected many previous errors and described for the first time several common animals from our area. All three of the previous workers were limited by available collections resources. Heath was reporting on the material taken by the U.S.S. Albatross in California waters. Schwabl analyzed the collections resulting from the Allan Hancock Foundation (AHF) efforts throughout the Bight and especially those produced by intensive investigations of the San Pedro Basin and the submarine canyons of Southern California. Collections made by the Bureau of Land Management throughout the Bight (related to offshore oil tract leasing) were identified by Jay Shrake, but he never published on his investigations. Scheltema studied this material in the collections of the Los Angeles County Museum of Natural History prior to working on the collections from the Santa Maria Basin and western Santa Barbara Channel taken by the Minerals Management Service (again related to offshore oil exploration). Her report in the MMS Taxonomic Atlas series provides information based on the earlier collections as well as on the material gathered under MMS auspices.

We also examined material from the earlier collections housed at the Natural History Museum of Los Angeles County (NHMLAC) as well as materials gathered during B'03 sampling. We augmented this material with collections made in 2003 by County Sanitation District of Los Angeles County (CSDLAC) at numerous slope and basin sites off Palos Verdes and the San Pedro Sea Valley. Additional material came from both the City of Los Angeles Environmental Monitoring Division (CLAEMD), and City of San Diego Metropolitan Wastewater Department (CSDMWWD) in screen-size comparison tests. Legacy materials taken by Robert Hessler of the Scripps Institute Oceanography (SIO) in the Tanner Basin in 1972, and others collected on the Cascadia Slope off the Columbia River in 1975 by A. G. Carey (Oregon State University) was also examined. This accumulated mass of material was helpful in defining variability in animals usually seen only one or two at a time.

III. The Bight '03 collections

Both chaetodermomorphs and neomeniomorphs were taken by participant agencies in their B'03 infaunal samples. While moving offshore to sample at greater depths on the continental slope increased the catch of aplacophores, half the records were from stations shallower than 200m. We examined 178 countable specimens (those with an intact anterior end) in 132 species lots from 94 stations (of 432 stations occupied) (Appendix A). Forty-nine of these collection sites were in less

than 200m water depth (52%) while 23 were located between 200 and 500m on the slope (24%). Twenty-one were from an additional 32 samples in the 500-1000m stratum taken unofficially by the Channel Islands National Marine Sanctuary staff, and 1 was an out-of-stratum sample from 572m retained by CSDLAC. Having fewer required samples to do than other agencies, CSDLAC processed all of the 33 samples from the deep stratum (500-1000m).

The specimens represented 11 identified taxa (Appendix A) and 2 residual unidentified categories. This is an order of magnitude increase in reported diversity from the B'98 infaunal analysis. Since aplacophores are almost exclusively an outer shelf to abyssal group, their abundance and diversity increases with increasing depth of collection while that of many other groups declined. Characterization of the benthic communities of the slope and near shore basins will benefit from aplacophore identification by not undervaluing the diversity of an important community constituent.

We will present a number of photographs taken during this investigation which document the appearance of whole animals, radulae, and spicules. Vouchers from each species will be archived at the NHMLAC Malacology Section. The bulk collections will also reside at the Museum for anyone wishing to review the specimens. This document and its figures will also be posted among the taxonomic tools on the SCAMIT website (www.scamit.org).

IV. B'03 Regional Data – Bathymetric distribution of the aplacophore species

Of the 132 taxa lots 9 (2%) could not be identified to species. These were left at either genus (*Chaetoderma*) or family (Chaetodermatidae) level because the specimens did not provide sufficient information for further identification.

Figure 2 compares the bathymetric distribution of the collected taxa that were reported from three separate collections: the AHF (Schwabl 1963), the CSDLAC from sampling of the shelf and slope off San Pedro and Palos Verdes in 2003, and B'03. While the range extremes in each differ as do coverage and collection area, the overall pattern is similar in the three. In some cases, such as *Falcidens longus*, the taxon did not exist in 1963, and consequently did not appear in the AHF Collection reported on by Schwabl. In CSDLAC samples *Chaetoderma marinelli* was not recorded, but was probably taken and misidentified either as *Chaetoderma pacificum*, *Chaetoderma nanulum*, or *Falcidens longus*. These samples have not yet been reevaluated.

Arranged by first occurrence, the species show overlapping distributions extending from the inner or outer shelf down onto the slope for *F. longus*, *C. pacificum*, *C. marinelli*, and *Limifossor fratula*. Neomeniomorpha sp C, *F. hartmanae*, and *C. nanulum* do not occur on the shelf, but begin showing up on the upper slope at around 200m. The remaining four species are mid-slope species, whose distribution may run into the lower slope; *Chaetoderma hancocki*, *Spathoderma californicum*, *Furcillidens incrassatus*, and *Chaetoderma* sp A.

On the inner shelf (10-30m based on B'03 cluster analysis) only a single species was taken in the present survey – *F. longus*. On the middle shelf (30-120m) two *Chaetoderma* species: *C. pacificum* and *C. marinelli* also occurred. A third species, *C. elegans* has been taken at 97m by CSDMWWD, but was not taken in B'03 samples. The outer shelf (120-200m) adds only *L. fratula* to the aplacophore mix, although another species not found during B'03 also occurs there (*Falcidens macracanthos*).

Thus the shelf aplacophore fauna consists of 6 species: *F. longus* and *F. macracanthos*; *C. pacificum*, *C. marinelli*, and *C. elegans*; and *L. fratula*. Of these, only *F. macracanthos* is restricted to shelf depths (82-145m Scheltema 1998). *C. marinelli* may also be (52-101m in B'03 data; 30-64m in Scheltema 1998), but AHF samples identified by Schwabl record this species to 860m. These deeper records require reevaluation, but occurrence of *C. marinelli* on the slope cannot yet be completely discounted. The remaining shelf species extend downward onto the slope and all have broad bathymetric ranges.

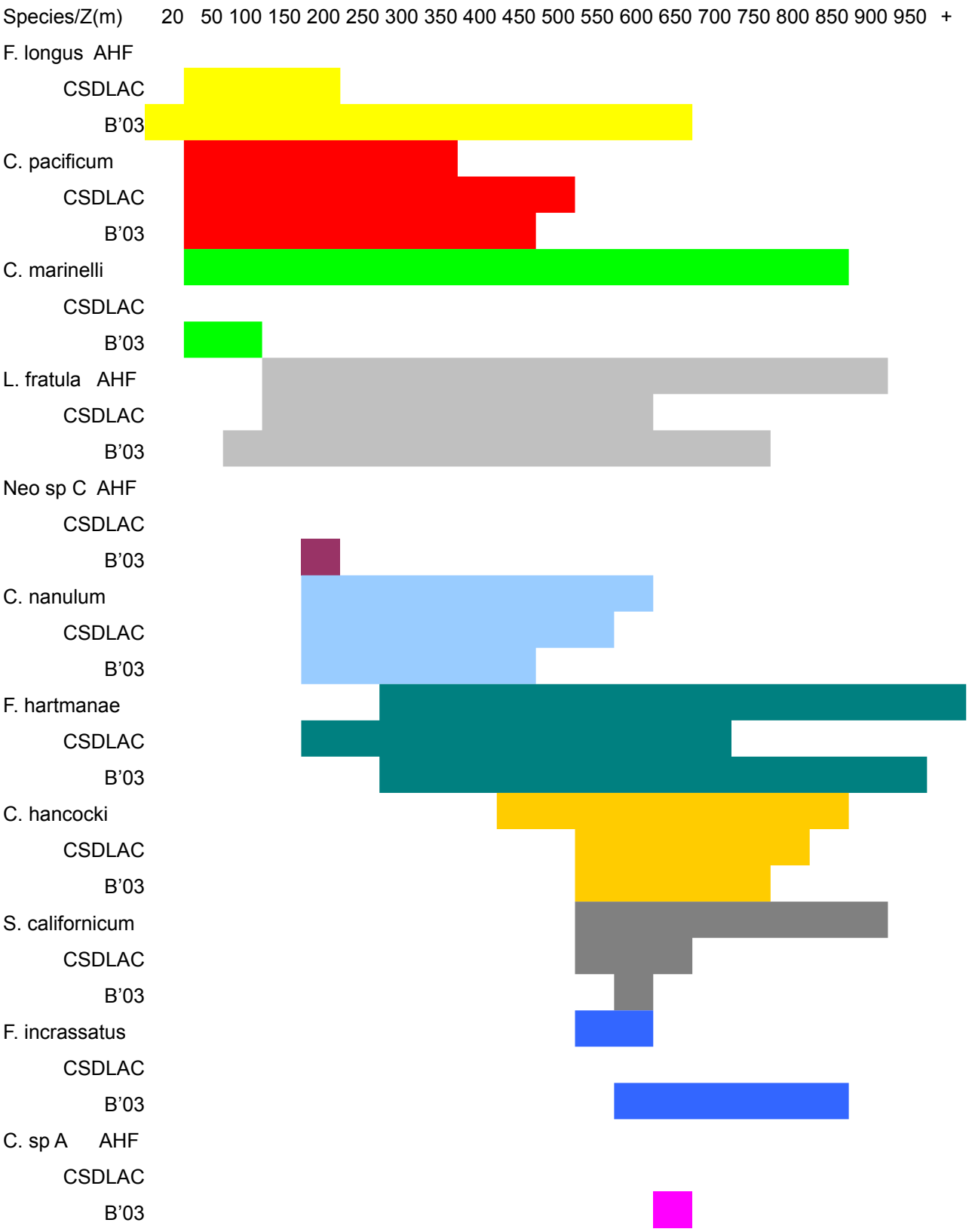

Figure 2. Species bathymetric range from AHF, CSDLAC, and B'03 collections

Slope-only species start abruptly at 200m in current data, with both *C. nanulum* and Neomeniomorpha sp C first taken at that depth. Scheltema records *C. nanulum* from the outer shelf too (as shallow as 160m) but it was not taken there in the Bight‘03 program. Neomeniomorpha sp C (200-223m) may also occur in a broader depth range once additional specimens are found.

Bathymetric distribution of *F. hartmanae* began at 310m in Bight’03 data, continuing through the upper and middle slope to 960m. Scheltema reports much the same upper end, but extends the distribution of the species beyond Bight’03 limits (300-1843m). This is a true slope species, as are *C. hancocki* (579-794m in Bight’03; 508-1830m in Scheltema 1998), *Furcillidens incrassatus* (610-668m in B’03: 504-549m in Scheltema 1998), and *S. californicum* (500-1800m, Scheltema 1998; 586-908m, Schwabl 1963). *C.* sp A may also prove to be, but only a single specimen is currently known.

A collation of lots from four sources, Schwabl 1963, CSDLAC monitoring, CSDMWWD monitoring, and B’03 allowed a further examination of bathymetric distributions. Several species seemed to have disjunct records either much too shallow or much too deep to fit with the rest of the records. In light of this the median depth of occurrence for each species was determined. These were: *Chaetoderma elegans* (97m), *C. hancocki* (700m), *C. marinelli* (71m), *C. nanulum* (394m), *C. pacificum* (150m), *Chaetoderma. recisum* (530m), *C. scabrum* (426m), *C.* sp A (660m), *F. hartmanae* (606m), *F. longus* (60m), *F. macracanthos* (no records), *Furcillidens incrassatus* (623m), *L. fratula* (361m), Neomeniomorpha sp A (508 m), Neomeniomorpha sp B (508m), Neomeniomorpha sp C (212m), *Plathymenia branchiosa* (800m), *Spathoderma californicum* (651m), *Spathoderma* sp A (643m).

V. Procedure for Examination of Specimens

Each specimen requires independent examination, as mixed lots of several similar species are commonly taken. To the extent practical each specimen should be disentangled and straightened, then cleaned of adherent debris. This allows more accurate assessment of the body regionation, if present, as well as spicule appearance and arrangement. If one or more specimens taken from a single grab are fragmented, the parts should be matched based on relative diameter and/or size, condition, color, or any other means available. If association of anterior and posterior fragments is problematic, the head ends should be counted and identified to the level possible from apparent structure.

Body length index (BLI – the ratio of length to width at widest point) should be assessed. However, painstaking measurement is not necessary. If the body is regionated, the relative length of each region should be determined. The state of the specimen’s contraction should be noted, along with retraction or extension of oral shield and gills.

Details of the oral shield should be determined where possible. Length vs. width of the shield, the depth and nature of the cleft, the definition or lack-there-of the lateral lobes, the location of the oral pore relative to the cleft can be of value in distinguishing some species. Detail should also be gathered at the specimen’s other pole by characterization of the posterium. The size, length, and density of fringing spicules, the size and definition of the dorsal sense organ, the presence or absence of spicules on the skirt of tissue between the spicular fringe and the flattened (or cone-shaped) peribranchial plaque; the arrangement of spicules on the peribranchial plaque; and the shape of the branchial opening can prove helpful characters. A specimen examination log form is appended (Appendix C) to help in recording characters.

Spicules for microscopic examination should be removed from the mid-anterior trunk. To remove spicules place a whole specimen on a slide with a few droplets of liquid. Use a needle probe to tease off spicules into the fluid. Remove the specimen and prepare a wet mount. The slide can be allowed to dry out but the wet mount allows some spicule manipulation by squishing them around under the cover slip.

VI. External characteristics of Aplacophorans

(see also the introduction in Scheltema 1998)

There are such disparate morphologies in the two groups of aplacophorans that they must be discussed separately.

A. Solenogastres (neomeniomorphs)

The animals have a longitudinal axis with a mouth near one end, and a cloacal chamber near the other. Both are usually ventral, but the cloacal chamber may be terminal in some species. Between the two runs a ventral pedal groove which is the foot remnant. This is a narrow area lacking spicules which bears ciliated tracts used in locomotion of the animal. Don Cadien has seen an undescribed species in this group alive; crawling over the bottom of a Petrie dish on its ciliated sole. Both the crawling and flexure of the animal were slow actions.

Dorsally the animal is usually undifferentiated and it may not even be possible to tell head from tail. Some forms have one or more dorsal carinas which do provide a dorsal character of value. There may be a difference in shape anteriorly and posteriorly, but in some it is the head that is pointed and the rear rounded, while in other forms it is the reverse. The body is generally short-vermiform with a length to width ratio in excess of 6. One local species, *Plathymenia branchiosa*, is quite short, only about twice as long as broad. Some of the larger forms (and there are some giants in the Antarctic) are quite thick for their length, resembling sausages.

Neomeniomorphs may be round, tall oval or flat oval in cross-section, or be almost ribbon-like (strongly laterally compressed) with parallel or subparallel sides. They are all covered by spicules, but the form of these varies, as does the number of layers of overlapping spicules, and the way in which the spicules are attached to the dermis. Spicule shape can be plate-like and rounded, tile-like and angular, or elongate as long hollow or solid spines. In some families specialized barbed “fish-hook” spines are found. Some tile-like spicules may be drawn distally into a pointed projection either shorter or longer than the basal portion of the spicule.

Spicules have been divided into three types based on their arrangement on the body (Scheltema and Schander 2000):

- **skeletal** or **tangential**, spicules in multiple layers lie flat in the cuticle at right angles to each other
- **upright** or **radial**, spicules in a single layer which is more or less erect with spicule tips extending beyond the cuticle
- **adpressed**, spicules in a single imbricated layer lying flat against the cuticle.

These types may occur mixed in a single species. The spicules which line the edge of the pedal groove are usually not the same as the general body spicules, and are frequently paddle-shaped (distally expanded). In such spicules the basal portion (handle) may be quite short or long.

Specialized spicules occur in pockets within the cloacal cavity at the rear end of the animal. These are termed copulatory spicules. Their number and form is highly specific, and helps to distinguish closely related congeners in some families.

The mix of spicules enveloping each species gives it a characteristic look which is a product of their types, sizes, and arrangement. A variety of terms are used to describe this state. These are:

- **mossy** - non-shiny and non-reflective (resembling the finely granular calcareous cover of some chiton mantles)
- **dull -** non-shiny but reflective
- **shiny** - strongly reflective and silvery

- **brilliant** - very shiny and highly metallic in appearance.

These four can be further modified by the texture descriptors

- **smooth** - small flat plates or small slender spicules laying tight against the cuticle
- **rough** - spicules not tightly adpressed to cuticle, but not attached at large angles to body long axis
- **shaggy** - spicules held at a greater angle to body's long axis so that they interrupt the outline of the animal
- **spikey** - some spicules much larger than others in length and/or diameter

Relative length and width of neomeniomorphs combines with their cross-section and their spicule density-derived stiffness to produce a series of typical forms for preserved animals:

- **C** - contraction along the pedal groove leads to a c shape with the dorsum convex and the ventrum concave. The contraction is in most cases equal on an anterior to posterior axis.
- **comma** - anterior contraction stronger than posterior contraction, but dorsum still convex
- **twig** - dorsal and ventral contraction much the same so that the animal remains nearly linear
- **sausage** diameter nearly half length, curvature very slight
- **ribbon** - strong lateral compression and length many times width lead to ribbon-like shape frequently folded back on itself
- **coil** - long slender animals whose strong ventral contraction causes coiling

Other externally visible features which can be of value in identification include: contracted shape of the mouth, contraction or openness of the cloacal chamber, nature and number of branchial plications on the inner surface of the chamber if any, and existence of a pedal pit separate from the anterior end of the pedal groove. Sensory pits, housing ciliated sensory cells, may occur frontally or dorsally on the anterior or near the posterior end. The mouth may be preceded by a separate atrium.

B. Caudofoveata (chaetodermomorphs)

While there are fewer families involved (only 5, with 4 represented in the NEP), the morphological diversity of this group of aplacophores is nearly as large as that in the Solenogastres. All chaetoderms lack a pedal groove, although there is a residual trace in the genus *Scutopus*. Chaetodermomorphs are elongate on the anterior-posterior axis, with the mouth terminal anteriorly, and the branchial cavity terminal posteriorly. The attenuate body ranges from 3-6 at the low end to over 20 at the high end of the body length index. Some of the longer and thinner members (i.e. *Scutopus* and *Psilodens*) are strongly coiled, but the average chaetoderm is basically linear. The shorter taxa (i.e. *Limifossor* on our coast) are usually bent into a shallow C shape with the dorsum slightly arched. Longer forms, while linear, may loop or tangle themselves during capture and preservation.

In the members of the families Limifossoridae and Prochaetodermatidae the body is not divided into a series of regions; only the two ends being different from the rest of the body. This is also true of the scutopids, but their coiling makes it difficult to ascertain. In the limifossorids and scutopids the body is much the same diameter between the two ends, while prochaetodermatids taper either weakly or strongly from front to rear. In the families Chaetodermatidae and Falcidentidae the body is regionated into anterium, neck, anterior trunk, posterior trunk, and posterium (Figure 3).

Transitions from one region to the next may be marked by a change in spicule type, size, or attachment angle; by a change in diameter; by a weak or strong constriction; or by a mixture of these signals. Regionation patterns tend to be of considerable fidelity for a given species, although several species (in more than one family) may converge on a common pattern. Each of the two families with regionation has a spectrum of different patterns, some of which are shared. Discrimination of family and generic placement cannot be based on regionation alone in some cases, and radular characters

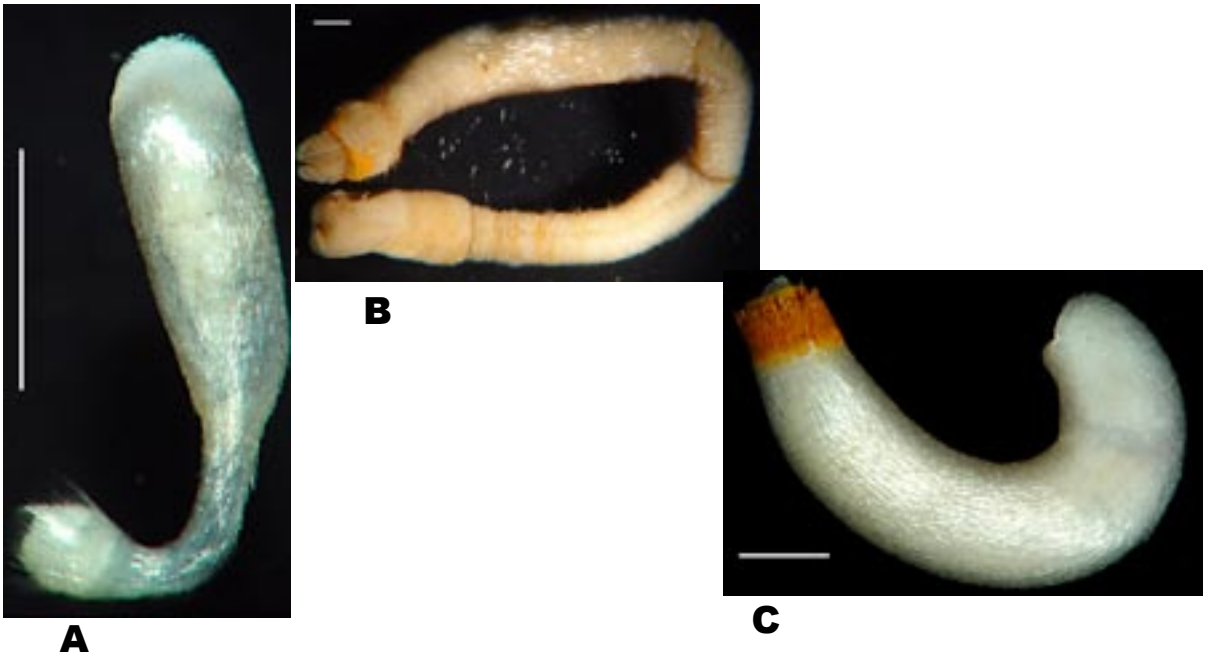

Figure 3. Body regionation in caudofoveaceans: A) posterior only (*Spathoderma*), B) full (*Chaetoderma*), C) none (*Limifossor*) Scale bars = 1 mm

are needed. Specific level identifications can usually be based on the pattern of body regionation, although for convergent pairs or triads of taxa, separation on external characters may require confirmation by radular examination.

Other externally visible characters are localized in a particular region. The anterium bears the oral shield with a mouth opening surrounded by a tissue pad of variable description (Figure 4). In a few forms this is either divided into two halves (all Prochaetodermatidae), or entire with the mouth pore surrounded on all sides by a continuous pad of tissue (individual species in the families Chaetodermatidae and Falcidentidae). The normal configuration is one in which the pad of tissue which forms the oral shield (OS) is cleft dorsally to the level of the mouth pore or beyond. This leaves the tissue flanking the cleft as two lobes which can be either well or poorly differentiated from the remainder of the OS. The extent of the cleft, the definition of the OS lobes, and the length/width ratio of the OS are all characters of value at species level. The entire OS can, however, be retracted into the head in some specimens.

In the Prochaetodermatidae the OS shape is uninformative, but the rows of thickened spicules which surround the mouth offer generic level information (Scheltema & Ivanov 2000). In *Prochaetoderma*, for instance, all species have two rows of enlarged spicules, while in *Claviderma* there are five.

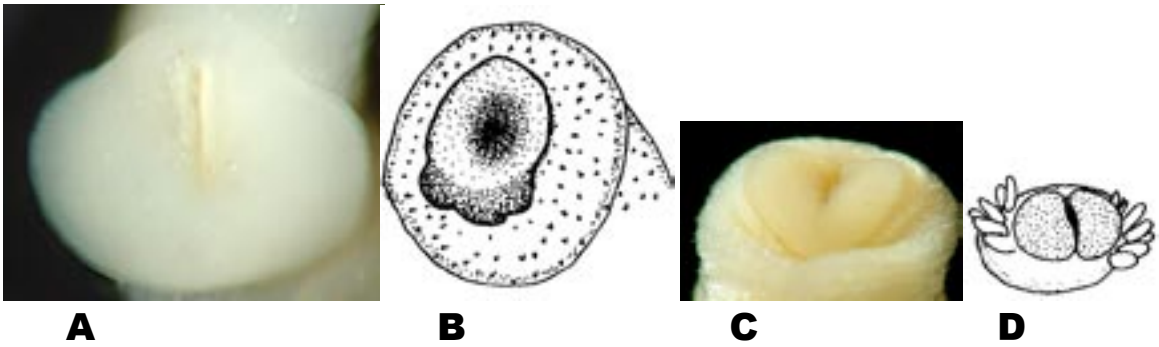

Figure 4. Oral Shield Types: A) wider than high, B) round and entire (from Scheltema 1993), C) as wide as high, D) separated (from Scheltema 1993)

These can be viewed without dissection, but a whole mount in a well slide may be necessary for this examination.

Examination of spicules (Figure 5 & 7) under polarized light has been used extensively as a diagnostic tool for separating species of caudofoveaceans. The birefringent patterns of color under such illumination provide information on the thickness of the spicule in various regions (Scheltema 1998, Scheltema & Ivanov 2004). We found this to be somewhat variable between individuals at various stages of growth for single species, and also between spicules taken from a single animal. The issue is further complicated by the apparent repeat cycling of the spectrum which yields the same color for more than one thickness. In actuality, as the thickness increases the hues become less saturated. In order to make absolute measurements you must compare color seen under polarization to a crystallographer's chart, e.g., the Michele-Levy Chart. Fortunately, this level of precision is not required here. What can be ascertained is the general topography of an individual spicule, including the thickest region, broad furrows, ridges, and edge details. This is done by comparing adjoining colors of an individual spicule with a color chart. For a given hue any colors to its left on the chart (Figure 6) will indicate thinner material and colors on the right will be thicker material. Consider the following hypothetical examples: Green abutting yellow indicates yellow is thicker. Green abutting blue indicates green is thicker. Blue abutting yellow with little or no transitional green in between would indicate a thicker ridge signified by yellow. Those with access to a polarizing microscope will find this additional information helpful in confirming or rejecting identifications arrived at using the key. A Nomarski or other differential interference contrast (DIC) illuminator will not work for this application.

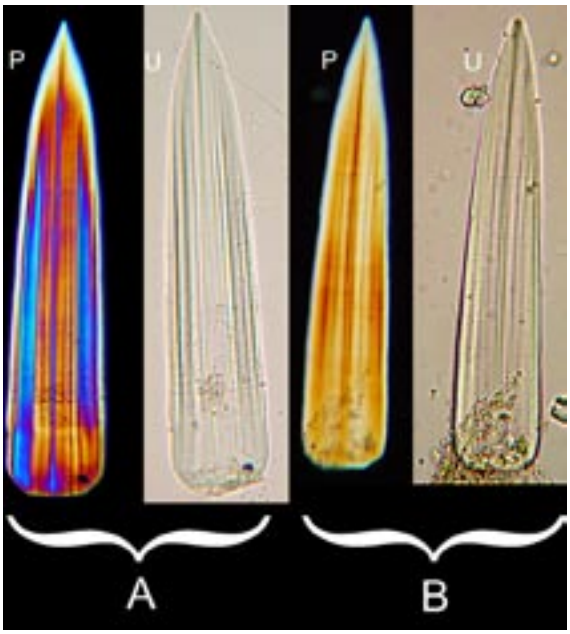

Figure 5. Spicules with polarizer (P) and unpolarized (U) A) *C. marinelli* B) *C. ellegans*

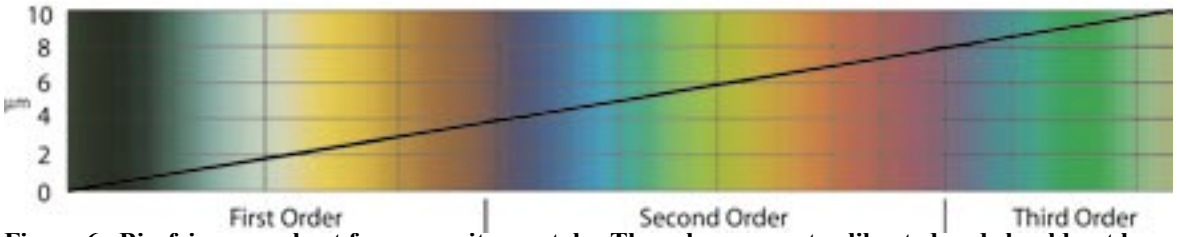

Figure 6. Birefringence chart for aragonite crystals. The colors are not calibrated and should not be used for absolute measurements (modified from Scheltema 1998).

VII. Internal Characteristics of Aplacophora

The internal anatomy of aplacophorans has been described by Scheltema et al (1994) who summarize and condense earlier literature. The internal features which particularly concern us here deal with the radula. Separation of genera is based on internal features including the radula. Given the convergence in external form between related genera, radular dissection is sometimes necessary to confirm the genus. General radular structure is treated by Scheltema (1972, 1981) and applied

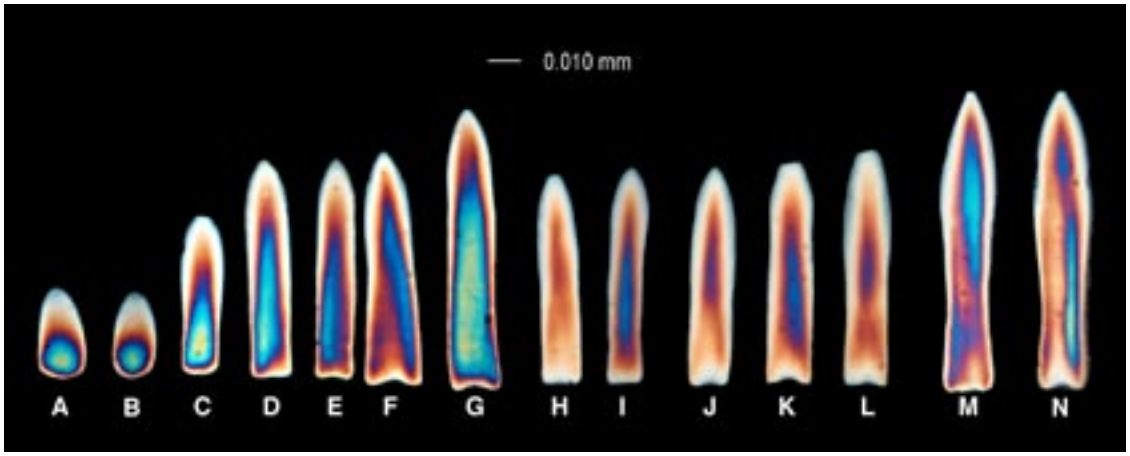

Figure 7. Chaetoderm spicules from the head of: A-G) *C. pacificum*; H-L) *F. longus*; M-N) *C. marinelli* under polarized light

to solenogasters by Scheltema & Schander (2000). Of particular concern is the radula of the Chaetodermatidae and Falcidentidae, which are functionally mysterious and barely recognizable as radulae at all (Figure 8). After a little practice the dissection is not difficult on many specimens, although small juveniles may require removal and dissolution of the entire head-end to recover the radula.

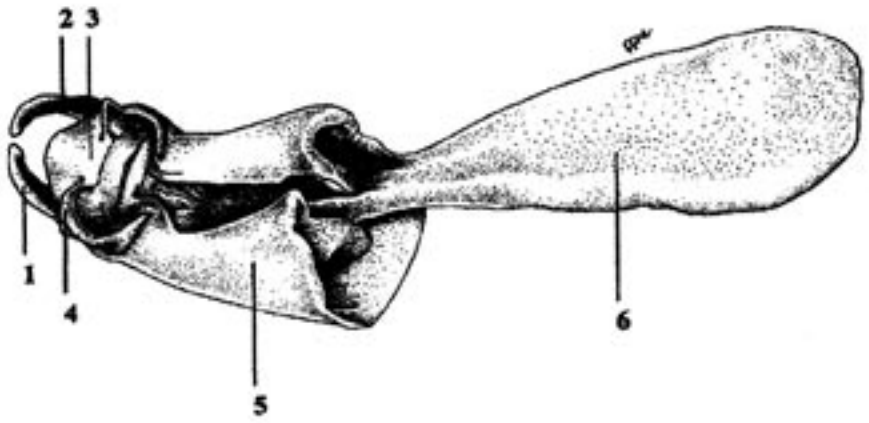

Figure 8. Structure of the falcidentid radula (from Cruz et al ,1998). 1 connective tissue sheath; 2. denticle (radular tooth); 3. triangular plate; 4. apophysis; 5. lateral membrane; 6. radular cone (flattened in this dry preparation)

Removing the radular apparatus of caudofoveaceans requires similar techniques typically used with other mollusks. Begin by making a short incision starting from just behind the oral shield running toward the posterior. Remove the buccal mass with a pair of forceps. It should be just behind the opening to the mouth. Often the denticles can be seen protruding out of the buccal mass tissue. Place the mass in a droplet of household bleach on a depression slide. While waiting for the tissue to dissolve, prepare a flat slide with a droplet of glycerin. When the radular apparatus is clear of muscle tissue move it to the glycerin using an Irwin loop. (These can be purchased from: Mark D. Schram at: schram@lyon.edu. They come as a set of three different microscopic size loops.) When placing the cover slip, keep an eye on the radula and mark its position with a fine point felt tip pen. This makes it much easier to find in the compound scope. A good sized meniscus of glycerin gives you the ability to roll the radula by nudging the cover slip. Rolling will provide a better view of the triangular plate and its associated apophyses (if present), and both lateral and frontal views of the cone to determine its three dimensional shape.

To compare the radular structure of the SCB species see Figures 9 & 10. Note that in several falcidentid species large specimens reportedly lack the triangular plate which characterizes the genus (Scheltema, 1998). In such cases the generic separation can still be made by the presence of relatively large curved teeth in species of *Falcidens*, and reduced nearly flat teeth in species of *Chaetoderma* (Salvini-Plawen 1975).

VIII. Provisional Species

A number of specimens which could not be confidently identified as described taxa were encountered in preparation for this report; two of them were taken in the Bight '03 collections. *Chaetoderma* sp A has a mix of characters which indicate it cannot belong to any of the other members of the genus. It is, however, as yet based on a single animal. More material of this form must be gathered before its variability can be characterized.

Neomeniomorpha sp C is similar to *Genitoconia mariensis* of Scheltema, but her original description was brief and we are keeping our specimens separate as a provisional pending more information. At least three other provisionals were encountered during the screen size study which preceeded Bight'03; *Spathoderma* sp A, Neomeniomorpha sp A (similar to Scheltema's *Gymnomenia minuta* in some characters), and Neomeniomorpha sp B. All are based on limited material, and cannot yet be fully characterized. They were not taken during the Bight'03 sampling. Many other provisionals were found in other materials studied in preparation for this report.

IX. Key to Known SCB Taxa (not all taken in B'03)

The following key represents modifications to the base key provided by Scheltema 1998. It includes additional species, and deletes taxa not known to occur in the SCB within the specified depth range.

Please note, while the key is intended to work for both juveniles and adults, it will work less well with juveniles. Younger individuals are smaller than adults, which means they are shorter. Where adults have a disproportionately long body region (some chaetodermomorphs) this disproportion will be less in smaller animals. Always ground-truth identifications arrived at with the key by comparing the specimen with the full description of the species the key places it in. Like other soft bodied animals, aplacs can be unusually stretched by events during their collection or preservation. Where portions of a regionated specimen are unnaturally elongated this should be detectable by the space between spicules. In a normally extended form, spicules will be adjacent or even over-lapping. In an artificially stretched specimen there will be distance between the bases of spicules.

Key to the aplacophores known from the Southern California Bight 0-1000m

1a) Cuticle interrupted by ventral longitudinal furrow; oral shield lacking, although oral pore or atrium may be visible; Solenogastres.....**2**

1b) Without ventral furrow; oral shield present (may be partially submerged into oral cavity; Caudofoveata **8**

2a) Body strongly laterally flattened, ribbon shaped .....Neomeniomorpha sp C

2b) Body oval or round in cross-section **3**

3a) Body very broad, short, and dorso-ventrally flattened; spicules uniformly short, forming an even covering; body length index 2-3..... *Plathymenia branchiosa*

3b) Body tall oval or round in cross-section; spicules various, forming an even or shaggy covering; body length index 4 or more **4**

4a) Body with sheaf of elongate spicules around cloacal chamber; comma shaped; body length index 4-5 .....Neomeniomorpha sp B

4b) Body lacking elongate spicular fringe; comma, C, or twig shaped; body length index greater than 5.....□ **5**

5a) A single irregular dorsal ridge runs the length of the body; body c shaped, body length index 5-6 ..... *Dondersia californica*

5b) Dorsal ridge lacking, dorsum smooth; body comma or twig shaped; body length index 6-10 ..... **6**

6a) Spicules arranged tangentially in more than one layer in cuticle; posterior end of body drawn out into long acute point..... *Dorymenia acuta*

6b) Spicules adpressed in single imbricated layer in cuticle; posterior end of body truncate, trumpet-shaped, or with subacute short process **7**

7a) Spicules predominantly elongate pointed ovals; body twig shaped ..... *Heathia porosa*

7b) Spicules subquadrate ovals lacking points; body comma shaped..... Neomeniomorpha sp A

8a) Body not regionated, even diameter from anterior to posterior end; body length index 4-7..... ..... *Limifossor fratula*

8b) Body regionated into distinct sections, or tapering from anterior to posterior; body length index 6-20+ **9**

9a) Oral shield divided into two separated halves; Prochaetodermatidae..... **10**

9b) Oral shield either entire or dorsally incised **11**

10a) Body tapered evenly from anterior to posterior ..... *Spathoderma californicum*

10b) Body diameter reduced sharply just before posterium, of nearly uniform diameter anterior to the reduction..... *Spathoderma* sp A

11a) Oral shield entire, mouth pore fully enclosed **12**

11b) Oral shield incised, mouth at least partially exposed..... **14**

(NOTE TRIPLET)

12a) Neck and anterior trunk of greater diameter than posterior trunk, which is frequently very narrow and elongate; triangular plate present in all but largest individuals; radular cone tapering evenly in frontal view, straight in lateral view ..... *Falcidens hartmanae*

12b) Neck and anterior trunk narrower than posterior trunk, triangular plate absent; radular cone tapering evenly in frontal view, strongly curved in lateral view..... 13

12c) Neck and posterior trunk of greater diameter than anterior trunk, which is subequal in length to both; triangular plate absent; radular cone unknown ..... *Chaetoderma recisum*

13a) Posterior trunk broader than anterior trunk and neck, about the same diameter as anterium, expanded strongly at posterium; radular denticles about 1/3 length of lateral plate..... ..... *Chaetoderma* sp A

13b) Posterior trunk broader than anterium, anterior trunk and neck, not expanded at posterium; radular denticles reduced to only 1/5 length of lateral plate ..... *Chaetoderma scabrum*

14a) Neck and anterium of much greater diameter than anterior trunk, posterior trunk also of greater diameter than anterior trunk ..... *Furcillidens incrassatus*

14b) Neck and anterium of similar diameter to anterior trunk..... **15**

15a) Anterior trunk more than twice as long as posterior trunk ..... *Chaetoderma elegans*

15b) Anterior trunk no more than 1 ½ times as long as posterior trunk **16**

16a) Anterior trunk shorter than posterior trunk (10% or more) **17**

16b) Anterior trunk subequal to or longer than posterior trunk **18**

17a) Anterior trunk spicules very long, extending well beyond neck diameter, and attached perpendicular to body axis ..... *Falcidens macracanthos*

17b) Anterior trunk spicules short, not extending beyond neck diameter, attached at acute angles but not perpendicular..... *Chaetoderma californicum*

18a) Anterior trunk between 1.2 and 1.5x posterior trunk **19**

18b) Anterior trunk and posterior trunk subequal in length **20**

19a) Oral shield taller than wide, posterium bulbous, with short non-protrusive fringing setae; peribranchial skirt lacking spicules; branchial aperture barbell shaped; anterium very broad relative to neck ..... *Chaetoderma hancocki*

19b) Oral shield wider than tall, posterium flat, with medium length protrusive fringing setae; peribranchial skirt with radially arranged spicules; branchial aperture a simple slit; anterium slightly broader than neck ..... *Falcidens longus*

20a) Neck narrower than either anterium or anterior trunk; anterium prominent; posterium with short spicular fringe; peribranchial skirt lacking spicules or with only a few scattered spicules .... *Chaetoderma pacificum*

20b) Neck equal to or broader than anterior trunk; anterium obscure; posterium with short spicular fringe; peribranchial skirt with numerous spicules **21**

21a) Neck widest anteriorly, equal in width to anterior trunk where they meet; oral shield about as long as tall; posterior trunk contracted strongly just prior to posterium; radular cone strongly basally inflated in frontal view, much narrower above, slightly curved in lateral view with one side slightly concave ..... *Chaetoderma marinelli*

21b) Neck often widest at midlength, wider than anterior trunk; oral shield wider than tall; posterior trunk hardly contracted prior to posterium; radular cone nearly evenly tapering to slight basal inflation in frontal view, not curved in lateral view with sides parallel .... *Chaetoderma nanulum*

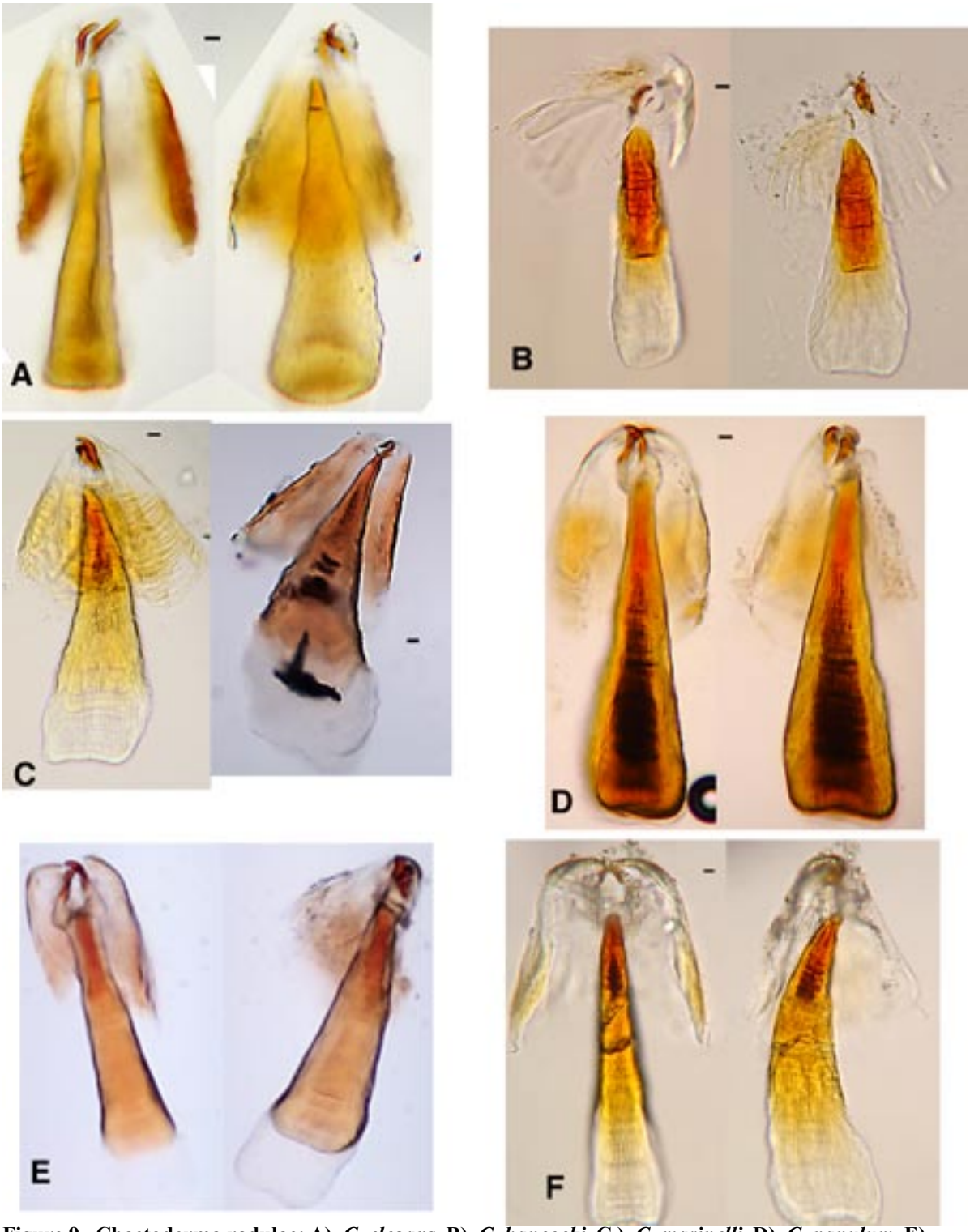

Figure 9. Chaetoderma radulae: A) *C. elegans*, B) *C. hancocki*, C.) *C. marinelli,* D) *C. nanulum,* E) *C. pacificum*, F) *C. scabrum*

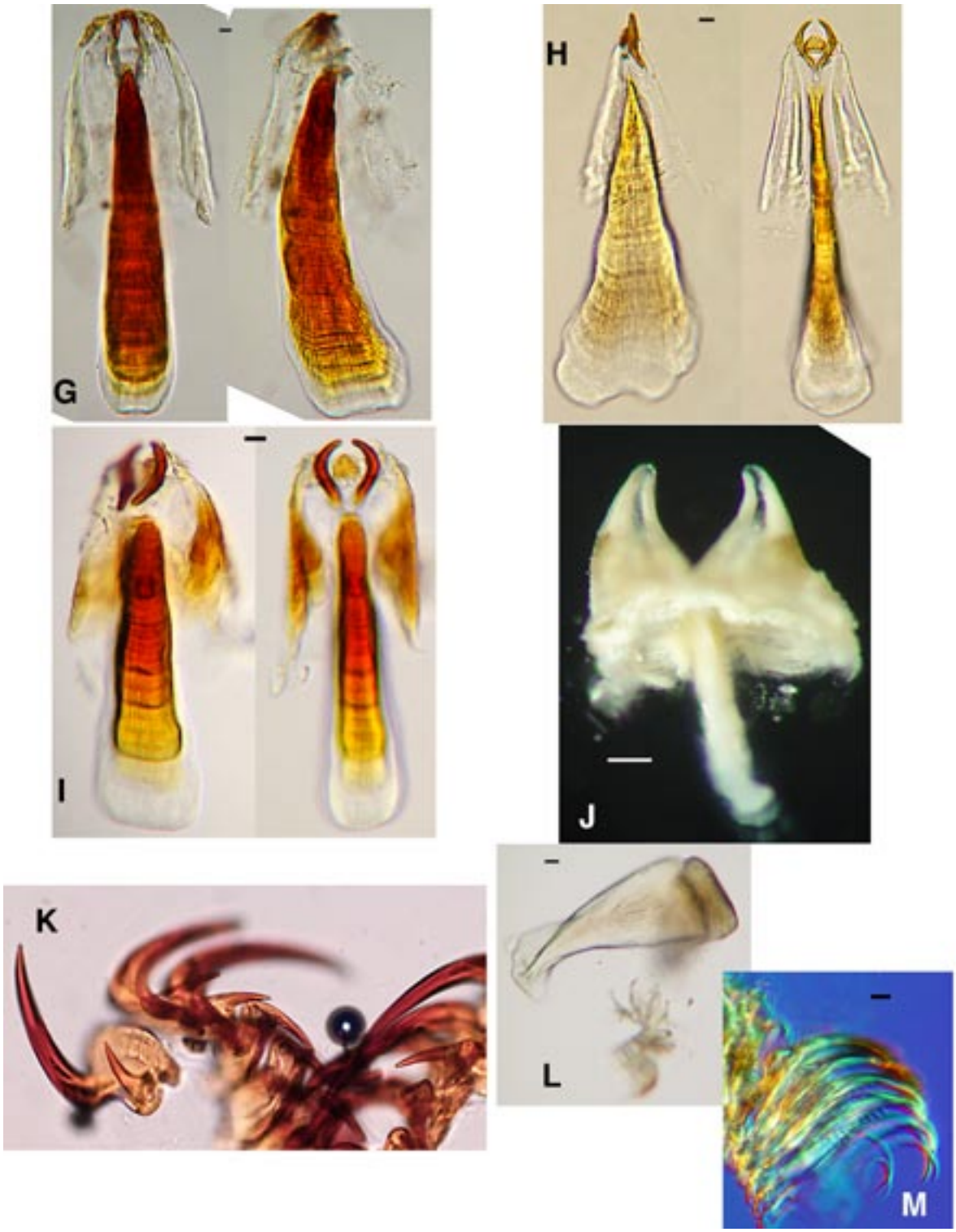

Figure 10. Caudofoveate radulae from B'03: G) *Chaetoderma* sp A, H) *F. hartmanae*, I) F. *longus*, J) *Furcillidens incrassatus*, K) *L. fratula* (lateral), L) *S. californicum* (jaws), M) *S. californicum* (radula lateral)

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Appendix A. Taxa known from the SCB at depths to 1000m (other species occur at greater depths). Those not recorded during B'03 are preceeded by an (*)

Subphylum Adenopoda
Class Solenogastres
Order Pholidoskepia
Family Gymnomeniidae
*Neomeniomorpha sp *A* SCAMIT 2005 §
Neomeniomorpha *sp C* SCAMIT 2005 §
Family Dondersiidae
**Dondersia californica* Heath 1911
**Heathia porosa* (Heath 1911) [family allocation questioned]
Order Cavibelonia
*Neomeniomorpha *sp B* SCAMIT 2005 §
Family Amphimeniidae
**Plathymenia branchiosa* Schwabl 1961
Family Proneomeniidae
**Dorymenia acuta* Heath 1911
Subphylum Scutopoda
Class Caudofoveata
Family Chaetodermidae
**Chaetoderma californicum* Heath 1911
**Chaetoderma elegans* Scheltema 1998
Chaetoderma hancocki (Schwabl 1963)
Chaetoderma marinelli (Schwabl 1963)
Chaetoderma nanulum Heath 1911
Chaetoderma pacificum (Schwabl 1963)
**Chaetoderma recisum* (Schwabl 1963)
**Chaetoderma scabrum* Heath 1911
Chaetoderma sp A SCAMIT 2005 §
Family Falcidentidae
Falcidens hartmanae (Schwabl 1961)
Falcidens longus Scheltema 1998
**Falcidens macracanthos* Scheltema 1998
Furcillidens incrassatus (Schwabl 1963)
Family Limifossoridae
Limifossor fratula Heath 1911
Family Prochaetodermatidae
**Spathoderma sp A* SCAMIT 2005 §
Spathoderma californicum (Schwabl 1963)

Appendix B. List of identified aplacophores by Bight '03 Station Number

Station	Z(m)	Final ID (count)	sample source
4006	60	Falcidens longus (5)	Regular B'03 sample - Hyperion
4007	430	Chaetoderma nanulum (1)	Regular B'03 sample - San Diego
4007	430	Chaetoderma pacificum (1)	Regular B'03 sample - San Diego
4007	430	Falcidens hartmanae (2)	Regular B'03 sample - San Diego
4007	430	Limifossor fratula (1)	Regular B'03 sample - San Diego
4009	610	Falcidens hartmanae (1)	deep water xtra sample
4009	610	Limifossor fratula (1)	deep water xtra sample
4009	610	Spathoderma californicum (1)	deep water xtra sample
4022	61	Falcidens longus (1)	Regular B'03 sample - Hyperion
4024	146	Chaetoderma pacificum (1)	Regular B'03 sample - MEC
4027	101	Chaetoderma marinelli (1)	Regular B'03 sample - MEC
4027	101	Falcidens longus (1)	Regular B'03 sample - MEC
4036	48	Falcidens longus (2)	Regular B'03 sample - San Diego
4038	131	Chaetoderma pacificum (1)	Regular B'03 sample - LACSD
4038	131	Limifosor fratula (1)	Regular B'03 sample - LACSD
4057	134	Chaetoderma pacificum (1)	Regular B'03 sample - Hyperion
4074	610	Spathoderma californicum (1)	deep water xtra sample
4077	57	Falcidens longus (1)	Regular B'03 sample - Hyperion
4086	93	Chaetoderma pacificum (2)	Regular B'03 sample - Hyperion
4086	93	Chaetodermatidae (1)	Regular B'03 sample - Hyperion
4088	410	Chaetoderma nanulum (1)	Regular B'03 sample - MEC
4088	410	Limifossor fratula (1)	Regular B'03 sample - MEC
4091	438	Falcidens hartmanae (1)	Regular B'03 sample - San Diego
4100	660	Falcidens longus (1)	deep water xtra sample
4100	660	Chaetoderma sp A (1)	deep water xtra sample
4100	660	Limifossor fratula (1)	deep water xtra sample
4101	38	Falcidens longus (1)	Regular B'03 sample - MEC
4103	153	Falcidens longus (1)	Regular B'03 sample - MEC
4106	600	Falcidens hartmanae (1)	deep water xtra sample
4106	600	Limifossor fratula (3)	deep water xtra sample
4110	139	Chaetoderma pacificum (5)	Regular B'03 sample - MEC
4115	92	Chaetoderma pacificum (1)	Regular B'03 sample - MEC
4124	700	Chaetoderma hancocki (1)	deep water xtra sample
4125	401	Chaetoderma pacificum (1)	Regular B'03 sample - San Diego
4125	401	Limifossor fratula (1)	Regular B'03 sample - San Diego
4135	400	Limifossor fratula (1)	Regular B'03 sample - San Diego
4141	57	Falcidens longus (1)	Regular B'03 sample - Hyperion
4144	190	Chaetoderma pacificum (2)	Regular B'03 sample - MEC
4144	190	Limifossor fratula (2)	Regular B'03 sample - MEC
4150	60	Falcidens longus (1)	Regular B'03 sample - Hyperion
4152	700	Chaetoderma hancocki (1)	deep water xtra sample
4152	700	Limifossor fratula (1)	deep water xtra sample
4153	750	Chaetoderma hancocki (1)	deep water xtra sample
4153	750	Limifossor fratula (1)	deep water xtra sample
4159	71	Chaetoderma marinelli (3)	Regular B'03 sample - San Diego
4160	757	Falcidens hartmanae (2)	deep water xtra sample
4165	34	Falcidens longus (3)	Regular B'03 sample - Hyperion
4167	188	Chaetoderma pacificum (1)	Regular B'03 sample - San Diego
4185	48	Falcidens longus (1)	Regular B'03 sample - MEC
4186	111	Falcidens longus (1)	Regular B'03 sample - LACSD
4187	187	Chaetoderma pacificum (1)	Regular B'03 sample - MEC
4199	462	Falcidens hartmanae (2)	Regular B'03 sample - San Diego
4200	56	Chaetoderma pacificum (1)	Regular B'03 sample - MEC
4201	350	Limifossor fratula (1)	Regular B'03 sample - MEC
4205	65	Falcidens longus (1)	Regular B'03 sample - Hyperion
4215	21.5	Falcidens longus (1)	Regular B'03 sample - ABC
4216	960	Falcidens hartmanae (2)	deep water xtra sample
4219	610	Furcillidens incrassatus (1)	deep water xtra sample
4220	794	Chaetoderma hancocki (1)	deep water xtra sample
4224	719	Falcidens hartmanae (1)	deep water xtra sample
4230	56	Falcidens longus (1)	Regular B'03 sample - Hyperion
4232	74	Chaetoderma pacificum (1)	Regular B'03 sample - MEC
4237	223	Neomeniomorpha sp SD3 (1)	Regular B'03 sample - San Diego
4239	227	Chaetodermatidae (1)	Regular B'03 sample - San Diego

Station	Z(m)	Final ID (count)	sample source
4240	310	Limifossor fratula (1)	Regular B'03 sample - MEC
4240	310	Falcidens hartmanae (1)	Regular B'03 sample - MEC
4249	630	Chaetoderma hancocki (1)	deep water xtra sample
4249	630	Falcidens hartmanae (1)	deep water xtra sample
4250	84	Chaetoderma sp (1)	Regular B'03 sample - LACSD
4251	98	Falcidens longus (1)	Regular B'03 sample - Hyperion
4251	98	Chaetodermatidae (1)	Regular B'03 sample -Hyperion
4252	700	Chaetoderma hancocki (1)	deep water xtra sample
4252	700	Limifossor fratula (1)	deep water xtra sample
4254	452	Chaetoderma pacificum (1)	Regular B'03 sample - LACSD
4254	452	Falcidens hartmanae (1)	Regular B'03 sample - LACSD
4261	321	Chaetoderma nanulum (1)	Regular B'03 sample - Hyperion
4261	321	Limifossor fratula (1)	Regular B'03 sample - Hyperion
4263	460	Chaetoderma nanulum (1)	Regular B'03 sample - San Diego
4263	460	Falcidens hartmanae (3)	Regular B'03 sample - San Diego
4263	460	Limifossor fratula (1)	Regular B'03 sample - San Diego
4263	460	Chaetodermatidae (1)	Regular B'03 sample - San Diego
4269	154	Limifossor fratula (1)	Regular B'03 sample - Hyperion
4278	64	Falcidens longus (1)	Regular B'03 sample - Hyperion
4280	40	Falcidens longus (1)	Regular B'03 sample - MEC
4286	41	Falcidens longus (1)	Regular B'03 sample - MEC
4297	450	Chaetoderma nanulum (2)	Regular B'03 sample - MEC
4297	450	Chaetoderma pacificum (2)	Regular B'03 sample - MEC
4297	450	Falcidens hartmanae (1)	Regular B'03 sample - MEC
4297	450	Limifossor fratula (2)	Regular B'03 sample - MEC
4298	628	Limifossor fratula (1)	deep water xtra sample
4316	868	Furcillidens incrassatus (1)	deep water xtra sample
4326	41	Chaetoderma pacificum (1)	Regular B'03 sample - LACSD
4327	420	Falcidens hartmanae (1)	Regular B'03 sample - San Diego
4327	420	Limifossor fratula (1)	Regular B'03 sample - San Diego
4328	28	Falcidens longus (7)	Regular B'03 sample - MEC
4329	234	Limifossor fratula (3)	Regular B'03 sample - MEC
4339	59	Falcidens longus (1)	Regular B'03 sample - MEC
4343	195	Chaetoderma pacificum (2)	Regular B'03 sample - Hyperion
4350	37.6	Falcidens longus (1)	Regular B'03 sample - MEC
4352	780	Falcidens hartmanae (1)	deep water xtra sample
4356	461	Chaetoderma nanulum (1)	Regular B'03 sample - San Diego
4361	754	Falcidens hartmanae (1)	deep water xtra sample
4362	51	Falcidens longus (1)	Regular B'03 sample - LACSD
4363	200	Chaetoderma nanulum (1)	Regular B'03 sample - MEC
4363	200	Chaetodermatidae (1)	Regular B'03 sample - MEC
4363	200	Chaetoderma pacificum (3)	Regular B'03 sample - MEC
4363	200	Limifossor fratula (2)	Regular B'03 sample - MEC
4363	200	Neomeniomorpha sp SD3 (1)	Regular B'03 sample - MEC
4368	650	Chaetoderma hancocki (1)	deep water xtra sample
4371	78	Chaetoderma marinelli (1)	Regular B'03 sample - MEC
4377	635	Furcillidens incrassatus (1)	deep water xtra sample
4378	271	Chaetoderma sp (1)	Regular B'03 sample - LACSD
4379	143	Chaetoderma pacificum (1)	Regular B'03 sample - Hyperion
4382	579	Chaetoderma hancocki (1)	out of stratum site - abandoned
4382	579	Falcidens hartmanae (1)	out of stratum site - abandoned
4382	579	Limifossor fratula (1)	out of stratum site - abandoned
4384	41.5	Falcidens longus (2)	Regular B'03 sample - MEC
4392	610	Falcidens hartmanae (3)	deep water xtra sample
4398	700	Falcidens hartmanae (1)	deep water xtra sample
4421	95	Chaetoderma pacificum (1)	Regular B'03 sample - San Diego
4425	162	Chaetoderma pacificum (1)	Regular B'03 sample - Hyperion
4453	52	Chaetoderma marinelli (1)	Regular B'03 sample - San Diego
4458	181	Chaetodermatidae (1)	Regular B'03 sample - San Diego
4545	172	Chaetoderma pacificum (3)	Regular B'03 sample - San Diego
4545	172	Chaetodermatidae (1)	Regular B'03 sample - San Diego
4778	342	Falcidens hartmanae (2)	Regular B'03 sample - San Diego
4778	342	Limifossor fratula (1)	Regular B'03 sample - San Diego
4810	342	Limifossor fratula (1)	Regular B'03 sample - San Diego
5002	319	Limifossor fratula (1)	Regular B'03 sample - San Diego
5034	394	Chaetoderma nanulum (1)	Regular B'03 sample - San Diego
A-2	29	Falcidens longus (3)	Regular B'03 sample - MEC

Appendix C. Specimen Examination Sheet

Species Number _____ Associated Specimens_____ _____
Presumptive ID _____ by:_____
Source Agency _____ Area _____
Source Sample _____ Depth _____
Body Length _____ Max Width _____
Anterium Length _____ Width _____
Neck Length _____ Width _____
Anterior Trunk Length _____ Width _____
Posterior Trunk Length _____ Width _____

ORAL SHIELD
anteriorly directed _____ oblique _____
entire _____ with anterior slit _____
lobes:
small straight_____ large _____ obscure _____
incision:
less than 1/3_____ 1/3-1/2 _____ >1/2 _____
flanked by oral shield spicules? Y / N
shape:
round_____ long oval_____ tall oval_____
size vs anterium diameter:
much smaller_____ smaller_____ subequal_____

ANTERIUM
retracted? Y / N
Anterium/Neck : >1/1/<1 _____
constriction between anterium and neck? Y / N
follows body long axis? Y / N

NECK
constriction betweeen neck and anterior trunk:
None____ Faint_____ Strong_____
spicule attitude on neck
adpressed _____ perpendicular_____ oblique_____
spicule size on neck
short_____ intermediate_____ long_____
spicule form on neck
straight_____ bent basally_____

ANTERIOR TRUNK
Diameter vs. Neck
less_____ equal_____ greater_____
Diameter vs. Posterior Trunk
less_____ equal_____ greater_____
Length vs. Posterior Trunk
much shorter_____ shorter_____ equal_____
longer_____ much longer_____ over twice_____
spicule attitude
adpressed_____ perpendicular_____ oblique_____
spicule size
short_____ intermediate _____ long_____

spicule density

scattered_____ abundant_____ dense_____

POSTERIOR TRUNK **Diameter vs. posterium**

less_____ equal_____ greater_____

spicule attitude

adpressed_____ perpendicular_____ oblique_____

spicule size

short_____ intermediate_____ long_____

spicule density

scattered_____ abundant_____ dense_____

POSTERIUM **form**

straight_____ bulged_____ flaired_____

separated from posterior trunk by constriction? Y / N

spicules extend

short of plaque_____ to plaque_____

slightly beyond_____ strongly beyond_____

peribranchial plaque

flat_____ rounded_____ obscure_____

branchial aperture

round_____ dumbbell_____ obscure_____

Post-examination ID: _____

by:_____ date:_____

Appendix D. SCAMITVoucher Sheets for Bight '03species

SCAMIT CODE: None

Date Examined: 5 April 2005
Voucher By: Kelvin Barwick/Don Cadien

SYNONYMY: None

LITERATURE: Scheltema 1998

DIAGNOSTIC CHARACTERS:

1. Anterium bent at 90° angle to neck, wider than neck (Figure A)
2. Animal very long and slender (Figure A), BLI 20-23; anterior trunk very long, around twice the length of posterior trunk; anterior trunk shaggy, with short spicules attached at large angles to body axis; posterior trunk smooth, with short spicules nearly parallel to body axis
3. Posterium small, barely set off from posterior trunk by slight constriction; spicular fringe flaring slightly; fringe spicules of intermediate length, extending part way along the convex peribranchial plate; peribranchial plate with adpressed spicules in roughly radial array (Figure C)
4. Oral shield deeply incised, somewhat wider than high, with small dorsal lobes (Figure B)
5. Radula with well developed denticles; radula cone tapering evenly towards denticles in anterior view, broader in lateral than in anterior view; slightly convex anteriorly in lateral view (Figure D)
6. Mid-anterior trunk spicules with well defined carina and numerous lateral ridges of several sizes; most of intermediate length and tapering more rapidly in distal ¼; some spicules about 30% longer than average and tapering more evenly throughout length; thickest medially (Figure E)

RELATED SPECIES AND CHARACTER DIFFERENCES:

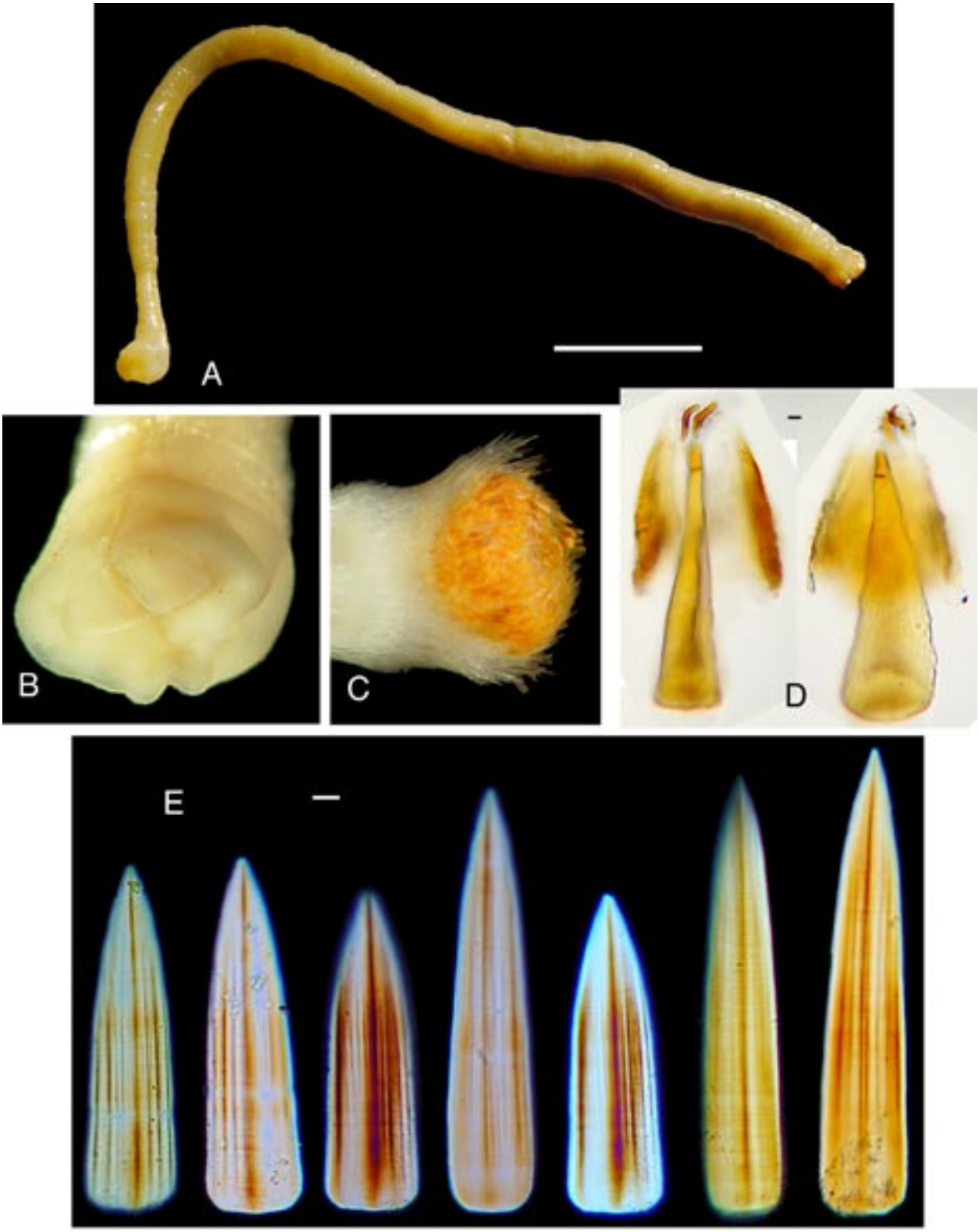
1. No other NEP Chaetoderma is as elongate as *C. elegans,* and none has a right angle turn to the somewhat inflated anterium. The most similar form would be *C. hancocki*, which is much less elongate (but BLI can reach 17 in particularly long adult specimens), but also has an inflated anterium which can be held at a small angle to the body axis. The latter species also differs from *C. elegans* in having large dorsal lobes on the oral shield, in having a spicule-free skirt around the peribranchial plate; in having a barbell shaped branchial aperture; and in having a very short spicular fringe on the posterium. It also has spicules that lack lateral ridges or a carina.
2. *Furcillidens incrassatus*, while very inflated anteriorly, has a BLI of only 3-4, far from that of *C. elegans*. Of the three *Falcidens* species, *F. hartmanae* (BLI to 13) is clearly differentiated by its inflated anterior trunk and slender posterior trunk. *Falcidens longus*, despite its name, has a BLI ranging from 5-9, and *F. macracanthos* has its notably long fringe of perpendicular anterior trunk spicules. All are clearly very different from *C. elegans.*

DEPTH RANGE: 49- 1808m

DISTRIBUTION: San Diego to Santa Maria Basin

DISCUSSION: The BLI listed above is measured from the holotype and the specimen illustrated in Figure A. The paratype from the Santa Maria Basin listed by Scheltema (1998), the holotype, and the specimen in Figure A are the only known specimens of this species. The animal in

Figure A has been confirmed as *C. elegans* by Amélie Scheltema (personal communication 3 Nov. 2003). Given the bathymetric and geographic ranges of this animal, it is likely to be relatively uncommon, or more specimens would have been taken in regular monitoring by SCAMIT agencies.



Chaetoderma elegans **Scheltema 1998: A. Whole animal, lateral view (scale bar 5mm) B. Anterior view C. Lateral posterior view D. Radula frontal and lateral views E. Spicules from mid-anterior trunk (scale bars 0.01mm) (CSD Sta. E2(2), 8JUL03, 97m)**

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: *Crystallophrisson hancocki* Schwabl, 1963
Crystallophrisson inflatum Schwabl, 1963
Crystallophrisson rectum Schwabl, 1963 (in part)
Crystallophrisson riedli Schwabl, 1963 (in part)

LITERATURE: Schwabl, 1963; Scheltema, 1998

DIAGNOSTIC CHARACTERS:

1. Body regionated; anterium inflated, often wider than posterior trunk (Figure A), set off from neck by pronounced constriction; neck shorter than anterium, about the same diameter as anterior trunk but differentiated from it by a second constriction; anterior trunk longer than posterior trunk.
2. Oral shield about as high as wide, dorsally incised (Figure C), with pronounced dorsal lobes; about ½ the diameter of the inflated anterium.
3. Posterium short, not or only slightly flairing, with short spicular fringe and broad spicule free peribranchial skirt (Figure D); peribranchial plate nearly flat, branchial opening barbell shaped. Gills, if protruded, normally held against peribranchial plate.
4. Radula with small denticles; radular cone tapering moderately in frontal view (Figure E), tip slightly curved in lateral view; cone slightly wider in lateral view when compared to frontal view.
5. Mid-anterior trunk spicules long, relatively coarse, tapering nearly evenly over length, with slight keeling and ridging basally; spicules distally nearly flat, with both keel and ridges fading out. Distal half thickest part of spicule. (Figure B).

RELATED SPECIES AND CHARACTER DIFFERENCES:

1. *Chaetoderma hancocki* belongs to the elongate group of NEP *Chaetoderma*, with BLIs of 10 or more, which includes also *C. elegans*, *C. marinelli*, and *C. pacificum*. It can be distinguished from these species by a combination of characters. *C. hancocki* is less attenuate (although larger) than *C. elegans* with BLIs of 7.4-17.1 rather than 20.6-22.9, and lacks the right angle orientation of the anterium found in that species. It also differs from *C. elegans* in having a spicule-free peribranchial skirt, and very short fringing spicules on the posterium.
2. Differentiating characters separating *C. hancocki* from *C. marinelli* are the inflated anterium, the spicule free peribranchial skirt, the short spicular fringe of the posterium, the strongly keeled and ridged spicules, the anterior trunk significantly (20% or more) longer than the posterior trunk, and *C. marinelli*'s basally inflated (anterior view) and strongly tapering radular cone
3. *Chaetoderma pacificum* and *C. hancocki* are quite similar in external appearance but can be separated by (in *C. hancocki*) presence of a well defined constriction between the anterium and neck, anterior trunk significantly longer than posterior trunk, oral shield about as high as wide, shorter posterium spicular fringe, flatter spicules with keel and ridges reduced, and larger radular denticles

4. While *Falcidens longus* can also be confused with *C. hancocki*, it typically has a lower BLI although the two species overlap in BLI range (5.5-8.9 vs. 7.4-17.1). *C. hancocki* differs from it in having large well-defined dorsal lobes on the oral shield, a more inflated anterium, a short spicular fringe on the posterium, a spicule free peribranchial skirt, a convex peribranchial plate, a barbell shaped branchial aperture, less sculptured spicules, smaller radular denticles which are not sickle-shaped, and in lacking a triangular plate in the radula

DEPTH RANGE: 480 - 1830m

DISTRIBUTION: Southern California Bight continental slope

DISCUSSION: Among local *Chaetoderma* species, *C. hancocki* is particularly large, with specimens of 4cm or more not uncommon. Scheltema (1998) lists its length up to 45mm, but larger specimens also occur. One giant taken at 830m off Palos Verdes was 73mm in length, and had lost nearly all of its spicules. As a true slope species, *C. hancocki* is usually found in silty and/or clayey sediments. Synonymy of several of Schwabl's (1963) new species with *C. hancocki* was based on reexamination of type material, or by inference from similarity of description where type material was no longer extant (Scheltema 1998).

Chaetoderma hancocki **(Schwabl 1963). A. Whole animal, lateral view (scale bar 1mm) B. Spicules from mid-anterior trunk C. Anterior view D. Lateral posterior view E. Radula lateral and frontal views (scale bars 0.01mm) (Bight 2003 Sta. 4249 23JUL03, 630m)**

SCAMIT CODE: None

Date Examined 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: *Chrystallophrisson marinelli* Schwabl, 1963

LITERATURE: Schwabl, 1963; Scheltema, 1998

DIAGNOSTIC CHARACTERS:

1. Body regionated; anterium broader than rest of body; neck tapering posteriorly to well-defined constriction between neck and anterior trunk (Figure A); anterior and posterior trunk subequal in length, posterior trunk slightly greater in diameter
2. Oral shield as tall as wide, dorsally cleft; with large well-defined dorsal lobes; more than 2/3 the diameter of the anterium (Figure C)
3. Posterium flared, but not preceded by a constriction at the end of the posterior trunk; with long spicular fringe (Figure B); peribranchial plate flat, peribranchial skirt small and spiculose if visible at all
4. Radula with small but evident denticles; denticles plate-like rather than sickle-shaped (lacking shaft); radular cone tapering sharply above expanded base in frontal view, with distal ½ tapering little (Figures D, E); tapering more evenly in lateral view
5. Mid-anterior trunk spicules relatively sharp tipped, broad basally, tapering gradually for proximal 80%, then more sharply in distal 20%; keeled, with multiple ridges nearly as strong as central keel running the length of the spicule. Often with pair of thickened ridges on either side of thick central keel (Figures F, G).

RELATED SPECIES AND CHARACTER DIFFERENCES:

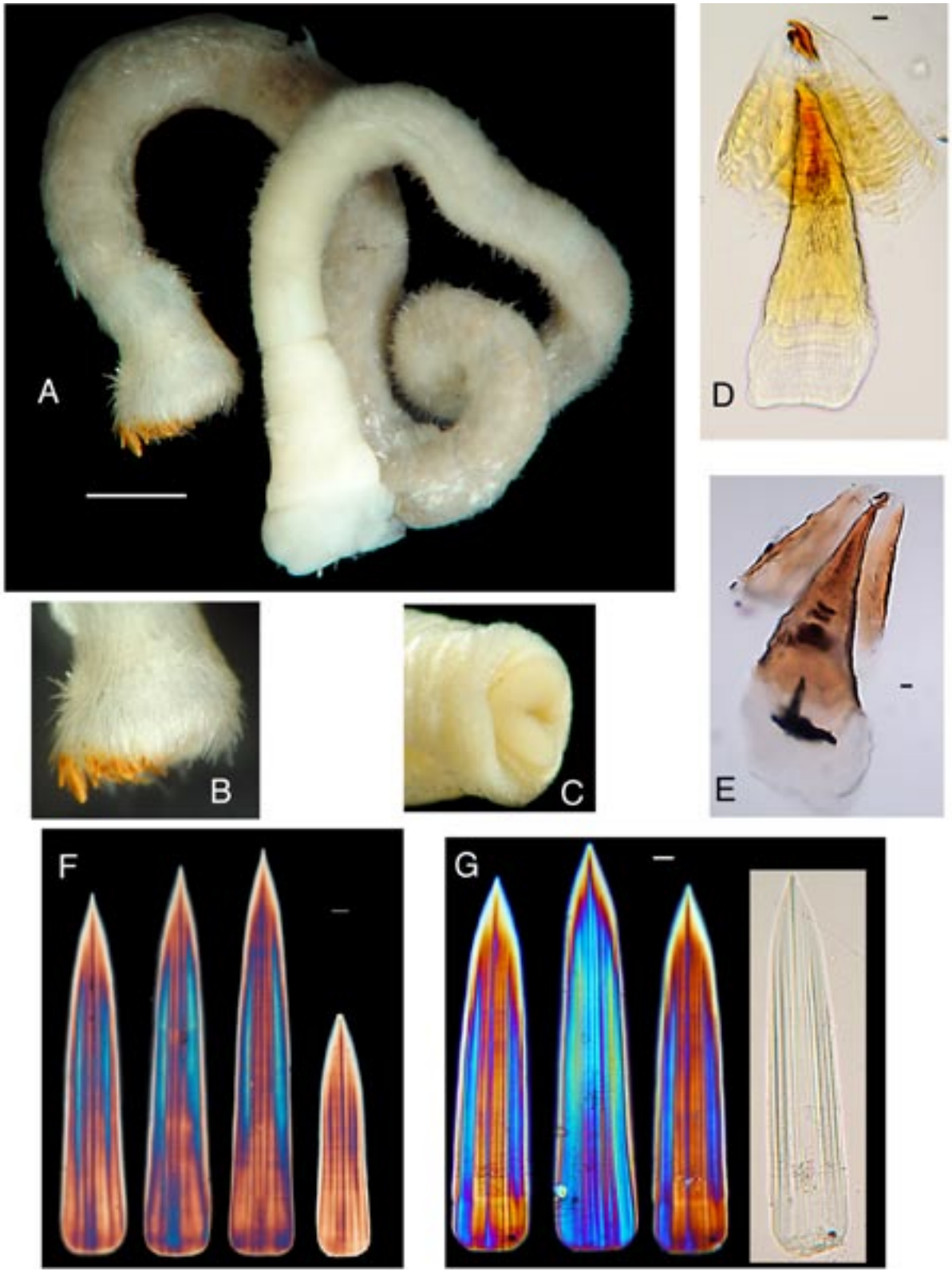
1. *Chaetoderma marinelli* belongs to the elongate group of NEP Chaetodermas which also includes *C. elegans, C. hancocki, and C. pacificum.* It can be differentiated from them by a combination of characters. It differs from *C. elegans* in having a smaller BLI (11.3-17.6 vs. 20.6-22.9), by not having the anterium carried at a 90° angle to the body axis, in a more flaired posterium with a flat rather than convex peribranchial plate, and in having an oral shield as tall as wide and bearing conspicuous dorsal lobes.
2. It differs from *C. hancocki* in having a less inflated anterium, a larger oral shield relative to the anterium, anterior and posterior trunk subequal in length, long spicular fringe on the posterium, in lacking a spicule-free peribranchial skirt, and in having more sculptured spicules.
3. *C. marinelli* can be separated from *C. pacificum* by the following characters: oral shield 2/3 the diameter of the anterium; posterium lacking spicule-free peribranchial skirt, peribranchial plate convex; radular cone bulbous basally in frontal view; spicules with central keel and lateral ridges subequal in strength. This last character can overlap the two species.
4. *Falcidens longus* can easily be confused with *C. marinelli*, but can be separated by having: an oral shield wider than tall, with poorly defined small dorsal lobes, which is ½ or less the diameter of the anterium; an anterior trunk which is significantly longer than the posterior trunk; a less expanded posterium not defined by a constriction at the posterior end of the posteior trunk; spicules with a central keel stronger than the lateral ridges; a radular cone which is not bulbously expanded in frontal view, and by large sickle-shaped radular denticles surrounding a triangular plate.

DEPTH RANGE: 29 - 101m

DISTRIBUTION: Southern California Bight continental shelf

DISCUSSION: This is one of a group of species whose characters tend to overlap, especially those characters dealing with regionation of the body and external appearance. It has often been misidentified in the past, and co-occurs with *Falcidens longus*. The two species are both characteristic members of the Continental Shelf aplacophore assemblage, and are quite convergent in external morphology. They can be clearly differentiated by the radular differences which separate the two genera *Falcidens* and *Chaetoderma*, but externally the two can seldom be separated with complete accuracy, even by an experienced eye. Spicule preparations help, especially when birefringent appearance is considered, but definitive placement requires examination of radulae. The specimen illustrated in Figure A was confirmed as *C. marinelli* by Amélie Scheltema (personal communication) and she has confirmed several more specimens from the San Diego area as belonging to this species.

The possibility that the slope records of this species in Schwabl (1963) are erroneous needs to be seriously considered. Scheltema (1998) did not note that material she re-examined was mis-identified, but did comment that she thought the species was restricted to shelf-depths. No specimens from deeper than 100m have been identified as *C. marinelli* in recent investigations. Given the convergence of *C. marinelli* with several other forms in many characters, misidentification, even by the taxon's author, remains at least possible, if not probable.



Chaetoderma marinelli **(Schwabl 1963) A. Whole animal, lateral view (scale bar 1mm) B. Lateral posterior view C. Anterior view D. and E. Radula lateral views F. and G. Spicules from mid-anterior trunk (scale bars 0.01mm) (Fig. A – C, E, G :CSD Sta. E21(2), 4APR00, 375ft.) (Fig. F: CSD voucher #M29 Sta. A10(1), 12JAN93, 154ft.) (Fig. D: location unknown)**

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: *Chaetoderma nanula* Heath, 1911
Chrystallophrisson riedli Schwabl, 1963 (in part)
Chrystallophrisson rubrum Schwabl, 1963
Chrystallophrisson scabrum of Schwabl, 1963 (in part) not Heath, 1911

LITERATURE: Heath, 1911; Schwabl, 1963; Scheltema, 1998

DIAGNOSTIC CHARACTERS:

1. Body regionated, relatively short, with BLI of 3.7-8.6; neck wider than anterior trunk and about as wide as posterior trunk (Figure A); anterior trunk varies between shorter than and longer than posterior trunk, with larger individuals having a longer anterior trunk.
2. Oral shield wider than tall, dorsally incised, with small indistinct dorsal lobes (Figure D); shield about ½ the diameter of the expanded anterium (Figure A).
3. Posterium only slightly flared, if at all; spicular fringe long, projecting well beyond flat peribranchial plate (Figure E); no peribranchial skirt evident; peribranchial plate with radiating spicules.
4. Radular denticles plate-like, slightly curved; radular cone tapering evenly from non-bulbous base; cone width in frontal and lateral views about equal (Figure B).
5. Mid-anterior trunk spicules flared at base, then tapering evenly throughout their length; with central keel and thickened margins, but lacking lateral ridges, with thickened bases (Figure C).

RELATED SPECIES AND CHARACTER DIFFERENCES:

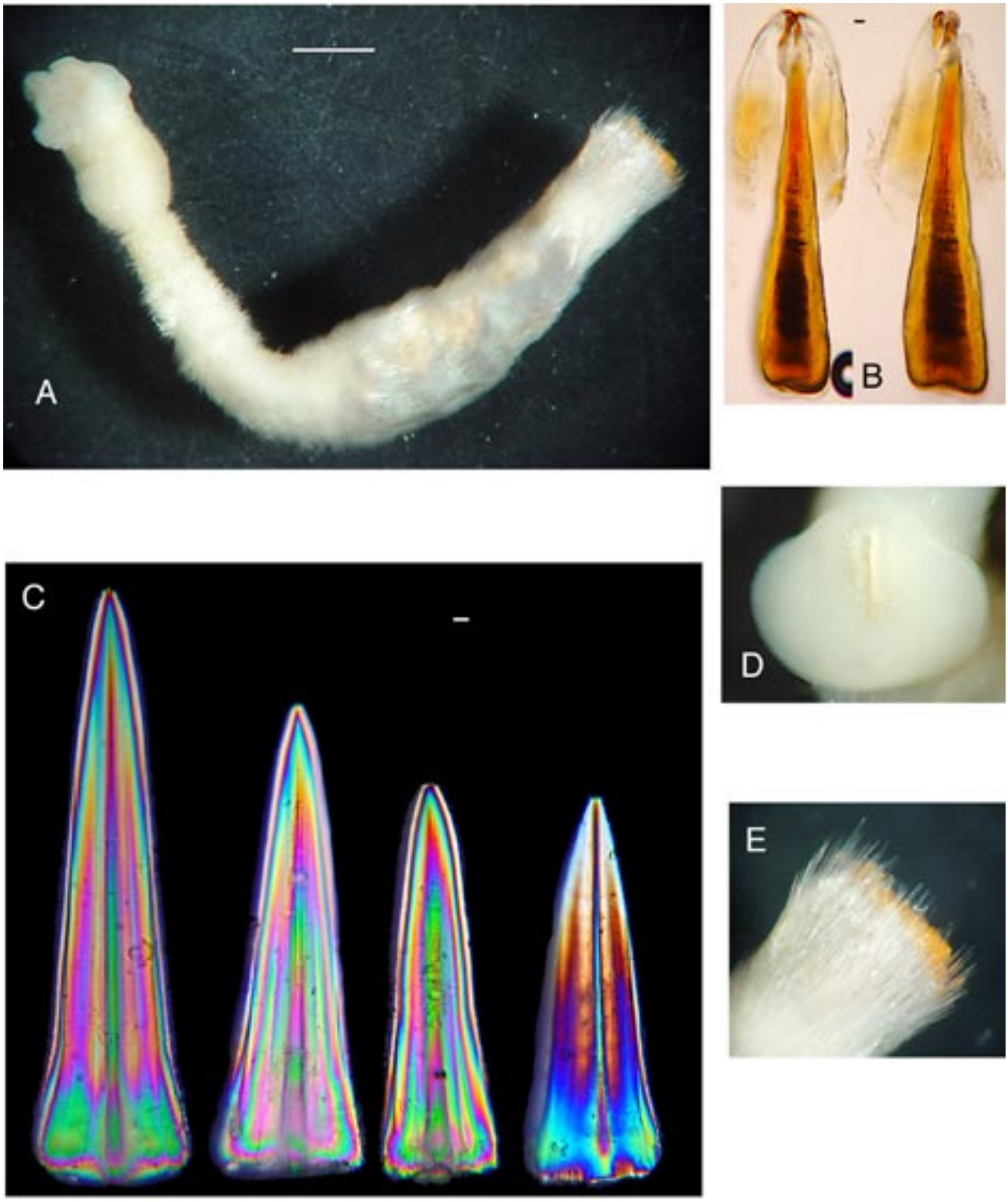
1. *Chaetoderma nanulum* is one of the short-bodied group (BLI < 10) of chaetoderms in the NEP. Other members are *C. californicum, C. recisum*, *C. scabrum*, *C.* sp A, *Falcidens longus*, and *F. macracanthos*. Many characters are convergent among these species, but they can be differentiated with combinations of characters.
2. *C. californicum* differs from *C. nanulum* in having: a much smaller anterium, shorter neck spicules, longer spicular fringe on the posterium, and spicules which lack thickened edges.
3. *C. recisum* differs from *C. nanulum* in having: an entire unincised oral shield, an anterior trunk narrower than either the neck or posterior trunk, and in spicules lacking thickened edges.
4. *C. scabrum* differs from *C. nanulum* in having: an entire unincised oral shield, very small radular denticles, a radular cone curved in lateral view, and spicules with a broader stronger central keel.
5. *C.* sp A differs from *C. nanulum* in having: an entire unincised oral shield, posterium with an annular expansion, very short spicular fringe on the posterium, and a radular cone curved in lateral view.
6. *Falcidens longus* differs from *C. nanulum* in having the anterior trunk significantly longer than the posterior trunk, in having shorter anterior trunk spicules, in having large sickle-shaped radular denticles, and in bearing a triangular plate between them.

7. *Falcidens macracanthos* differs from *C. nanulum* in having the oral shield taller than wide, neck narrower than anterior trunk, anterior trunk with longer spicules which are not edge thickened and basally expanded, large sickle-shaped radular denticles, and a triangular plate between them.

DEPTH RANGE: 160 - 1843m

DISTRIBUTION: Outer continental shelf and upper continental slope; Southern California Bight to Santa Maria Basin

DISCUSSION: Several of the species mentioned above are known from single specimens and may have a broader range of variability than is currently recognized. Since *C. nanulum* appears to be particularly variable in anterior trunk length it may overlap more with these species than is currently appreciated. *Chaetoderma* sp A, for instance is known from a single specimen, as is *C. recisum*. The case of *C. recisum* is particularly difficult since Schwabl's original description was not detailed, and no radular description was provided. The type could not be located at the Natural History Museum of Los Angeles County for reexamination and photography.



Chaetoderma nanulum **Heath 1911 A. Whole animal, lateral view (scale bar 1mm) B. Radula frontal and lateral views C. Spicules from mid-anterior trunk (scale bar 0.01mm) D. anterior view E. Posterior lateral view (location unknown)**

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: *Crystallophrisson nitidulum* var. *pacificum* Schwabl, 1963

LITERATURE: Schwabl, 1963; Scheltema, 1998

DIAGNOSTIC CHARACTERS:

1. Body regionated; neck narrower than either anterium or anterior trunk (Figure B); anterior and posterior trunk subequal in length, posterior trunk larger in diameter (Figure A); spicules frequently lost or reduced on anterior trunk.
2. Posterium flaring, with short spicular fringe that protrudes along peribranchial skirt (Figure D); peribranchial skirt bare or with few scattered spicules; peribranchial plate slightly convex but not bulbous.
3. Oral shield dorsally incised, wider than tall, with large well-defined dorsal lobes (Figure C).
4. Radular denticles of moderate size, plate-like, slightly curved; radular cone tapering evenly in both frontal and lateral view; cone nearly equal in width in lateral and frontal aspects. (Figure E).
5. Mid-anterior trunk spicules with strong central keel and thickened edges (Figure G); lateral ridges generally lacking; tapering more strongly at distal end; if unbroken can be sharp tipped (Figure F).

RELATED SPECIES AND CHARACTER DIFFERENCES:

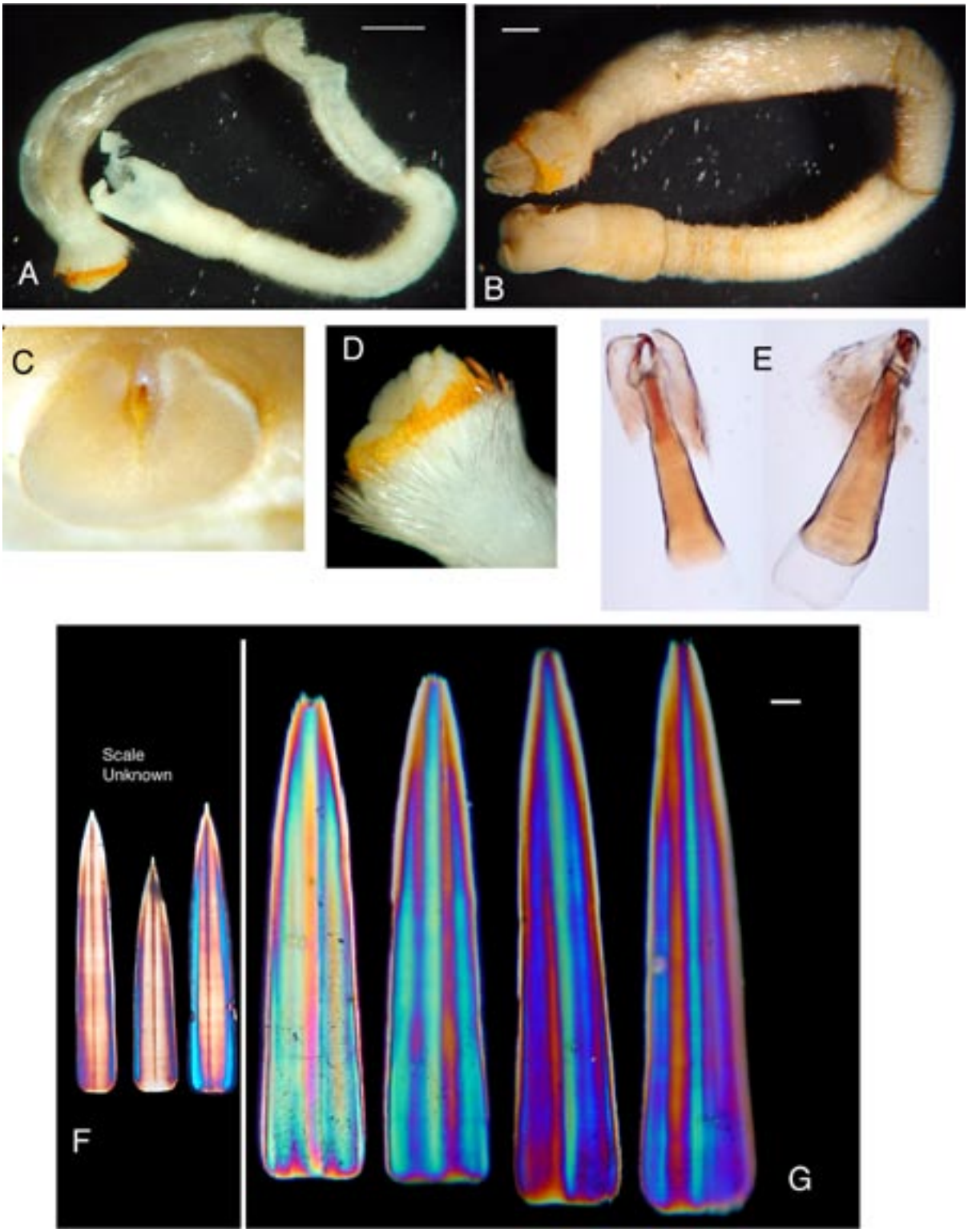
1. *Chaetoderma pacificum* is in the elongate group of species with BLI over 10. Other group members are *C. elegans*, *C. hancocki*, and *C. marinelli*. *Falcidens hartmanae* can also be relatively elongate, but can easily be separated from any of the *Chaetoderma* group members by its inflated anterior trunk and very narrow posterior trunk.
2. *C. elegans* can be separated from *C. pacificum* by having: anterium inflated, but carried at a large angle (about 90°) to the body axis; a much higher BLI (20.6-22.9 vs 11.1-15); an oral shield with small poorly defined dorsal lobes; a more bulbous peribranchial plate; and anterior trunk spicules bearing lateral ridges.
3. *C. hancocki* can be separated from *C. pacificum* by having: more inflated anterium separated by a strong constriction from the neck; anterior trunk significantly longer (20%+) than posterior trunk; very short posterium fringing spicules; a barbell shaped branchial aperture; anterior trunk spicules that lack or have very weak central keels; very small radular denticles; and anterior curvature of the radular cone (in lateral view).
4. *C. marinelli* can be separated from *C. pacificum* by having: neck tapering (often strongly) from front to rear; oral shield about as tall as wide; a flat peribranchial plate; a radular cone which is bulbous basally in frontal view; anterior trunk spicules with numerous lateral ridges; and by lacking a bare peribranchial skirt on the posterium.
5. *Falcidens longus* can be confused with smaller specimens of *C. pacificum*, with which they co-occur. They can be separated by the radular differences (sickle-shaped denticles and triangular plate in *Falcidens*), and by having: anterior trunk significantly longer than posterior trunk; longer spicular ring on the posterium; flat rather than dome-shaped peribranchial plate; and lack of spicule-free peribranchial skirt.

DEPTH RANGE: 22 - 1464m

DISTRIBUTION: Continental Shelf and upper to mid Continental Slope; San Diego to Santa Maria Basin

DISCUSSION: *Chaetoderma pacificum* is one of the more common species encountered on the outer shelf and upper slope of the Southern California Bight. It was the second most abundant aplacophore species in the Bight '03 samples. It often co-occurs with *Falcidens longus*, the two being, along with *C. marinelli*, the main constituents of the shelf aplacophore fauna. While not as large a species as *C. hancocki*, *C. pacificum* can reach up to 30mm in length (Scheltema 1998). Their tendency to have the spicules of the anterior trunk loosely attached and easily lost is noteworthy. The identification of figures A and D thru F where confirmed by A. Scheltema (personal communication 10 May 2003)

Schwabl originally described this (1963) as a subspecies of the North Atlantic *Chaetoderma nitidulum*. It was raised to full species status by Scheltema (1998).



Chaetoderma pacificum **(Schwabl 1963) A. Whole animal, lateral view B. Whole animal, lateral view (scaler bar 1mm) C. Anterior view D. Posterior lateral view E. Radula frontal and lateral views F. and G. Spicules from mid-anterior trunk (horizontal scale bar 0.01mm) (Fig. A, D - F: Kelvin Barwick voucher #0255 CSD Sta. 2747(1), 16JUL01, 585ft.) (Fig. B, C and G: Bight 2003 Sta. 4007, 24AUG03, 430m)**

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: *Chaetoderma scabra* Heath, 1911

LITERATURE: Heath, 1911; Schwabl, 1963; Scheltema, 1998

DIAGNOSTIC CHARACTERS:

1. Body regionated, BLI 6-8; body generally widest in posterior trunk, although other regions only slightly narrower (Figure A); anterium may be somewhat inflated relative to neck and anterior trunk; a strong constriction between the anterium and the neck
2. Oral shield entire, about half the width of the anterium (Figure C)
3. Posterium nearly linear, not flaired; in some specimens preceded by a slight waist between the posterior trunk and the posterium; spicular fringe short, but extending beyond the flattened peribranchial plate (Figure B); spicular fringe frequently bearing ferric deposits (Figure D)
4. Radula bearing very reduced denticles; radular cone broadening basally in frontal view, curved in lateral view, with the anterior edge concave and the posterior edge convex (Figure E)
5. Mid-anterior trunk spicules relatively short and triangular, with a strong median keel weakening towards the base of the spicule (Figure F)

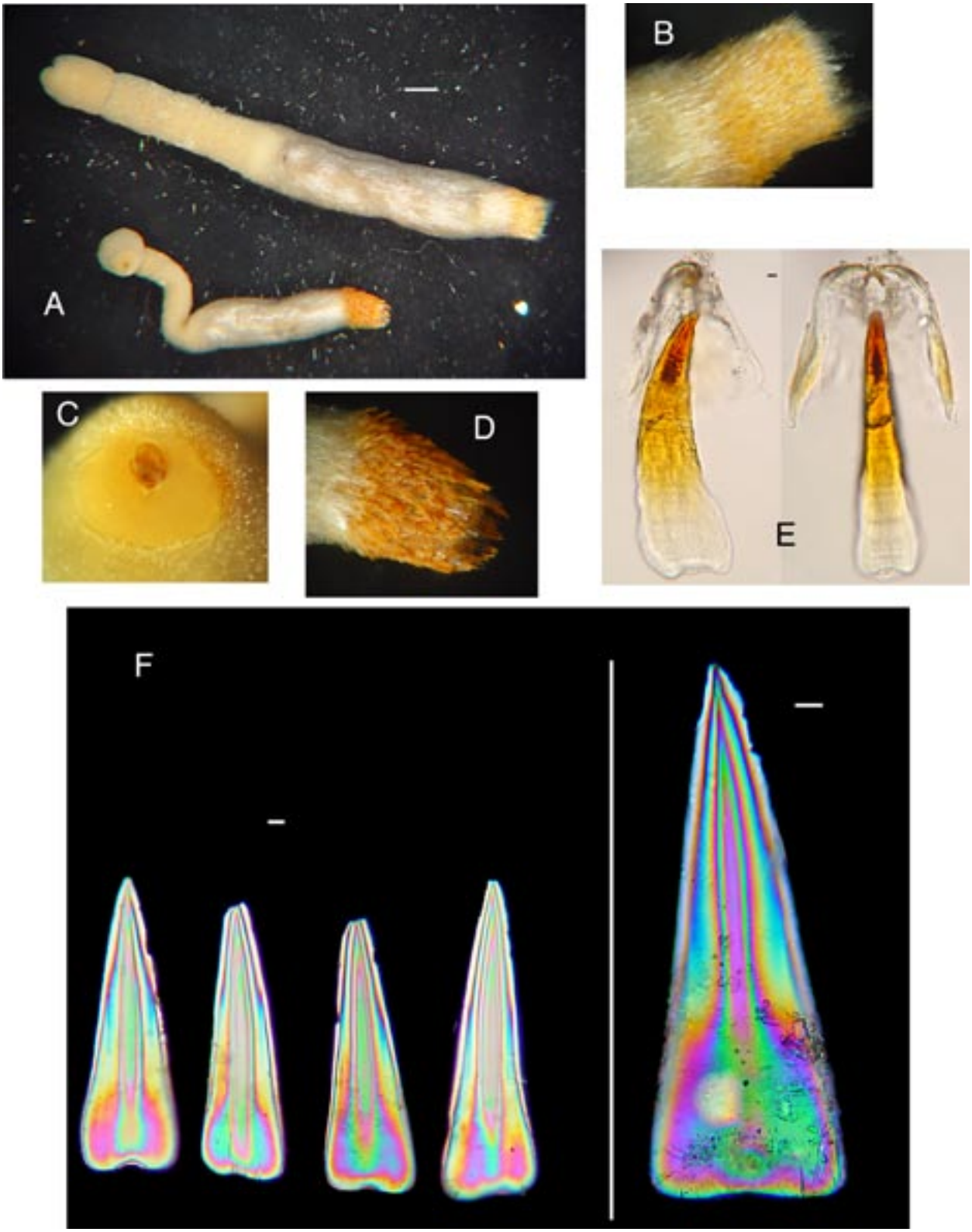
RELATED SPECIES AND CHARACTER DIFFERENCES:

1. Three other species have an entire oral shield; *Chaetoderma recisum*, *C.* sp A, and *Falcidens hartmanae*. *C. scabrum* can be separated from *C. recisum* based on the basically linear body with all regions similar in diameter. In *C. recisum* the anterium, neck, and posterior trunk are all much greater in diameter than the anterior trunk, but not as much as in *Furcillidens incrassatus*. *C.* sp A can be separated based on the presence of an annular expansion of the front part of the posterium, the short spicular fringe (not reaching to peribranchial plate), more elongate and less triangular spicules, and larger denticles on the radula. *Falcidens hartmanae* can be separated from *C. scabrum* based on the inflation of its anterium, neck and anterior trunk relative to its posterior trunk, by its large sickle-shaped denticles, and by the presence of a triangular plate in all but the largest specimens. The radular cone of *F. hartmanae* is also nearly straight-sided in lateral view rather than concave anteriorly and convex posteriorly as in *C. scabrum.*
2. Only *Chaetoderma nanulum* and *Falcidens macracanthos* have roughly the same BLI as *C. scabrum*. Separation of these short species can be based on the presence of an entire oral shield in *C. scabrum*. If the oral shield is not evident or is damaged, *C. scabrum* can be separated from *C. nanulum* by the orientation of the anterior trunk spicules; nearly perpendicular in *C. nanulum* (because they are basally bent) and nearly parallel to the body axis in *C. scabrum*. The spicules of the two species also differ, with those of *C. nanulum* bearing lateral ridges flanking the central keel.
3. The same anterior trunk spicule orientation is seen in *F. macracanthos*, but the spicules are truely perpendicular to the body axis and are very long, making the apparent diameter greater than either the neck or the posterior trunk. The spicular fringe of the posterium is longer in *F. macracanthos* than in *C. scabrum*, and the radula has much stronger denticles and a triangular plate.

DEPTH RANGE: 504 - 1568m

DISTRIBUTION: Upper and mid Continental Slope; Southern California Bight to Monterey Basin

DISCUSSION: No specimens of *Chaetoderma scabrum* were taken in the Bight '03 survey, and none have been reported by participating agencies during their regular monitoring over past years. This is appropriate given the bathymetric distribution of the species. The specimens photographed were from off Oregon at 1372m. The species has also been recorded from deeper than 1150m in the Tanner Basin offshore in the Southern California Bight. The holotype is from Monterey Bay, and from the deepest part of the species bathymetric distribution. Scheltema (1998) indicates that upon reexamination of material identified as *C. scabrum* by Schwabl, she found all extant specimens to be *C. nanulum*. The above comparisons between *C. resisum* and *F. macracanthos* are based on literature only. No specimens of these species were available for examination during this effort.



Chaetoderma scabrum **Heath 1911 A. Whole animal, lateral views (scale bars 1mm) B. Posterior lateral view C. Anterior view D. Posterior lateral view E. Radula lateral and frontal views F. Spicules from mid-anterior trunk (scale bars 0.01mm) (Sta. ESB-067, 1372m)**

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: None

LITERATURE: Scheltema, 1998

DIAGNOSTIC CHARACTERS:

1. Body regionated, BLI 6.7; anterium somewhat inflated, neck equal in diameter to anterior trunk; anterior and posterior trunks subequal in length, posterior trunk of greater diameter (Figure A); slight reduction of body diameter at end of posterior trunk and beginning of posterium (Figure B)
2. Posterium abruptly expanded into an annulus under the peribranchial plate; peribranchial skirt not evident; spicular fringe very short, not reaching peribranchial plate (Figure B).
3. Oral shield entire, not dorsally incised (Figure D).
4. Radular denticles of moderate size, about 30% the length of the lateral plate; radular cone straight and gently tapering in frontal view; cone concave frontally and broader in lateral view (Figure E)
5. Mid-anterior trunk spicules of anterior trunk with strong central keel; little or no lateral ridging; edges thickened. Some with rounded bases others with ragged squared-off bases. (Figure F).

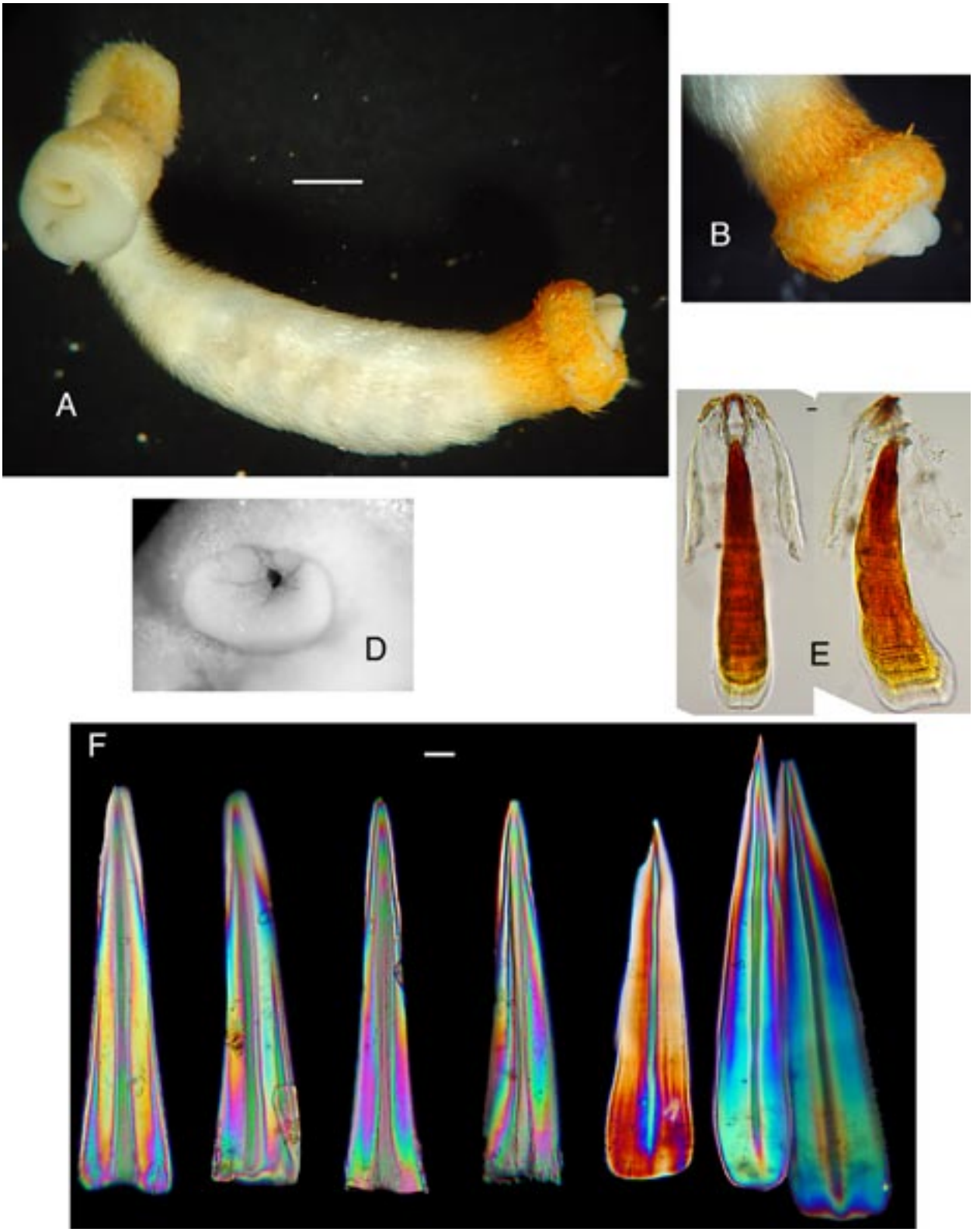
RELATED SPECIES AND CHARACTER DIFFERENCES:

1. *Chaetoderma* sp A is among the shorter chaetodermomorphs in the NEP. The short group also includes *C. californicum*, *C. nanulum*, *C. recisum*, *C. scabrum*, *Falcidens longus*, and *F. macracanthos*. It can be distinguished from *C. californicum*, *C. nanulum* and the two *Falcidens* species by having an entire, unincised oral shield.
2. *C. recisum* differs from *C.* sp A in having: an inflated neck wider than the anterior trunk; and in the long spicular fringe of the posterium;
3. *C. scabrum* can be separated from *C.* sp A by: neck narrower than anterium; posterium not annularly expanded; spicular finge extending over peribranchial plate; radular denticles very small, 20% or less the length of the lateral plate.

DEPTH RANGE: known from a single specimen taken at 660m

DISTRIBUTION: Upper Continental Slope; Southern California Bight

DISCUSSION: Only a single specimen of this form has been recognized to date. More may remain misidentified as another species in collections. The degree of variability in body proportions and spicule morphology cannot yet be defined, but the specimen does not fit into any of the described species, although it is particularly close to *C. scabrum*. It is also close to *C. nanulum* in many charaters of the body regionation, but can easily be separated by the entire oral shield.



***Chaetoderma* sp A SCAMIT 2005§ A. Whole animal, lateral view (scale bar 1mm) B. Posterior lateral view C. Anterior view E. Radula frontal and lateral views F. Spicules from mid-anterior trunk (scale bars 0.01mm) (Bight 2003 Sta. 4100, 20JUL03, 660m)**

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: *Crystallophrisson hartmani* Schwabl, 1961

LITERATURE: Schwabl, 1961; Schwabl, 1963; Scheltema, 1998

DIAGNOSTIC CHARACTERS:

1. Body regionated; anterium and neck about equal in diameter to anterior trunk; posterior trunk much narrower than anterior trunk, and narrower than posterium (Figure A)
2. Oral shield entire, uncleft dorsally; surrounding mouth (Figure B)
3. Peribranchial plate flattened to dome shaped, spicular fringe protruding (if plate flat) or not protruding (if plate convex and dome shaped)(Figure C).
4. Mid-anterior trunk spicules with single or double central keel, otherwise lacking ridges (Figure E), slightly bent toward body axis (Figure F)
5. Radula with triangular plate well developed, bearing a pair of apophyses. Denticles strong, sickle-shaped, with long robust bases (Figure D)
6. Radular cone narrow and straight in frontal view, broad and somewhat asymmetrically extended anteriorly in lateral view (Figure D)

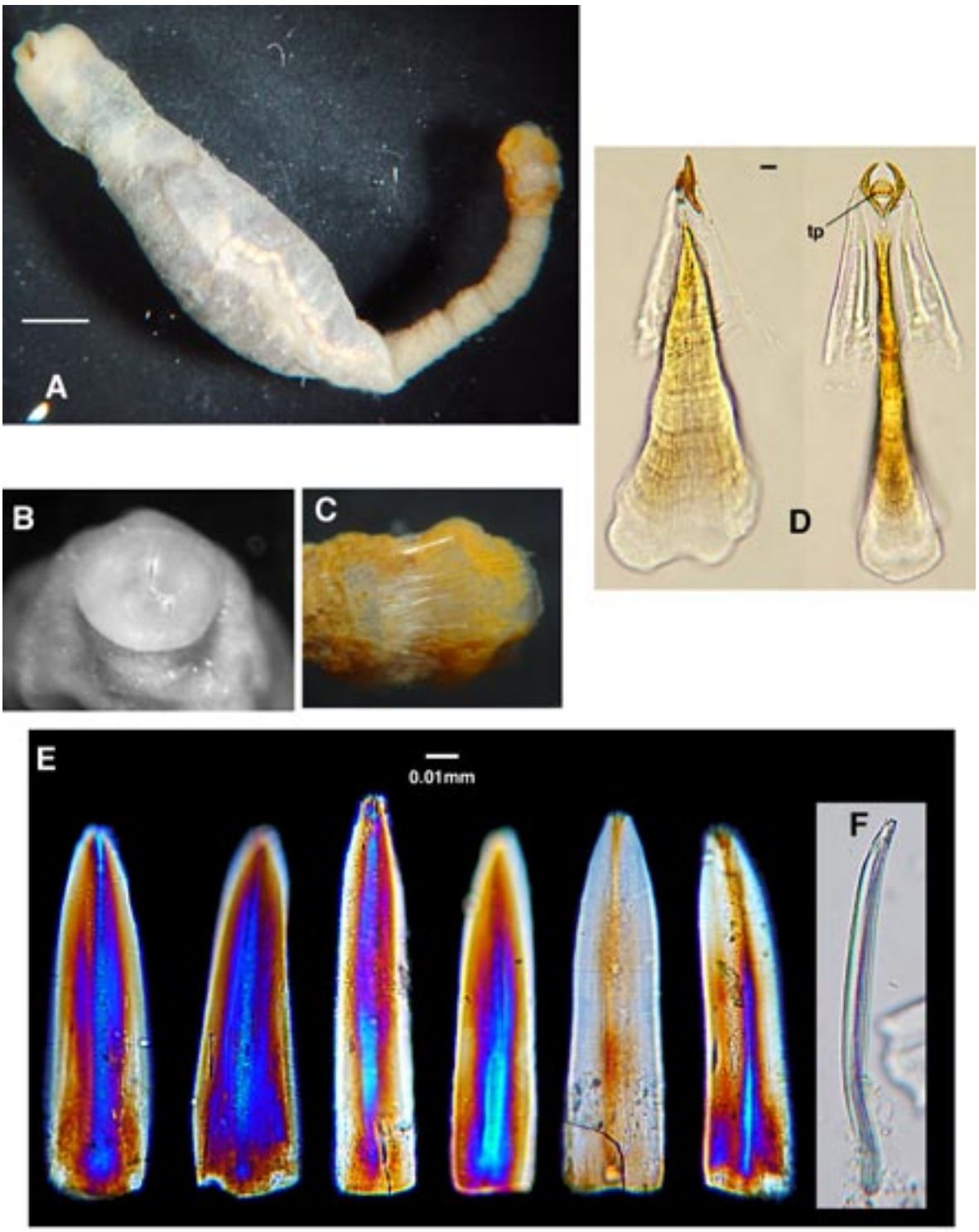
RELATED SPECIES AND CHARACTER DIFFERENCES:

1. Differs from all other NEP chetodermomorphs in the strongly inflated anterior trunk which is much wider than the posterior trunk (forming a shank-like tail)
2. Similar to *Chaetoderma* sp A, *C. scabrum* and *C. recisum* in having an entire oral shield. Can easily be differentiated from all three on the basis of body regionation and posession of a triangular plate in the radula

DEPTH RANGE: 200 - 1843m

DISTRIBUTION: Upper and mid Continental Slope; Southern California Bight to Oregon

DISCUSSION: *Falcidens hartmanae* is quite distinctive in its body form among Southern California Bight chaetodermomorphs, although this particular pattern of regionation is reasonably common among members of the genus. The type species of *Falcidens*, *F. crassotus* from northern Europe, has this pattern. Species off West Africa and Australia also have a very broad anterior trunk followed by a narrow posterior trunk. An entire cephalic shield is infrequent among NEP chaetodermomorphs, but occurs in three species of *Chaetoderma*, and in an undescribed *Scutopus* from off California and Oregon. To the north there are several similar appearing undescribed species of *Falcidens* from the Gulf of the Farallones and the Oregon Slope. Scheltema (1998) indicates these differ in size of radula and spicules from *F. hartmanae*. Fine structure of apophyses associated with the triangular plate may also help distinguish a similar form from Oregon. In the B'03 collections *F. hartmanae* was the fourth most abundant and wide-spread aplacophore species, occurring at 20 sites (29 total individuals). In the survey it was taken at sites ranging from 310m to 960m in depth. Mean depth of occurrence was 573m, modal depth was 579m, and median depth was 590m. Other collections found this species both shallower and deeper.



Falcidens hartmanae **(Schwabl 1961) A. Whole animal, lateral view (scale bar 1 mm) B. Anterior view C. Posterior lateral view D. Radula lateral and frontal views (tp, triangular plate) E. Spicules from mid-anterior trunk F. Spicule edge view (scale bars 0.01mm) (location unknown)**

SCAMIT CODE: None Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: *Crystallophrisson incrassatum* Schwabl 1963
? *Chaetoderma* sp B of Shrake 1985

LITERATURE: Schwabl, 1963; Scheltema, 1998; Salvini-Plawen, 1975

DIAGNOSTIC CHARACTERS:

1. Body regionated (Figure A); anterium and neck inflated, much broader than anterior trunk; posterior trunk broader than anterior trunk; posterium often has the appearance of an annulus or ring, and may be set off from posterior trunk by distinct ridge, lacking spicular fringe (Figure B)
2. Animal very short for a chaetodermomorph, with a BLI of 3-4 due to the inflated anterium/ neck and posterior trunk (Figure A)
3. Oral shield incised, wider than tall, with well-defined dorsal lobes, less than half the width of the inflated anterium (Figure C)
4. Radula lacking denticles; radular cone continuous with robust forked process extending forward like tongs and covered in a heavy sheath of connective tissue (Figure E); cone narrow in anterior view, broad in lateral view
5. Anterior and posterior trunk spicules similar, adherent, lacking keel, ridges, or grooves, long and narrow (Figure D)

RELATED SPECIES AND CHARACTER DIFFERENCES:

1. Several NEP *Chaetoderma* species have inflated anteriums, but none have the combination of inflated anterium and neck and short broad posterior trunk which make this animal so distinctive. In *Chaetoderma elegans* the animal is very long and narrow (BLI 24) and the inflated anterium is carried at a nearly right angle to the main body axis. In *Chaetoderma hancocki* the animal is also much more attenuated than is *F. incrassatus*, with a typical BLI of 10
2. Other members of the families Chaetodermatidae and Falcidentidae have radulae very unlike that of *F. incrassatus*. While some *Chaetoderma* species may lack or have very tiny denticles (as discussed and illustrated by Salvini-Plawen, 1975), they also lack the robust forked anterior extension of the radular cone. All NEP *Chaetoderma* species have denticles, and are easy to distinguish from *Furcillidens* on that basis alone. The same is true of *Falcidens* species. Even those large specimens that lack a triangular plate still bear robust sickle-shaped denticles and lack the forked anterior process of *Furcillidens*.

DEPTH RANGE: 504 - 868m

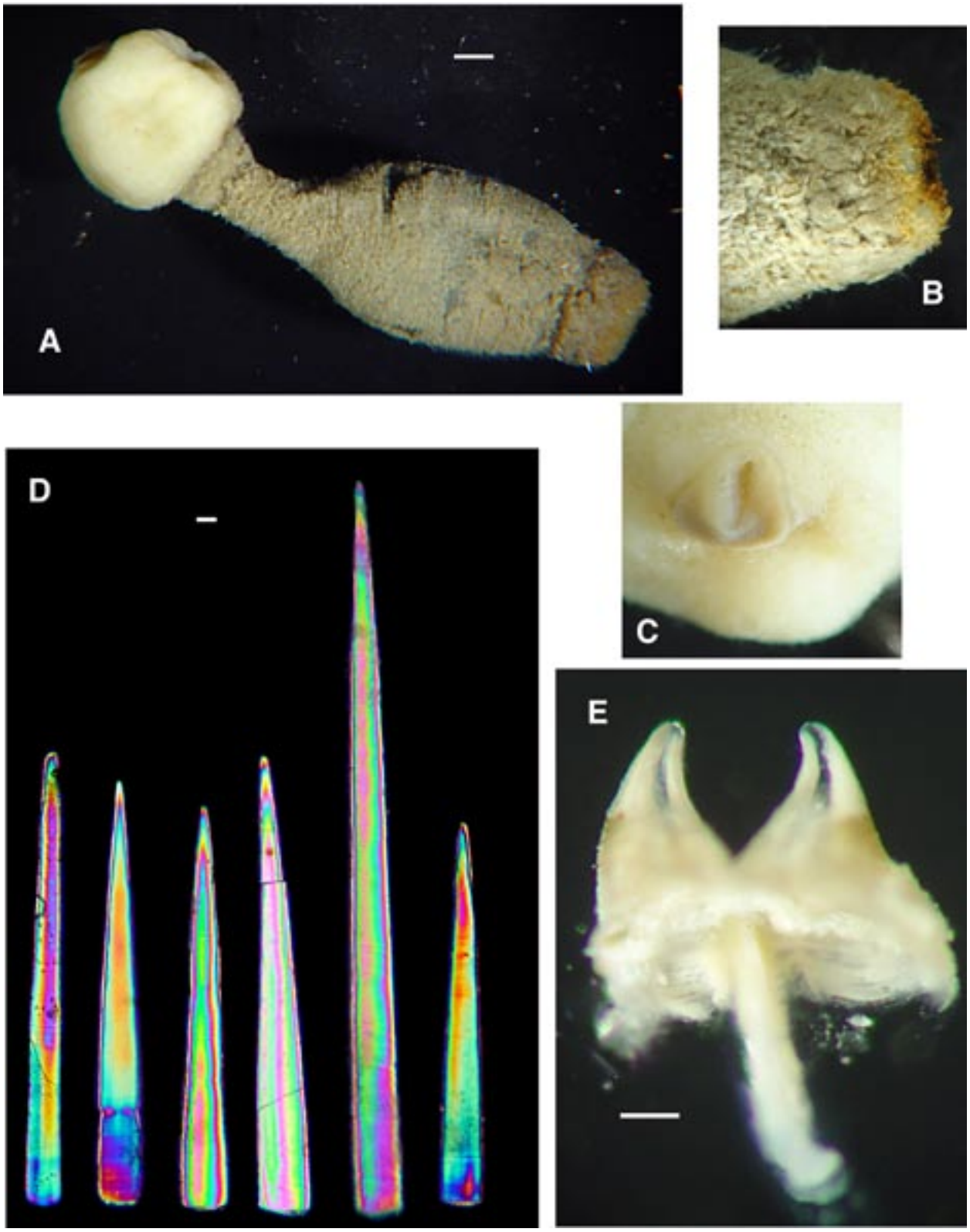
DISTRIBUTION: Upper Continental Slope; Southern California Bight

COMMENTS: If, for some reason, the exterior appearance of a specimen does not unequivocally place it in *F. incrassatus*, a radular preparation will soon demonstrate the difference from other chaetodermomorphs. At present the genus is monotypic, but there may be other species in the genus yet undiscovered. It cannot yet be determined which of the characters mentioned above is unique to this species, and which will be common to other members of the genus once they are found.

DISCUSSION: The radula of this species is very odd, even for a chaetodermomorph. The large forked anterior process looks like a pair of fangs, and seems in some views to have a central lumen or canal. It is not impossible that this may carry some substance for immobilization or digestion of prey. Too little is known of the detailed anatomy of the animal to evaluate this supposition.

Scheltema (1998) indicates that in the three lots she examined no other species of aplacophores occurred. Schwabl (1963), in her original description of the animal indicated that it was taken with *Limifossor fratula* at one of the two sites where it was found In Bight '03 the three collected specimens did not co-occur with any other species. Scheltema suggests that the fineness of the sediments at sites where this species occurs (silts with less than 5% sand and up to 35% clay) forms a habitat not favored by other aplacophore species.

Comparison of the figure provided by Schwabl in the original description, the drawing in Scheltema (1998) and figure A shows that the length of the posterior trunk is quite variable in this species. It is consistently longer than the anterior trunk, but varies in length and degree of inflation relative to the anterior trunk



Furcillidens incrassatus **(Schwabl 1963) A. Whole animal, lateral view (scale bar 1mm) B. Posterior lateral view C. Anterior view D. Spicules from mid-posterior trunk (scale bars 0.01mm) E. Radula frontal view (scale bar 0.1mm) (Bight 2003 Sta. 4219, 19JUL03, 610m)**

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: *Falcidens* sp B SCAMIT 1985§

LITERATURE: Scheltema, 1998

DIAGNOSTIC CHARACTERS:

1. Body regionated (Figure A), BLI 5.5-8.9; anterium somewhat inflated, separated from neck by a constriction; neck short, separated from anterior trunk by constriction; anterior trunk significantly longer than posterior trunk; posterior trunk larger in diameter than any other region except anterium.
2. Posterium slightly expanded, not set off from posterior trunk by a narrowing; spicular fring of posterium long, extending well beyond peribranchial plate (Figure C); plate flat to very slightly convex, covered with radiating spicules; no peribranchial skirt evident
3. Oral shield dorsally incised, wider than tall (Figure B), with small, poorly defined dorsal lobes; about ½ as wide as anterium.
4. Radular denticles large, sickle-shaped, and meeting at the top of the radular cone; triangular plate present (can be lost); radular cone barely tapering in frontal view (Figure D), normally tapering in lateral view; cone much narrower in frontal than in lateral view.
5. Mid-anterior trunk spicules centrally keeled, with thickened edges; a few lateral ridges may be present. Under birefringence mid-anterior spicule colors, typically are white with yellowish brown ridges with the central keel being darkest. (Figures F)

RELATED SPECIES AND CHARACTER DIFFERENCES:

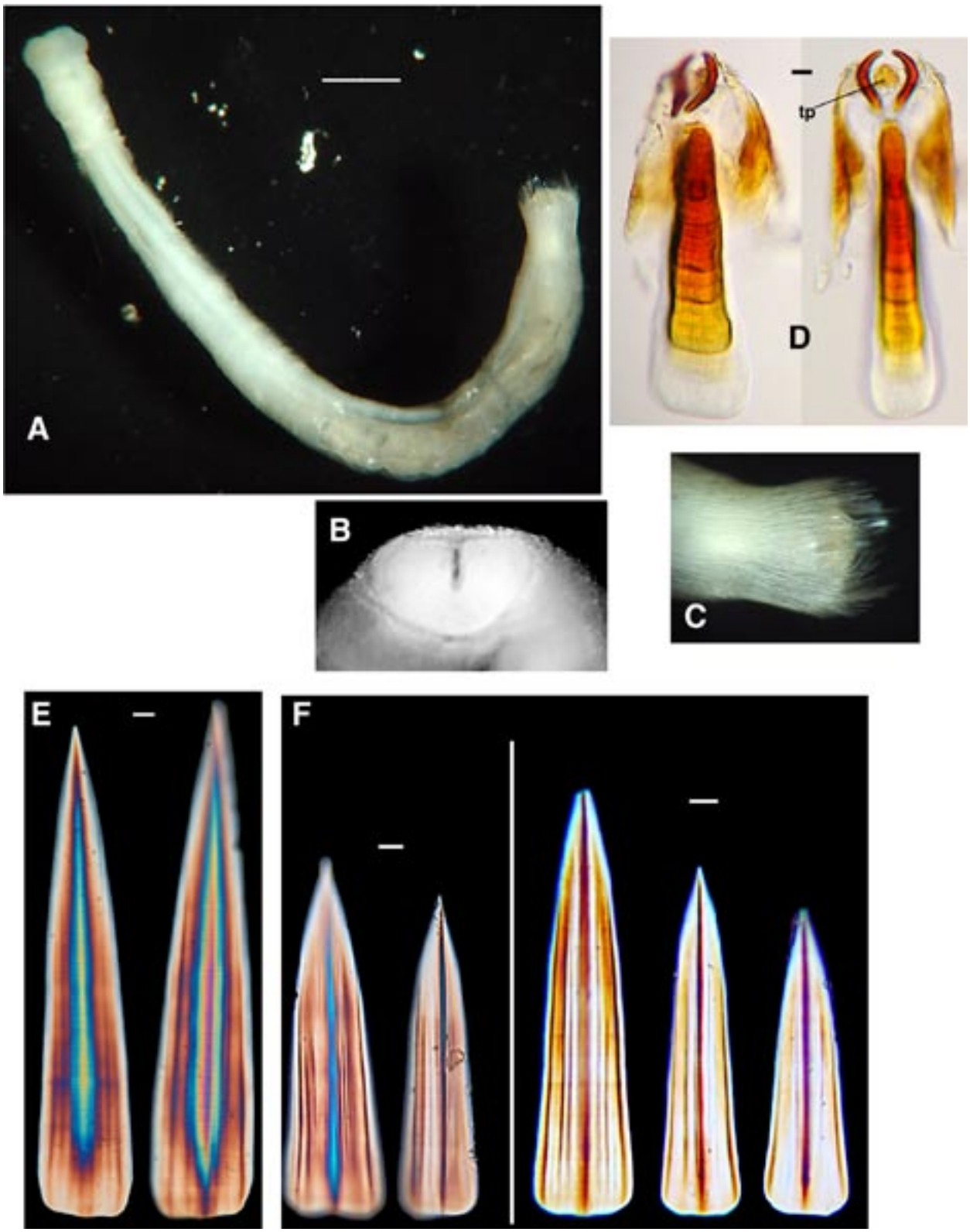
1. Despite its name, *Falcidens longus* has a BLI which places it among the short group of chaetodermomorph species in the NEP. Other members of this group are *Chaetoderma californicum*, *C. nanulum*, *C. recisum*, *C. scabrum*, *C.* sp A, and *Falcidens macracanthos*. These species can be distinguished using several characters. The birefringence images shown on figure F are typical for *F. longus*.
2. *Chaetoderma recisum*, *C. scabrum*, and *C.* sp A all have an entire oral shield which lacks the dorsal incision. They can be quickly separated from *F. longus* on this basis.
3. *Chaetoderma californicum* can be separated from *F. longus* by having: the anterior trunk shorter than the posterior trunk; anterium no wider than the neck; no constriction separating the anterium and neck; by the long spicular fringe of the posterium; by spicules with a weak central keel restricted to the distal 1/2 of spicule length; by very small radular denticles which are not sickle-shaped, and in lacking a triangular plate (can be lost in some *F. longus* however).
4. *Chaetoderma nanulum* can be separated from *F. longus* by having: anterior and posterior trunk subequal (either may be somewhat longer); no constriction separating anterium from neck; a shorter spicular fringe on the posterium; spicules that are not as strongly centrally keeled; anterior trunk spicules that are attached at large angles to body axis (but not perpendicular); radular denticles that are not large and sicklel-shaped; and in lacking a triangular plate (can also be lost in some *F. longus* however).

5. *Falcidens macracanthos* can be separated from *F. longus* by: anterior trunk shorter than posterior trunk; no constriction separating anterium from neck; oral shield as tall as wide and very deeply incised; anterior trunk spicules that are attached perpendicular to the body axis and very long, extending beyond the neck diameter; radular denticles which are large, but with poorly developed handles (curved but not very sickle-shaped); a radular cone which is much broader in lateral view than in frontal view.

DEPTH RANGE: 21.5 - 1812m

DISTRIBUTION: Continental Shelf and Upper to mid Continental Slope; Southern California Bight to Vancouver Island, Canada

DISCUSSION: This sheet replaces an earlier one by Jay Shrake published in 1985 in the SCAMIT newsletter Volume 4 Number 8. The species was still undescribed at that time, and was then called *Falcidens* sp B SCAMIT 1985. While *F. longus* has a low BLI because it is both long and broad, it can be confused with members of the long group as well as members of the short group with which it was compared above. It co-occurs frequently with both *C. marinelli* and *C. pacificum* at shelf depths, and with *C. pacificum* on the upper slope. It was the most abundant species in the Bight ’03 samples, and occurred at more sites than any other species of aplacophore. The fact that the triangular plate may be lacking in members of this species is troubling, but it can still be identified as a *Falcidens* by radular examination because of its large sickle-shaped radular denticles.



Falcidens longus **Scheltema 1998 A. Whole animal, lateral view (scale bar 1mm) B. Anterior view C. Posterior lateral view D. Radula lateral and frontal views (tp, triangular plate) E. Spicules from mid-poserior trunk F. Spicules from mid-anterior trunk (horizontal scale bars 0.01mm)**

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: None

LITERATURE: Heath, 1911; Schwabl, 1963; Scheltema, 1998

DIAGNOSTIC CHARACTERS:

1. Body not regionated, of uniform diameter throughout; spicular cover very even, adherant, shiny, silvery (Figure A)
2. Posterium not preceeded by a shank, continuous with trunk; spicular fringe short, not reaching peribranchial disk (Figure B); disk nearly flat, surrounded by narrow skirt lacking prominent spicules
3. Animal normally bent into a shallow C shape (Figure A), BLI 3-7, normally 3-4
4. Oral shield divided into two hemispheres separated by the mouth (as in prochaetodermatids), but the two halves approximated ventrally and widely separated dorsally; mouth large relative to cephalic shield dimensions
5. Radula large, distichous, with multiple rows of heavily sclerotized teeth, each with a large lateral denticle and a median denticle on a broad base (Figure D)
6. Mid-anterior trunk spicules relatively thick, relatively evenly tapered, with a very short keel at the distal end (evident in the right spicule in Figure C)

RELATED SPECIES AND CHARACTER DIFFERENCES:

1. Unlike chaetodermatids and falcidentids in being unregionated; unlike prochaetodermatids in lacking a shank and knob posteriorly; unlike all solenogastres in lacking a pedal groove; unlike scutopids in having a cephalic shield widely separated dorsally and approximated ventrally
2. Differs from the other NEP *Limifossor talpoideus* in body proportion, normally being shorter and thicker (BLI 3-5 vs 6). Unfortunately very relaxed *L. fossor* can extend to a BLI of 7, but this is very uncommon. *L. fossor* also has larger more robust teeth, with larger lateral denticles; larger spicules; and a thicker hypodermis which makes it more rigid than *L. talpoideus*. The later species is not known to occur south of San Francisco, and is not common south of Alaska

DEPTH RANGE: 131 - 1830m

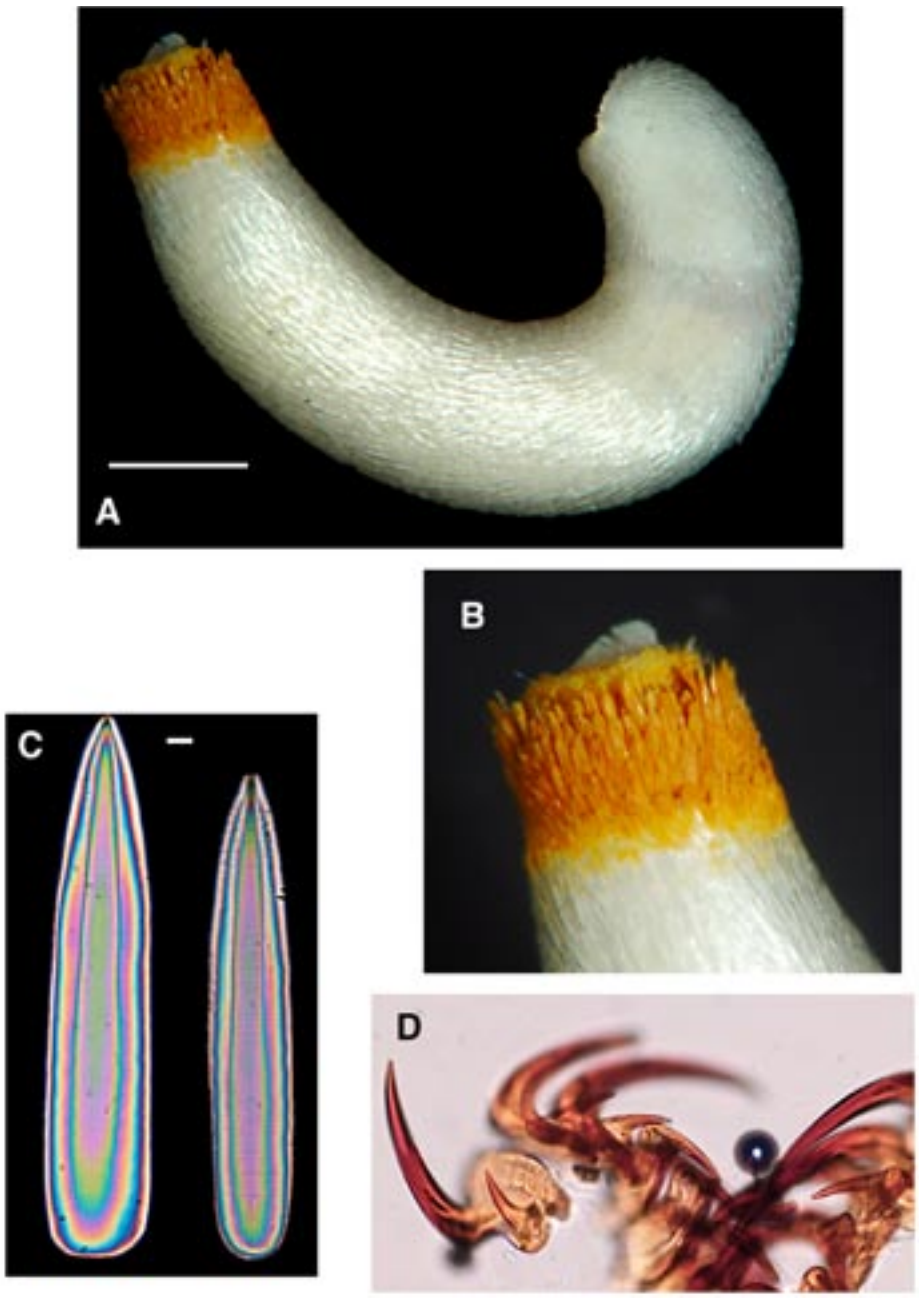
DISTRIBUTION: Outer Continental Shelf and Upper to mid Continental Slope, Southern California Bight to Oregon

DISCUSSION: One of the commonest and most easily recognized aplacophores in the NEP, occurring both on the Continental Shelf and on the Continental Slope. It is replaced from Oregon to Alaska by *Limifossor talpoideus*, which occurs as far south as San Francisco. In the Bight ’03 collections *L. fratula* was the third most abundant taxon, with 33 individuals.

During initial examination of the material there was some concern over relatively elongate specimens such as that illustrated in Figure A. These animals, with BLIs of 5-7 seemed too elongate to fit comfortably in the described body form of *L. fratula* (BLI of 3.2-3.5, Scheltema 1998). Comparisons of spicules and radulae from the most compact and the most elongate

specimens showed no differences. We concluded that there was just a single species in the genus in our material, and that it was *L. fratula*.

This sheet replaces one prepared by Jay Shrake in 1985 and published in SCAMIT Newsletter Volume 4 Number 8. Specimens were exchanged prior to the publication of the sheet. We haven't learned much more about the species in the intervening 20 years.



Limifossor fratula **Heath 1911 A. Whole animal, lateral view (scale bar 1mm) B. Posterior lateral view C. Spicules from mid-anterior trunk (scale bar 0.01mm) D. Radula (location unknown)**

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: Neomeniomorpha sp SD1 Barwick 2003§

LITERATURE: Salvini-Plawen, 1978; Scheltema, 1998

DIAGNOSTIC CHARACTERS:

1. Animal small, just over 2mm in length; body not regionated, twig or very shallow C shape; tall oval with a ventral pedal groove (Figure A, arrows indicate groove); mouth not connected to pedal groove, which ends in a pedal pit; pedal groove continuous with cloacal chamber posteriorly.
2. Spicule coat dull; spicules adpressed in a single layer of slightly imbricated scoop-like spicules (less than 2 micro meters thick) (Figure B).
3. Radula, if present, unknown.
4. Copulatory spicules, if present, unknown

RELATED SPECIES AND CHARACTER DIFFERENCES:

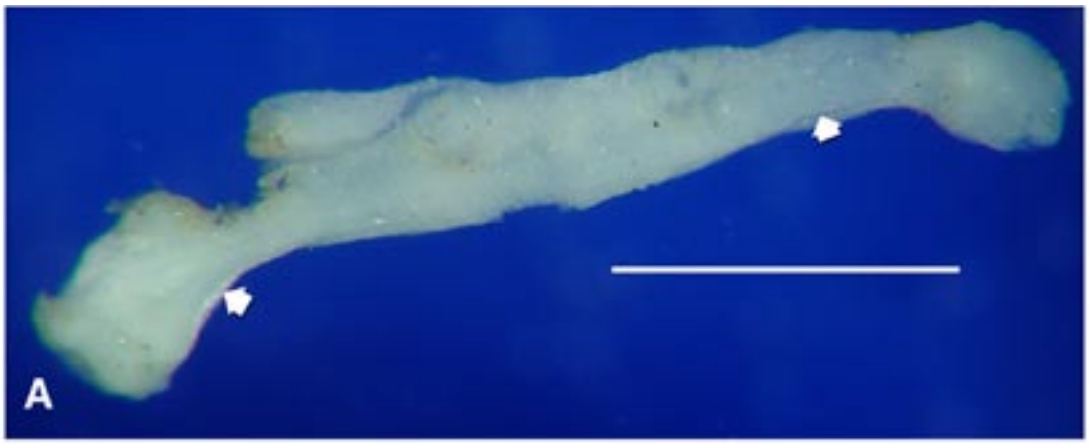
1. Neomeniomorpha sp A can be separated from *Heathia porosa* by having spicules not tapering at one end; by being an order of magnitude smaller; by lacking an attenuated posterior end.
2. It can be differentiated from *Dondersia californica* by being much smaller; in not having a crenulate carina dorsally; and in having scoop-shaped spicules.
3. It can be separated from *Dorymenia acuta* in being much smaller; in lacking multiple layers of tangential spicules in the dermis; and in not being attenuate posteriorly.
4. It differs from *Platymenia branchiosa* by having a much greater BLI; by having adpressed rather than upright spicules; by having solid scale-like spicules rather than short needle-like spicules; and by being taller than wide rather than wider than tall.
5. Neomeniomorpha sp A can be separated from Neomeniomorpha sp B by: being larger; having a greater BLI; by having adpressed rather than upright spicules; by having solid scale-like spicules rather than long hollow needle-shaped spicules; and by lacking a spiculose fringe around the cloacal chamber.
6. Neomeniomorpha *sp A* can be separated from Neomeniomorpha sp C by being larger; by having a dull rather than shiny spicule coat; by having spicules drawn into a long or short point over a rounded base; by having the spicules attached in a radial rather than an adpressed fashion.

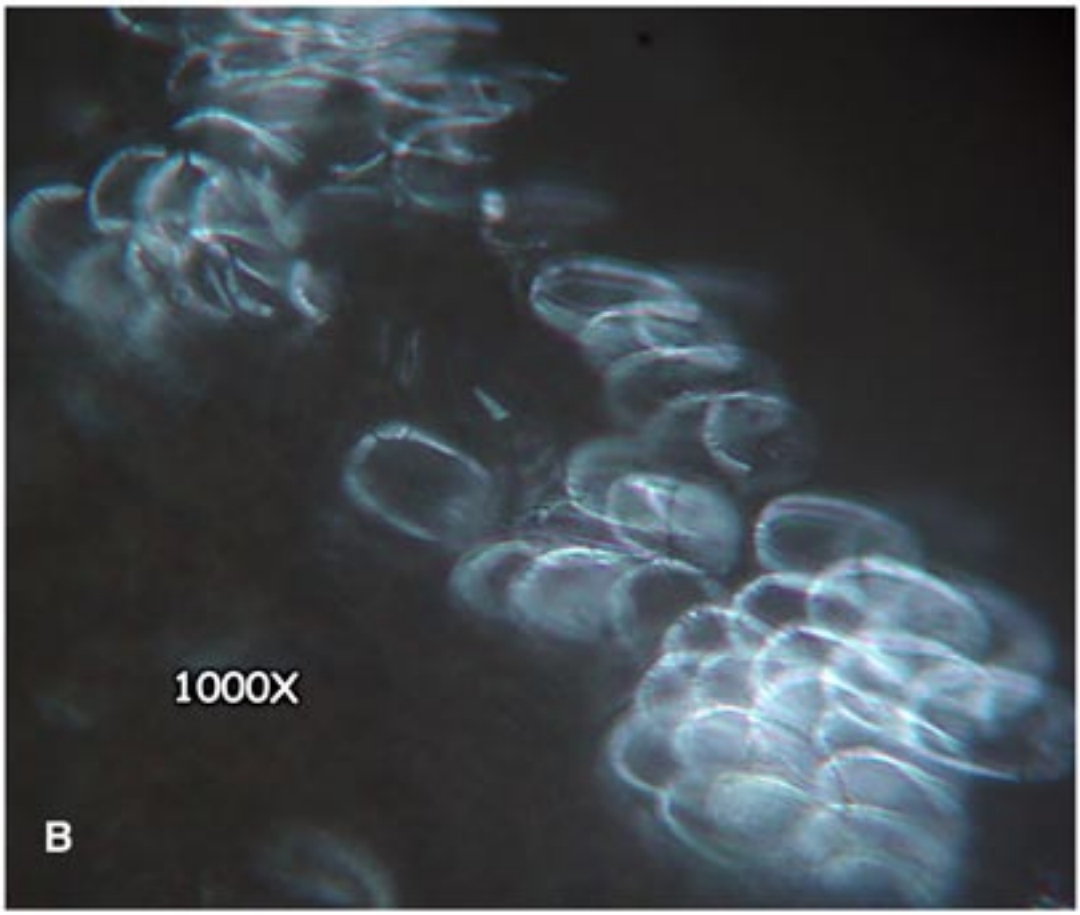
DEPTH RANGE: known from a single specimen from 508m

DISTRIBUTION: Upper Continental Slope, off San Diego

DISCUSSION: It is likely that this species is the same as the *Gymnomenia minuta* described by Scheltema (1998) and noted as occurring within the Southern California Bight. The main similarities are in the overall body shape and in the shape and size of the spicules. If a radula and copulatory spicules can be recovered from this or another future specimen, the identity with *Gymnomenia minuta* may be established. For the moment we merely suspect that the two may

be either the same or closely related. Between our single undissected specimen, and the brief description provided by Scheltema, sufficient differences remain to retain this as a separate provisional species





Neomeniomorpha sp A SCAMIT 2005 A. Whole animal, lateral view (scale bar 1mm) B. Spicules from ventral furrow (arrows Fig. A) (CSD Sta. DS1, 25APR03, 500m, 0.5mm screen size)

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: Neomeniomorpha sp SD2 Barwick 2003§

LITERATURE: Salvini-Plawen 1978

DIAGNOSTIC CHARACTERS:

1. Body un-regionated, with ventral pedal groove (indicated by arrows in Figure A); animal small, bent into a shallow C shape with anterior and posterior ends clearly differentiated; cloacal chamber well defined and fringed by long spicules (Figure A)
2. Spicules attached in two ways, a surface tangential layer, and a second upright array which penetrates through the surface layer; spicules hollow needles (Figure B)
3. Radula, if present, unknown

RELATED SPECIES AND CHARACTER DIFFERENCES:

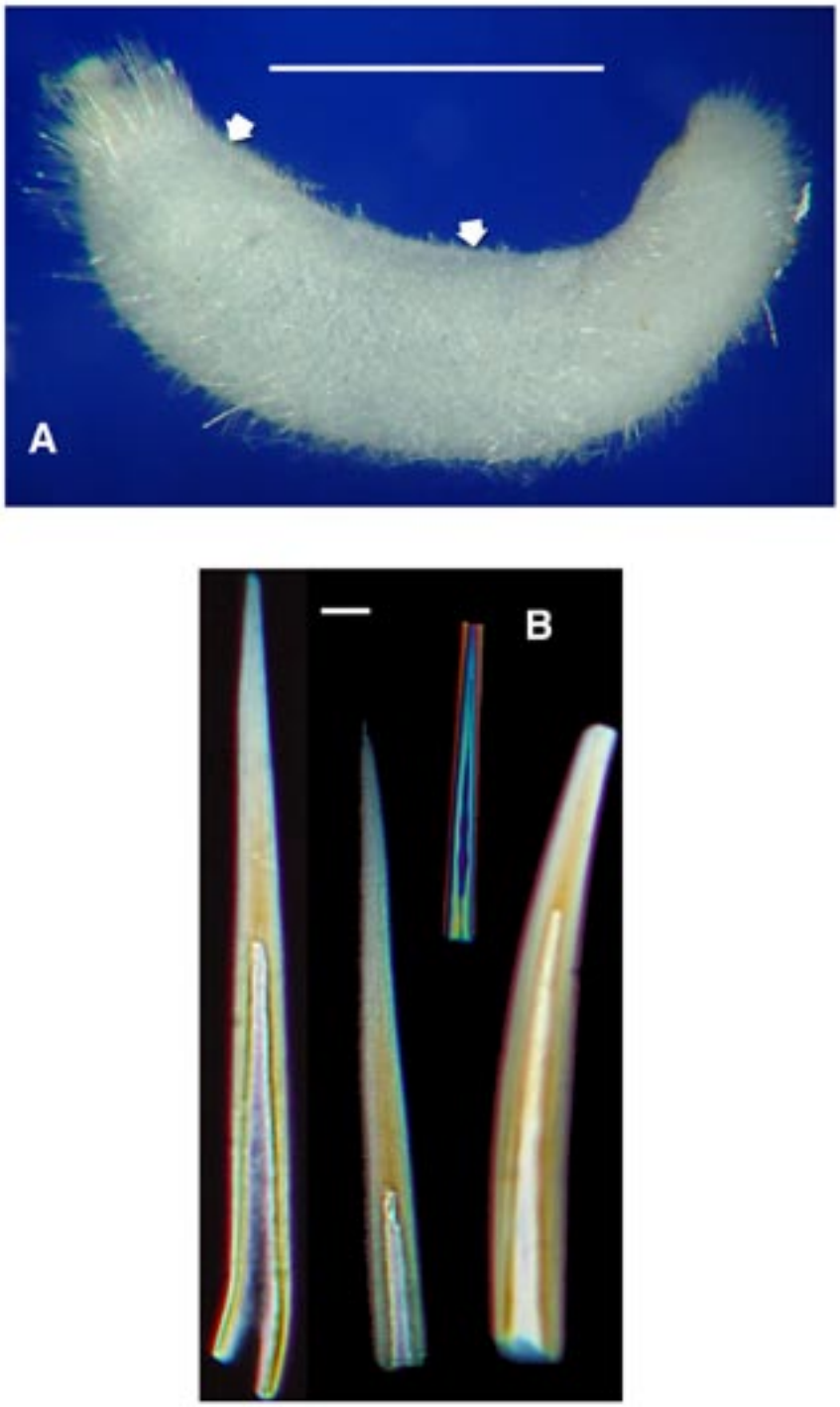
1. Neomeniomorpha sp B can be separated from Neomeniomorpha sp A, *Heathia porosa*, *Gymnomenia minuta*, *Genitoconia mariensis*, *Nematomenia* sp, and Neomeniomorpha sp C in having needle-like rather than plate-like spicules, which are not adpressed to the epidermis.
2. It can be differentiated from *Dondersia californica* by being much smaller; in not having a crenulated carina dorsally; and in having a fringe of spicules around the cloacal chamber.
3. It differs from *Dorymenia acuta* in having a single surface layer of tangential spicules supplemented with upright spicules rather than multiple layers of tangential spicules only, and in having a relatively blunt posterior end rather than a finger-like ventrally concave posterior extension of the body.
4. Neomeniomorpha sp B can be separated from *Plathymenia branchiosa* by being round rather than dorsoventrally flattened; in having a larger BLI; and in having both a surface layer of tangential spicules and an upright layer of long hollow needle-like spicules.

DEPTH RANGE: known from a single specimen taken from 508 m

DISTRIBUTION: Upper Continental Slope, off San Diego

DISCUSSION: This tiny animal was taken by CSDMWWD during preparations for Bight '03 sampling, in their screen size comparison sampling. It was taken in the same grab as Neomeniomorpha sp A. The animal is very small, and may easily escape a 1.0mm screen, so is not likely to be reported by a survey using our standard processing methods. The present specimen may also be a juvenile, in which case the adult may be of a size which would more routinely be retained on a 1.0mm screen.

The hollow needle-like spines clearly place this species in the Cavebelonia, all of which share the same sort of spicules. There are several somewhat similar species from the Oregon Slope, but whether the specimens belong to the same species awaits examination of radula and perhaps internal anatomy of the anterior digestive system.



Neomeniomorpha sp B SCAMIT 2005§A. Whole animal, lateral view (arrows indicate ventral furrow) (scale bar 1mm) B. Spicules (scale bar 0.01mm) (CSD Sta. DS1, 25APR03, 500m, 0.5mm screen size)

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: Neomeniomorpha sp SD3 Barwick & Cadien 2004§

LITERATURE: Salvini-Plawen, 1967; Salvini-Plawen, 1978; Scheltema 1998

DIAGNOSTIC CHARACTERS:

1. Body un-regionated, with ventral pedal groove (indicated by arrows in Figure A); edges of pedal groove closely appressed, not evaginated to form a sharply V-shaped furrow; body round to tall-oval in cross-section; anterior and posterior ends poorly differentiated (Figure A).
2. Spicules in single imbricated layer; adpressed basally, but with pointed distal extensions of the scale-like spicules protruding from surface (visible on right side of the specimen in Figure A).
3. Spicules shield or scale-like, all distally pointed, but some drawn out into a long spine-like distal prolongation (Figure B).
4. Radula, if present, unknown.

RELATED SPECIES AND CHARACTER DIFFERENCES:

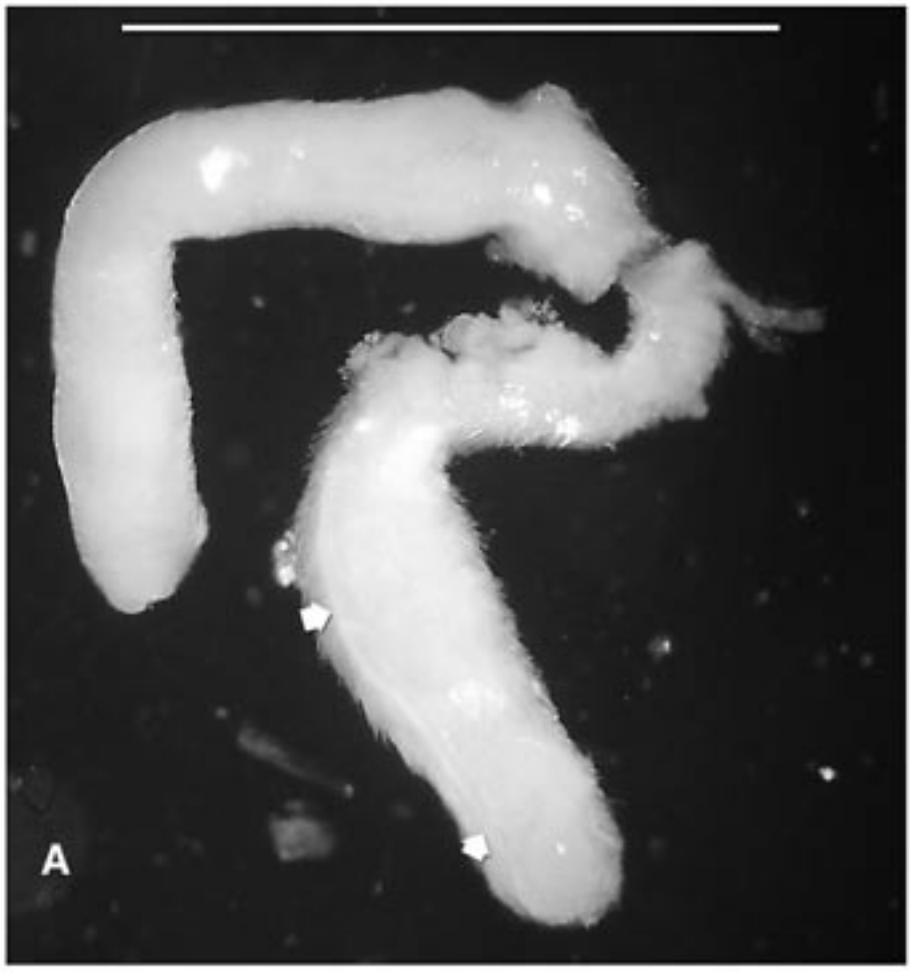
1. Neomeniomorpha sp C can be separated from Neomeniomorpha sp B, *Plathymenia branchiosa*, and *Dorymenia acuta* by having a single layer of shield-like spicules rather than hollow spine-like spicules in single or multiple layers in the epidermis.
2. It differs from Neomeniomorpha sp A and *Gymnomenia minuta* by having shield-shaped rather than tile-shaped spicules with thickened edges; and in having poorly differentiated anterior and posterior ends
3. *Nematomenia* sp (Scheltema 1998) and *Dondersia californica* both differ from Neomeniomorpha sp C by having a dorsal carina
4. Neomeniomorpha sp. (Scheltema 1998) differs from Neomeniomorpha sp C in spicule shape, with spicules shaped like long handled spoons rather than pointed scales.
5. *Heathia porosa* is similar, but can be separated by having drop shaped (rather than shield-shaped) spicules which bear longitudinal striations, and are not drawn out into elongate pointed extensions. The body of *Heathia* also has clearly distinguishable head and tail ends, the latter drawn into a finger-like pointed extremity.
6. It is very similar to *Genitoconia mariensis* and is currently distinguishable from that species only in having somewhat more attenuated spicules; tightly appressed rather than evaginated margins of the pedal groove; and in being smaller (about ½ the size).

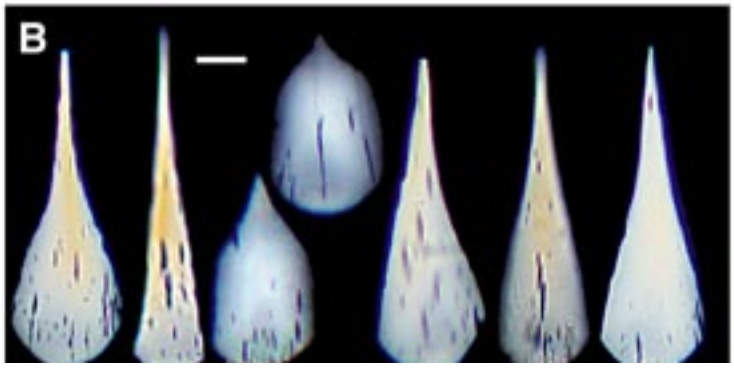
DEPTH RANGE: 200-223m

DISTRIBUTION: Upper Continental Slope, Southern California Bight

COMMENTS: The great similarity of Neomeniomorpha sp C and *Genitoconia mariensis* will probably lead to their synonymy once both taxa are better defined. Scheltema's description provides some detail, but not enough to have a thorough appreciation of what her species represents. Since we only had two specimens taken in the Bight '03 program, both very small, no dissections or sectioning has been attempted on Neomeniomorpha sp C. Without knowledge

of the radula and copulatory spine configuration it would be premature to allot our two Bight '03 specimens to the existing species, and we retain them here as a separate provisional pending further investigations by ourselves or others. Only two specimens of *Genitoconia mariensis* (the holotype and a paratype) are known. Further material of both these forms is needed to clarify their relationship.





Neomeniomorpha sp C SCAMIT 2005 A. Whole animal, lateral view (arrows indicate ventral furrow) (scale bar 1mm) B. Spicules (scale bar 0.01mm) (Bight 2003 Sta. 4363, 27JUL03, 199m)

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: *Prochaetoderma californicum* Schwabl 1963

LITERATURE: Schwabl, 1963; Scheltema, 1985; Scheltema 1998

DIAGNOSTIC CHARACTERS:

1. Body not regionated, tapering relatively evenly from front to back (Figure A)
2. Oral shield divided into two hemispheres surrounding mouth (prochaetodermatids), two rows of enlarged spicules lateral to shield (Figure C)
3. Shank variable in length, typically between 1.5-3x length of knob; shank diameter about 1/3 diameter of trunk; knob diameter more than half that of trunk
4. Color always whitish silver, uniform throughout body; lacking ferric incrustations seen in some other chaetodermomorph species (especially *Limifossor*)
5. Posterior knob with protrusive spicular fringe. Fringe spicules originate about midway on the knob, and are straight to slightly divergent (Figure B)
6. Body spicules are waisted at about 55-60% of length; bent laterally distal to waist by 3-8 degrees; lacking ridges or chevrons; thickest centrally with thin edges (Figure F). Spicules are normally held closely adherant to body axis; only specimens damaged by rough handling will appear to have any degree of spicular shagginess
7. Radula distichous, with each radular tooth strongly curved medially with denticles along inside of curve (Figure G). Paired jaws are robust, much larger than the radula, with recurved masticatory borders (Figures D and E)

RELATED SPECIES AND CHARACTER DIFFERENCES:

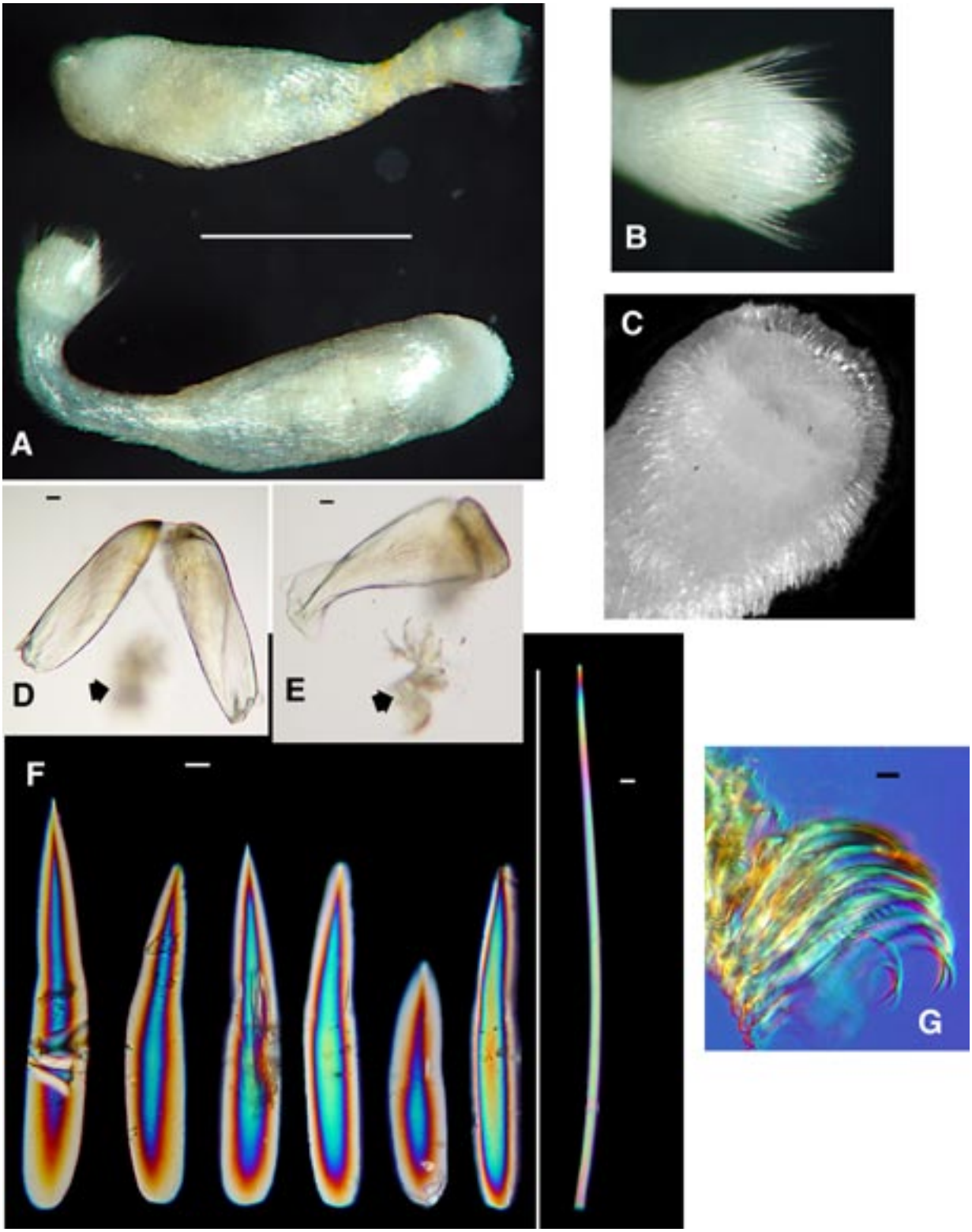
1. Differs from *Spathoderma* sp A in color, in being more tapered, with a more gradual transition between the trunk and the shank; in the orientation of the spicular fringe; and in the degree of lateral bend in the body spicules. Jaw and radular differences probably also are present, but those structures are yet to be examined for *S.* sp A.
2. Differs in size and detailed structure of body spicules from several other provisional species of *Spathoderma* from the Gulf of the Farallones and from off Oregon according to Scheltema. These very similar species are not known to occur south of Point Conception. The only prochaetodermatids known from the Southern California Bight are this species and *Spathoderma* sp A.

DEPTH RANGE: 500 - 1800m

DISTRIBUTION: Upper and mid Continental Slope; Southern California Bight to Monterey Bay

DISCUSSION: Because the species is fairly diminutive it is better retained on a 0.5mm screen. It is not uncommon in the above depth range, and shows some indication of being more prevalent in areas of glass sponge occurrence (Schwabl 1963). This was the first described prochaetodermatid from the North East Pacific, and remains the only well known one. There are apparently several closely related species that occur to the north of Point Conception in the Gulf of the Farallones and off Oregon. These species apparently can only be separated based on size differences in the spicules, and in details of the radula (Scheltema 1998). Another related species from 950m off Oregon is similar, but has a very elongate body relative to the other

Spathoderma species. Also off Oregon there is a species, probably a *Niteomica*, which can be distinguished externally by the attitude, length, and point of origin of the spicular fringe on the knob. Additional separatory characters must await detailed examination of jaws, radulae, and spicules of all these forms. The NEP prochaetodermatid fauna, which currently consists of *S. californicum* and *Chevroderma whitlatchi* from several thousand meters of water, will become diverse once these additional forms are described.



Spathoderma californicum **(Schwabl 1963) A. Whole animal, lateral view (scale bar 1mm) B. Posterior lateral view C. Anterior view D. Jaws side view E. Jaws medial view (arrows indicate radula) F. Spicules G. Radula enlarged view(scale bars 0.01mm) (Sta. GCT2, 643m, IV 0.5a, 24Mar03)**

SCAMIT CODE: None

Date Examined: 05 April 2005
Voucher By: K. Barwick/D. Cadien

SYNONYMY: *Chevroderma* sp LA1 Cadien 2003§

LITERATURE: Scheltema, 1985; Scheltema & Ivanov, 2000

DIAGNOSTIC CHARACTERS:

1. Body robust anteriorly, tapering abruptly to a short shank, pale golden in color; anterium often inverted (Figure A)
2. Oral shield separated into two hemispheres surrounding the mouth, (prochaetodermatids) (Figure C)
3. With two rows of enlarged spicules surrounding cephalic shield
4. Posterior knob with protrusive spicular fringe, spicules emergent at more than half the length of knob; spicules convergent, knob only slightly larger in diameter than shank (Figure B)
5. Spicules very similar to those of *Spathoderma californicum*; broad, waisted at about 55-60% of length, lacking ridges or chevrons, thickest centrally with thin edges (Figure D)

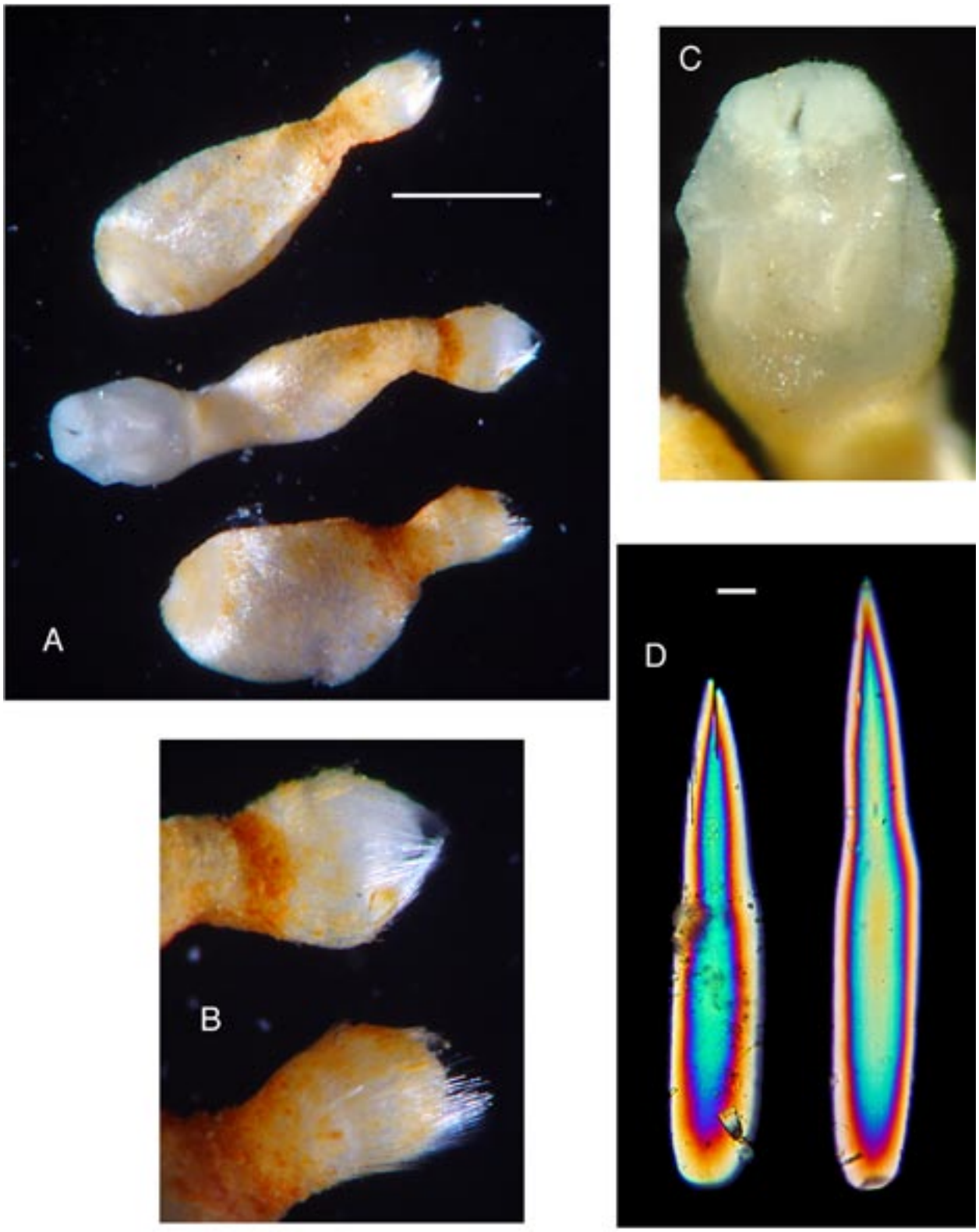
RELATED SPECIES AND CHARACTER DIFFERENCES:

1. Similar to *Spathoderma californicum* in many characters, but of very different body proportions. Hardly tapering prior to shank, shorter than knob; shank and knob together nearly half trunk length
2. Could be confused with several other prochaetodermatids known from the Oregon Slope, but differs from all in the extremely short, thick non-tapering trunk and short shank. Spicule attitude is closely appressed throughout length, not at all shaggy. Spicular fringe of knob is convergent rather than straight or divergent

DEPTH RANGE: 643m

DISTRIBUTION: off Palos Verdes Peninsula, California

COMMENTS: The species looks like the anterior end of a Limifossor grafted onto the posterior end of a Spathoderma. All five specimens so far known are of a pale golden color, markedly differing from the clear silver of S. californicum. Four of the specimens have the anterium completely inverted, making the trunk shorter and broader than in the anterium everted specimen. This accentuates the similarity to Limifossor. The spicules of S. sp A are a bit straighter than typical S. californicum spicules, but otherwise quite similar. No radula has yet been extracted from these specimens, so jaw detail and radula structure are not yet known. It co-occurred with Spathoderma californicum in both samples where it was taken.



***Spathoderma* sp A SCAMIT 2005 A. Whole animal, lateral view (scale bar 1mm) B. Posterior lateral view C. Anterior view D. Spicules from mid-anterior trunk (scale bar0.01 mm)**
(GCT2, 643m, IV 0.5a, 24Mar03)