

An Unending Saga of Unanswered Questions

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This is author's comments for the monograph on bivalves of the Northeastern Pacific which is in press. Taxonomic problems, concerned with some families and genera, are considered.

Бесконечная сага нерешенных вопросов

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Авторские комментарии к сданной в печать монографии по двустворчатым моллюскам тихоокеанского побережья Северной Америки. Рассмотрены таксономические проблемы, касающиеся отдельных семейств и родов.

We have been working to complete a book on the bivalves of the north-eastern Pacific begun by the late Frank Bernard (Pacific Biological Station, Nanaimo, B.C., Canada V9R 5K6) nearly 20 years ago. This revision has turned out to be a larger task than we had hoped. The book will cover the entire fauna from the Arctic coast of Alaska to the central portion of the other coast of Baja California, including the deep-water fauna.

The publication will have synonymies, descriptions, distributional information, illustrations, and citations of biological literature of every species. We also seek to make the treatment as useful as possible to bivalve workers outside of the eastern Pacific by having anatomical figures of every genus covered and citation of the most important literature world-wide on every genus and family treated. Whenever possible, we will highlight major unresolved problems in order to prompt other researchers and students to assist in solving them.

A complete faunal review is both an exciting and sobering task. A large overview is a significant contribution, in that an up-to-date, accessible identification manual is useful in a wide variety of disciplines - ecology,

paleontology, archaeology, environmental studies, and fisheries to name a few. Everyone is thus thankful for the effort. Moreover, a side benefit of a comprehensive review is that one gets an unparalleled opportunity to obtain an overview of the challenging unresolved problems.

A review of this extent is also a horrible task. There are mountains of errors compounding errors, vexing nomenclatural questions, and, most significantly, important taxonomic questions that must remain unresolved. As taxonomists used to settling most questions to the extent possible, we have found the preparation of reviews of group after group without having time to tackle the interesting problems has been frustrating, unsettling, and aggravating. But if one gets diverted into working out the enticing and seemingly easy questions, one rapidly falls behind on the far bigger task at hand.

We had not previously considered ourselves as taxonomic lumpers, but have found ourselves synonymizing a large number of taxa that were based on juvenile specimens or specimens that are only morphological variants. In general, we have adopted an attitude of "guilty until proven innocent", that is, unless we can explain in words and pictures how to tell two things apart, they belong together. Of course, if biological evidence has been advanced that there are two closely related species that cannot easily be distinguished on the basis of shell morphology, we are recognizing them, but lacking any such evidence, the burden of proof pushes the conclusion in the other direction.

The purpose of this informal paper is to point out some of the more interesting questions that will remain unresolved when we are done with the book, and then to draw some more general conclusions about approaches to these key problems.

A great deal is known about the order *Solemyida* as a result of studies by Pojeta, Reid, Kuznetsov, and others. We don't want to be repeated ourselves, and we try to avoid here references which are numerous in our book. What is most needed now is a global review of the species of *Solemya* and *Acharax*. The lines between genera, subgenera, and species are very unclear.

The classification of the *Nuculidae* is very much in need of a modern synthesis. As Maxwell has pointed out, there are at least two lines that have been distinct since the early Mesozoic, but this information has not yet been correlated with the available anatomical information. Moreover, no one has looked carefully at the eastern Pacific species in many decades, and we had little difficulty in concluding that there were significantly fewer northeastern Pacific species than recent lists presume. We recognize

about half the number than were proposed in the original Bernard manuscript.

We have little opinion about the tiny species of the *Pristiglomidae*, except to suggest that these species, and all other deep-water families, must continued to be studied on a world-wide basis.

Much progress has been registered in the classification of the rest of the protobranchs as a result of the studies of Allen, Filatova, Shileiko, Sanders, Waren, Hannah, Maxwell, and others. Taxonomic and nomenclatural stability has yet to be achieved, however and what is most needed is much greater multidisciplinary international collaboration.

In greatest need of attention is the complex surrounding the genus *Nuculana*. In the eastern Pacific, we believe that there are many fewer species than have been supposed. (Almost everyone has missed the two papers by the Russian paleontologist Savizky in 1969 proposing new generic taxa; (see: Kafanov & Savizky, 1995). Most significantly, this ecologically important group is hardly known anatomically and should be a high priority for study. Workers have almost achieved the necessary global perspective on the genera *Ledella* and *Bathyspinula* (the generic name *Spinula* being a junior homonym).

The species of *Tindaria* need a world-wide review, and we see somewhat fewer eastern Pacific species than on earlier lists. Some species of *Tindaria* prove instead to belong to *Neilonella* and *Austrotindaria*.

The species of the *Malletiidae* seem to hold up better, but the subgeneric divisions of *Malletia* seem to have little merit and only confuse matters, so we have abandoned them.

The oldest family-level name for the remainder of the protobranchs appears to be the *Sareptidae*, around which hang rather uncomfortably *Yoldia*, *Yoldiella*, *Portlandia*, and *Katadesmia*. We venture no opinion on how this classification will hold up, but we can say that we see fewer species of *Yoldia* and *Portlandia* than previous workers have recognized. The literature on *Yoldiella* remains perplexing, with different workers having very different interpretations of these wide-spread, deep-water species, and some maintaining that *Yoldiella* is instead related to *Ledella*.

We have a major problems at the species level with *Glycymeris*. There are only one or two species, not the six that had been proposed. Equally overnamed was *Limopsis*, and we see five rather than nine.

The biggest species-level problem with the mytilids, aside from how to interpret the taxonomy of "*Mytilus edulis*", are the species of the genus *Musculus* and its allies. Again, there seem to be fewer of them than has been supposed. We have come to believe that the small, brooding species

taylori and *phenax* are probably allied to *Modiolus* rather than to *Musculus*, where they were previously placed, a fact that our Russian colleagues discovered some time ago. The genus *Modiolus* contains a couple of difficult species-level problems. We see no rational way to distinguish more than one New World species each of *Crenella* and *Gregariella*, with these being problems that clearly need additional attention.

The species of the *Limidae* are much in need of attention. From a world-wide point of view, there may be significantly more of them than there are names, particularly within the genus *Limatula*. It is unfortunate that the study of Stuardo done many years ago has never been published, and perhaps someone else should take up the challenge.

While Harold Harry's conclusions about the classification of the oysters have not met with universal acceptance, no one else is promoting alternative schemes. A group this important merits much more systematic attention.

The eastern Pacific species of the anomiid genus *Pododesmus* need additional attention. Evidence suggests that there may be two of them, but there is insufficient information to explain how to tell them apart on the basis of shell morphology. This is a problem that requires other methodologies.

Both of the tropical eastern Pacific species of *Isognomon* occasionally get as far north as southern California. In preparing this family, we discovered that the "Treatise on Invertebrate Paleontology" got the type species of the genus wrong, so a minor shift is necessary, with *Isognomon*, s.s., belonging with the hammer-shaped, Indo-Pacific taxa.

The deep-water vesicomyids also need more attention. Although the species seem relatively clear, there are more generic units than useful information about their arrangement. The subgenera of *Calyptogena* are unrecognizable and we have abandoned them.

A very big problem exists with the arctic-boreal species of *Astarte*, with less-than-useful generic units, and species named many, many times over. *Astarte crenata* has perhaps 20 synonyms, and *Astarte borealis* has at least that many. The best we can do in order to end up with anything useful to other workers is to sink all of the subgenera and most of the species-names. There is little doubt that this is a taxonomically complex group that broods its young and forms many unique-looking populations. Perhaps the species we will treat are really species complexes. This group is the ultimate challenge for a PhD thesis.

The Arctic-Boreal species of *Cyclocardia* are almost as tough for similar

reasons, and the entire *Carditidae* should be a high priority for a world-wide revision to come up with a classification.

In examining the type species of generic units near *Diplodonta*, it quickly became apparent that much more work needs to be done on this family before subgenera can be used with any confidence. Those that have been applied in the eastern Pacific - the Japanese *Felaniella* and the New Zealand *Zemysia* probably have no place here.

In spite of some very interesting work on the arrangement of the *Lucinidae* over the years, we remain less than fully confident that there is a stable classification. Our species are relatively clear, except for *Parvilucina*, where we believe no convincing case has yet been made to recognize more than one species.

The species of the *Thyasiridae* are in great need of world-wide attention, particularly the deep-water forms. There is some evidence that there are anatomical distinctions not reflected in the rather plastic shell morphology, and we have major problems providing a useful treatment of our species.

The species of the eastern Pacific *Cardiidae* are in relatively good shape, except for some vexing problems separating some species of *Clinocardium*. The higher classification of the family is need of additional attention. The recent work by Kafanov has shed light on shell structure, but this new information has yet to be fully integrated with other work, and comparative anatomical information is much needed [see: Schneider, 1992, 1994, 1995].

The galeommatids will provide continuing opportunities for discovery. Whereas we know a great deal about many of the species, the classification of the families and genera within the *Galeommatoidea* continues to be elusive on a world-wide scale.

The ecologically, economically, and stratigraphically important superfamily *Veneroidea* remains surprisingly poorly understood. A great deal is known about a few species, and, for the most part, the identity of the species is clear. The exception is the small forms that have taken up brooding, which has apparently happened several times. The *Turtoniidae* is one such case, and we also face a complex of species that have been placed into *Psephidia* and *Nutricola*. The most important problem, however, is the classification of the entire family into subfamilies and genera. No matter what array of characters chosen, the current system breaks down. We hope that the studies current system breaks down. We hope that the studies currently underway by Harte, Pauley, and other, will shed additional light. Here is a group in which teamwork by experts on

anatomy, nomenclature, and paleontology would pay great dividends.

A similar problem occurs in the *Tellinidae*, and the ecologically and economically importance of this group gives such multi-disciplinary studies high priority. Clearly, the loss of lateral teeth has occurred more than once, so the concept of "*Macominae*" has little taxonomic significance at present. This family cries out for studies in comparative functional morphology. Similar family-level taxonomic problems are present in the *Donacidae*, *Psammobiidae*, and *Solecurtidae*: species mostly clear, classification muddy. The study of Willan [1993] on the *Psammobiidae* is very helpful.

In the *Mactridae*, the species are mostly well understood, except for some puzzling problems with the genus *Tresus*. However, the classification of the family is much in need of world-wide revision.

In the *Hiatellidae*, the Arctic species of *Panomya* are less than well understood, and anatomical studies are needed to supplement information from the rather plastic shell morphology. The world's species of *Hiatella* merit additional studies, as do the species of *Saxicavella*.

There remains significant instability in the North Pacific species of the genus *Mya*, in spite of several attempts in recent years to make sense of them.

It is to be hoped that someone will take up and complete the studies on the classification of the *Periplomatidae* begun by the late Joseph Rosewater. That group and the *Pandoridae* need attention.

As with the protobranchs, the three families that are placed in perhaps polyphyletic "septibranchs" need world-wide attention. Our review of material in the U.S. National Museum of Natural History demonstrated that there are probably fewer species than have been named within all three families, particularly the *Poromyidae*, and the studies by workers in different countries very much need additional correlation. A recent Russian study adds interesting new information and a classification inflated beyond all reason. The recent monograph and compilation by Poutiers & Bernard [1995] is a useful first step.

From this quick overview of the bivalves of the northeastern Pacific, we draw the following general conclusions:

1. Much greater international communication and collaboration are needed. It surprised us to see many cases of workers in one place evidently being unaware of work that had been done and published in another. There are too few taxonomists for this to be happening, and little excuse in the unfolding era of modern communications. We should consider measures that would help improve the situation - lists of workers and

projects, informal newsletters, key repositories for all published papers. A few key problems from among those we have suggested above, undertaken by a team of workers in different parts of the world would yield great benefits.

2. Important taxonomic questions cannot be resolved without being tackled in a multi-disciplinary manner. Required are a working knowledge of nomenclature, types, and the International Code of Zoological Nomenclature together with a knowledge of fossil literature, anatomical information, the results of newer molecular methodologies, and some general philosophy of sensible classification systems. If any part of this formula is absent, the resulting classification is less than stable. Given the demands made upon museum and university scientists, it is now virtually impossible for a single worker to undertake a revision of a large and complex family and actually accomplish the task in a lifetime, however skilled that person is in all the required fields.

3. In bivalves, as must be the case with many other groups of animals, there has been a tendency to let newly acquired information from the latest data-set unduly influence the classification is required.

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