Southern California Association of
Marine Invertebrate Taxonomists

3720 Stephen White Drive
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# SCAMIT Newsletter

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| **SUBJECT:** | B'98 Non-polychaete problem animals |
| **GUEST SPEAKER:** | none |
| **DATE:** | 13 September 1999 |
| **TIME:** | 9:30 a.m. to 3:30 p. m. |
| **LOCATION:** | City of San Diego Marine Biology Lab<br>4918 N. Harbor Dr. #201<br>San Diego, CA |

*Eucrassatella fluctuata* (Carpenter 1864)
station 2081, 7/24/98, 50m, Catalina Is.
Photo ID by P. Scott 8/12/99

The first September Meeting will be held at the City of San Diego's Marine Biology Lab on the 13th. It will be a continuation in a series of meetings dealing with all problem identifications arising from the B'98 project. All phyla except polychaeta are open for discussion. The second meeting of the month will deal with polychaete ID's and is scheduled for 27 September at the Los Angeles County Museumof Natural History.

## NEW LITERATURE

Biological invasions, their monitoring, their outcomes, and the perspectives they provide on ecological principles are an increasing area of attention in the literature. The invasion of North American freshwaters by the european Zebra Mussel is only the most conspicuous example of this trend. In California waters we have been closely watching the progress of the introduced New Zealand marine snail *Philine auriformis*, and now the European Green Crab

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*Carcinus maenas* and the Chinese Wooly-Handed Crab *Eriocheir sinensis*. Fortunately the latter two have yet to penetrate into the waters of the southern California Bight, but they are on their way.

We have a much more established invader still garnering its share of attention in the literature, the south-east Asian clam *Musculista senhousia*. We usually do not see this animal, as it is restricted to harbors, bays, and estuaries. During Bight '98, however, we encountered it in abundance. In the upcoming EMAP West Coast estuarine investigations it will also be prominent. Two recent papers provide additional information on the status of *M. senhousia* in southern California (Reusch 1998, Reusch & Williams 1998). In the first of these the author addresses how indigenous predators affect the invasion success of the introduced exotic. In this case the predator is the muricid snail *Pteropurpura festiva*. It feeds preferentially on *M. senhousia* rather than co-occurring indigenous bivalves, probably because the locals have much thicker shells. In exclusion experiments he demonstrated that predation can potentially prevent establishment of the high density nest-beds of *M. senhousia* which smother subsurface fauna and prevent establishment of eel-grass, strongly impacting the indigenous biota.

The relationship between *M. senhousia* and the eel-grass *Zostera marina* is a spatial competitive one. Both establish high density contiguous populations to the detriment of the other. It has been shown previously that *M. senhousia* byssal mat provides an inhospitable environment for the establishment of eel-grass beds, and now Reusch & Williams (1998) demonstrate that conversely eel-grass decreases growth and increases mortality of *M. senhousia*.

It has often been observed that infaunal community composition and abundance are modified in ecotonal areas around benthic hard bottoms such as reefs (and outfalls). The mechanism is not always clear, and undoubtedly varies with the case examined. Dahlgren et al (1999) examined the effect of reef-based bioturbators on the adjacent infauna. They found that the sea-cucumber *Holothuria princeps* was the dominant bioturbator of the system, and that it's activities in turning over surface sediments are of sufficient impact to be a significant structuring element of the infaunal community adjacent to the reef. Predation associated with reef attracted or reef resident fish and invertebrates is probably of even greater impact, but they found the bioturbation component far from negligible.

Results of this study may not be directly applicable to the activities of *Parastichopus californicus* in our area, because, unlike *H. princeps*, our local species does not burrow. The authors' results do, however, point to an effect which should be considered in examination of local hard/soft bottom ecotones.

Childress & Seibel (1998) examine the adaptations of animals at another ecotone; that between oxic and anoxic waters. They specifically address the animals living in oxygen minimum layers such as that found off California. While the discussion is primarily illustrated with examples of midwater forms, the types of respiratory adaptations they exhibit also apply to benthic animals in the zone of impingement of the minimum layer on the upper slope. They point out that adaptations to this stable long-term minimum layer differ in kind from those of fluctuating or temporary low oxygen exposures such as intertidal mud-flats.

Such environmental stresses as low oxygen, pollution, extremes of temperature, etc., impact the presence and abundance of parasites. In NPDES and other monitoring permits it is usually assumed that anthropogenic pollutants result in higher incidence and severity of parasite infestation. Lafferty & Kuris (1999) review how stress and parasites interact on host

populations. They report that the relationship between environmental stresses and parasite impact on hosts is not the simple linear one assumed in most monitoring. Parasite load is a stressor of both individuals and populations which may either augment or offset the effects of other stressors. They even discuss the case in which stress associated reductions in the host populations drop the host density beyond the threshold necessary for the parasite to exist, leading to its local extinction. Parasites are everywhere, and are usually under-examined in routine monitoring. We need to pay more attention to them, and the current review is helpful in fitting them into the broader ecological framework.

"...and bigger fleas have smaller fleas..." is the case with the parasitism of a lithodid crab by the barnacle *Briarosaccus callosus* in the south Atlantic (Watters 1998). The barnacle is in its turn parasitized by an undescribed liriopsine cryptoniscid isopod hyperparasite. What is particularly interesting about this case is the isopod uses the same hormonal tricks to control it's barnacle host as the barnacle uses to control the crab. Thus the barnacle, which has hormonally sterilized the crab, is hormonally sterilized by the isopod. Local king crabs in the genus *Paralithodes* host ostensibly the same barnacle, but no isopod hyperparasites have yet been noted.

Bight '98 trawling around Catalina and the northern Channel Islands yielded several specimens of the hexactinellid sponge *Rhabdocalyptus dawsoni*. Ecological information on this form has been virtually non-existent. Now Leys & Lauzon (1998) discuss features of its natural history derived from monitoring of populations in the waters of Saanich Inlet and Barkley Sound in British Columbia. From their measured growth rates they estimated the age of average sized individuals at 35 yrs., and of specimens 1m long at 220 yrs. They studied a number of individual sponges in situ, revisiting them over a three year period.

An examination of nemertean interrelationships using data from mitochondrial 16S rDNA is provided by Envall (1998). Although a nemertean group is used as the test case, the test actually is of the method. Envall tests the impact of use and non-use of probability weighting of ribosomal DNA data on most parsimonious tree topology. Weighting has been used to counteract the differences in mutation frequency in different regions along this molecule. He reports that the greater the genetic distance between two organisms, the greater the impact of weighting. At genetic distances of less than 19% the weighted and unweighted treatments produced concordant results.

Paucity of data is always a potential problem in this relatively early stage of genetic sequencing of invertebrates. Siddall et al (1998) definitely found this to be a problem in determining the phylogenetic position of the Echiura and Pogonophora. They present an examination of the results reported by McHugh (1997) which reported echiurans and pogonophores were derived annelids. While the current authors are not averse to that position, they found that McHugh's analysis was laced with methodological problems, largely stemming from the nature of the selected gene, the EF-1 gene (elongation factor 1), and/or the 356 base pair fragment of it used. One of the approaches used by Siddall et al was inclusion of additional taxa for which equivalent molecular data was available. In so doing they found that the results presented by McHugh lost significance or were contradicted by information from the additional taxa. They conclude that reassessment of the relationship between annelids, echiurans, and pogonophorans should not be based on EF-1 data, and that McHugh's conclusions were not sufficiently supported.

The resolution of sibling species complexes using molecular evidence mentioned in the last newsletter continues apace. Simison & Lindberg (1999) tackle the *Notoacmea*



*fascicularis* complex. This was a single species whose variability of radular morphology suggested that it might contain more than a single taxon. Shell characters which might suggest a second sibling species within *Notoacmea fascicularis* were, however, never identified. A third line of evidence from Cytochrome c Oxidase subunit I was gathered from specimens exhibiting differing radular morphologies. The results coincide with the lack of variation in shell morphology, and suggest that there is a single taxon, *Notoacmea fascicularis*, which is clinally variable in radular morphology. Molecular data provided evidence, not of additional hidden taxa as in previous cases, but of considerable variability in a character of a single taxon.

**MINUTES OF 16 AUGUST MEETING**

First order of business was to pass around a picture of Susan Hamilton's 3 year old nephew wearing a tiny SCAMIT t-shirt. A discussion ensued as to whether we still had SCAMIT t-shirts, and if so, where would they be located. I, (Megan Lilly), for one, would be interested in owning such a shirt, perhaps in a slightly larger size than the one pictured. It has been a number of years since SCAMIT has had "stuff" available for sale. Our supply of coffee mugs and hats is long since exhausted, and shirts, if any remain, are limited to sizes suitable for 3-year-old nephews [sorry Megan]. Let's hear from the membership and/or NL readers concerning this. Are you interested in such paraphernalia? Should be make an attempt to recreate the old versions or do something different [tote-bags, mouse pads, cocktail napkins, anoraks]? All opinions welcome. Contact any of the officers, or send comments to Don Cadien for inclusion in the NL [end of digression].

We were fortunate to have Dot Norris from the City and County of San Francisco joining us for the day. She passed along a request that the SCAMIT meetings, when and where possible, be scheduled and announced six weeks in advance. It takes approximately this long for the paper work to be processed to allow CCSF workers to attend meetings in Southern California. There is a strong interest by our northern members to join us periodically, an interest we should do what we can to foster.

Don Cadien then shared a story concerning a friend, nudibranchs and the Lacey Act. We have discussed the impact of the Lacey Act previously in the NL, but perhaps a brief review is in order. The act requires than any biological specimens entering the United States be demonstrably collected legally under the laws of the country of origin. That is, if you don't have the appropriate paperwork from the source country you are in violation of U.S. law if you bring in specimens. This applies even if the country of origin has, but does not bother to enforce laws about the taking of biota.

This was the case in the incident reported at the meeting. It stemmed from a trip into central west Mexico in January and early February, in which the participants did not attempt to obtain the appropriate permits. Previous experiences of themselves and others indicated that the average time to get permits was several years, and that they would only be issued for known quantities of particular species. The trip was intended to sample the fauna, so no such permit could reasonably be obtained. As in past years a series of living nudibranchs were returned for more refined photography and to be maintained until they produced nidosomes [eggmasses] which would in their turn be photographed as would the veliger larvae which hatched from them. While crossing the border, however, the customs agents decided that the animals required a consult from the Department of Fish and Wildlife. They in turn decided that this was potentially a violation of both the Lacey Act and of the CITES treaty. The animals were inventoried [as well as could be since roughly 2/3 of the taxa were undescribed] and released into the custody of the person carrying them



pending contacts with Mexican authorities, and higher level decisions about the nature of the violations, and the appropriate response of the agency.

In July two agents showed up to examine the custodial animals and deliver paperwork formally charging 5 counts of violation of the Lacey Act [CITES was recognized to be uninvolved] and to present a notice that a fine of $200 would be imposed. The two companions of the bucket carrier were not charged, only the person in possession of the animals being viewed as culpable by the authorities. It is unclear how the number of counts was established [there were roughly 45 animals of 18 or so species], or how the fine was arrived at. We are subject to this law, and it's violation may have consequences if the violator is detected. Whether or not it is possible to comply given the bureaucracies of many countries remains a moot point. Although it may be impossible to comply with some laws, it is certainly possible to enforce them, and to punish violators.

Pictures of one of the nudibranchs mentioned above were then passed around. The species is believed to be *Favorinus tsuruganus*, originally from Southern Japan but in this instance collected in the state of Nayarit, on the northern shore of Banderas Bay. The animal is an egg-predator, feeding on the egg-masses of other opisthobranchs. One of the photographs showed the animal with it's head inserted into the globose egg-sac of *Melanochlamys diomedea*, a cephalaspid found locally both on mud-flats and off-shore.

Don Cadien informed the members of the loss of yet another noted taxonomist and systematist, Dr. Mihai Bacescu of Romania. A brief note of his passing was posted on the CrustL list server by Dr. Ileana Negoescu, a compatriot and co-worker of Dr. Bacescu. His work covered a broad spectrum of crustaceans, but most effort was on the taxonomy of cumaceans, tanaids, and mysids. He did publish one paper on the Californian fauna [describing several new mysids with Linda Gleye], but mostly worked on the tropical biota of the Atlantic and Indo-Pacific. His earliest work was concentrated on the Mediterranean and adjacent eastern waters. He will undoubtedly receive an obituary in either Crustaceana or in Journal of Crustacean Biology, and others in european journals such as Revue Roumaine de Biologie, Vie et Milieu, Revue Suisse de Zoology, and Travaux du Museum d'Histoire Naturelle "Grigore Antipa" where many of his papers were published. Watch them in upcoming issues for more detail on his life.

A series of abstracts of articles pertinent to the care and feeding of natural history collections was sent to the meeting by Tom Parker (CSDLAC). They all came from Collections Forum, an on-line journal of the Society for the Preservation of Natural History Collections [**http://www.geo.ucalgary.ca/spnhc**]. We mentioned one in the last NL, and Tom provided a series of others from recent issues of the journal. A number of articles on preservatives, labeling, and long-term storage considerations in this journal are pertinent to our activities.

Don shared with us some new books from Sea Challengers, since the descriptions provided on their website -

**http://www.seachallengers.com**

are brief . A general guide on Indo-Pacific marine invertebrates by H. Matsuda [in Japanese, but with beautiful color photos], Part III of the Marine Invertebrates of Southern Australia, and two slim volumes on sea stars and other echinoderms were examined. One, Sea Stars of Australasia and their relatives by Neville Coleman has no overlap with our biota, but the second (1998. A Field Guide to Sea Stars and other Echinoderms of Galápagos by Cleve Hickman) does. We had some concerns over some of the asteroids pictured in the book, doubting the identity of the illustrated animals .



The *Astropecten armatus* pictured was a brilliant red, a color form we don't see here in Southern California. It also had a very different structure than our local *A. armatus*, appearing somewhat less robust, and bearing a very different arrangement of the lateral arm spines. In local specimens these are large, flattened, largest at the base of the ray, and overlapping in the interambulacra. In the illustrated Galápagan specimen they are longest about 1/3 of the way out the arm, are smaller and non-overlapping at the base of the ray, and do not appear flattened. The distal lateral arm spines are much longer in the illustrated individual than those seen in California specimens. No mention is made of the prominent spines of the interambulacral superomarginal plates in the text, and the photo is not large enough to demonstrate either presence or absence of such spines.

The adjacent photo of *Luidia foliolata* looks much like Southern California Bight specimens, but seemed to show arms broader for their length, longer lateral arm spines, and an absence of the scattered individual white paxillae which are characteristic of the species in our area.

It was finally time to start actually looking at specimens and mollusks were first up. Kelvin Barwick (CSDMWWD) brought an interesting and beautiful little opisthobranch from a Catalina Island station. After much examination it was determined that the animal belonged to the genus *Akera*. The genus has not hitherto been reported from the Eastern Pacific, and is almost certainly a new species. Two species are known from the tropical West Atlantic, several others from the western Indo-Pacific, and specimens of the genus were taken from the Pacific coast of Nicaragua in 1973. Their identity was never investigated, but they differed from the present specimen in being larger, and proportionately longer. The genus is the sole member of the family Akeratidae, and is related to the sea-hares. There are only a few species world-wide.

A cephalaspid brought by Kelvin turned out to be a small *Aglaja* which was left as Aglaja sp. due to its small size. Another specimen which Megan Lilly (CSDMWWD) had examined was represented by only a shell. The animal had totally dissolved in the bleach used to remove the shell and gizzard plates. No gizzard plates were found, and the remaining minute shell had a strengthening rib running along the sweep of the anterior margin. It was reminiscent of a very small notaspid shell, rather than a philinid or aglajid cephalaspid. The absence of gizzard plates also matches with a non-cephalaspid. In the absence of the animal this was left at Opisthobranchia.

A few small bivalves were then brought forth and turned out to be *Diplodonta sericata* and *Rochefortia coani*. Megan Lilly (CSDMWWD) brought two small clams she believed to be the Thyasiridae sp LA 1 examined at an earlier meeting. It was confirmed that these were indeed the same animals. They were the cover illustration on the April NL [Vol. 17 No. 12]. These specimens were also from the Channel Islands (B '98 Station 2523) and were taken at a depth of 106m.

The differences between the gastropod genera *Astyris* and *Alia* were reviewed as small specimens of both were examined. The lamellae in the periostracum of *Astyris aurantiaca* were easily viewed once Don positioned the animal properly. These were very thin and transparent on the juvenile examined, and were not easy to see. The paucispiral protoconch of *Astyris* spp. was also present, but not well marked. The tiny *Alia* examined was too small for specific determination, but looked like it might well be an *A. carinata* juvenile.

After lunch echinoderms were next on the agenda as we had Nancy Carder visiting us specifically for the purpose of examining this group. Kathy Langan (CSDMWWD) brought some holothuroids discovered at the Channel

Island station 2514 at 57 m. After looking at ossicle mounts from the two animals present it was determined that the animals most closely fit the description and keyed to the *Havelockia* variant pictured by Bergen in the Taxonomic Atlas (Figure 9.21F page 235 ). The ID recorded for these specimens will be *Havelockia* sp.

*Astropecten* were then examined. While out at sea a few weeks ago Megan Lilly (CSDMWWD) was finding *Astropecten* in trawls from 90 ft that appeared to be *Astropecten verrilli* in most aspects, but had small spines on some of the superomarginal arm plates. After examination back at the lab, all the animals were concluded to be *A. verrilli*. The "spines" being seen were not the large spines seen in *Astropecten armatus* but small spinules on the superomarginal plates. This difference can be tricky and subtle, so don't be fooled by it in the field. "A rose is a rose is a rose", but a spine may not necessarily be a spine in a diagnostic sense. Rely on some of the other character differences, i.e., arm length to disk diameter ratio, and the appearance of the lateral arm spines to assist in the final determination of species.

*Dendraster excentricus* and *Dendraster terminalis* were again compared side by side for the benefit of Nancy Carder and Dot Norris. Seeing the animals next to one another greatly assists understanding of the differences between the species, although the differences are well delineated in Rich Mooi's recent treatment of the genus.

Finally, the crustaceans were tackled. Dean Pasko (CSDMWWD) had a *Cancer* crab that at first appeared to be *C. anthonyi*. However, upon closer inspection the animal was seen not to be this species, differing in chelae, dorsal carapace tooth structure, and areolation of the carapace. It was also briefly thought to be *Cancer amphioetus*, however, this ID was incorrect as well due to the shape of the dorsal carapace teeth, the size of the animal (too big) and the configuration of the chelae. In addition, this animal was hirsute ventrally. It was decided to erect a provisional and call the specimen *Cancer* sp SD1. It does not match with any of the species treated by Nations (1975), but comes closest to a species from Japan, *C. nadaensis* Sakai 1969.

Next, a *Lophopanopeus* of uncertain species was brought forth. After some examination Don Cadien recommended that Dean examine Menzies' review of the genus (1948). The animal did seem peculiar; having relatively smooth carpi on the legs, and lacking pigment in the chelae. After further examination, the specimen was identified as *L. leucomanus leucomanus*.

The next crab caused some excitement as it belonged to the family Palicidae and to the genus *Palicus*. This family has only been recorded once before from the Southern California Bight. The previous record was from off Palos Verde in 30m of water. The CSDMWWD specimen was from station 2101,124 ft, July 1996. This animal was not discovered during the B'98 project, rather it was captured during sampling for the City of San Diego's ITP (International Treatment Plant) monitoring. The ID was left at *Palicus* sp. Dean will key the animal in Rathbun, hopefully arriving at a species identity.

Caprellids were then the order of business. Dean Pasko previously sent out a message to the B'98 Taxonomic Listserver discussing two caprellids that he'd been seeing. A copy of the original message follows: "Dear Crustacean folks: I recently ran across two species of caprellids from San Diego Bay that appear to be new. Both are closely related to *Mayerella banksia*.

***Mayerella* sp SD1**

The first species, *Mayerella* sp SD1, is a dead ringer for *M. banksia* except for the composition of pereopod 5. Where P5 of true *M. banksia* consists of three subequal articles,

*Mayerella* sp SD1 has an elongate article 2 (approx twice the length of article 1) and a very small third article that is indistinctly separate (partially fused to article 2). After seeing several specimens, the new species can be readily distinguished by the two long, robust setae that emanate from the distal end of P5, article 2. *M. banksia* have relatively thin setae visible along the distal half of P5 (articles 2 and 3).

**Caprellidae sp SD1**

The second species can also be easily mistaken for *M. banksia* if one is not careful. This species, Caprellidae sp SD1, has 2-segmented pereopods on pereonites III and IV, but no P5. Additionally, the mandibular palp appears to be vestigial, and seems to be represented by a single seta."

After examining Dean's *Mayerella* sp SD1, Don suggested the next step would be to check Benedict 1977 and look at the description of *M. acanthopoda.* This has been done and the ID confirmed as *M. acanthopoda*.

There was no resolution for Caprellidae sp SD1 other than it is being removed to ordinal level and will be referred to as Caprellidea sp SD1. Don and Dean discovered a strange "ping-pong" paddle shaped structure on the 5th leg on closer examination. This will require some literature research to identify and deal with.

The next group to be discussed were tanaids. Dean had a specimen he'd referred to as *Paraleptognathia* cf *gracilis* from a Channel Islands station in 106 m of water. The chelae did not match the description for those of *P.* cf. *gracilis*, more closely matching those of *Scoloura phillipsi* , but the animal keyed to *P.* cf. *gracilis* in Dojiri & Sieg 1997. At this point there was no resolution and the specimen was recorded as Tanaidacea sp SD1. Many points of the anatomy of the chelae, legs and urosome matched closely with *Scoloura*, but the specimen totally lacked the lateral urosomal spines which characterize *S. phillipsi*, and are treated as generic level characters in definition of the genus.

Lastly, a strange *Euphilomedes* from San Diego Bay. The carapace of the animal was very similar to *E. carcharodonta*, however, the formula of the caudal furca did not match the description of the aforementioned animal. The specimen will be referred to as *Euphilomedes* sp SD2.

**AMPHIPODS TOO**

During our monitoring trawl series at CSDLAC we routinely encounter fish parasites in abundance: (1) isopods on a variety of species; (2) copepods on Pacific Sanddabs, sharks and a few more; (3) leeches on many species, and (4) turbellarian flatworms on halibut. Now, after years of searching, I can report parasitic amphipods too. At our monitoring station T1-305 in 1000' of water we took an unusual fish [for us] during our August trawls; a large *Sebastes melanostomus*, or Black Gill Rockfish. While it was examined to determine it's species small animals came off the head of the fish, and were picked up on the hands of my co-worker Bill Power. He directed my attention to them, and I collected 47 individuals from the fish by the time I was convinced there were no more to be had.

They proved to be members of the exclusively parasitic amphipod family Laphystiidae, last reported from our waters by Brad Myers in the 70's. Literature on the group is scant, but there is one paper which treats the North American species (Bousfield 1987). The current animals seem to belong to the genus *Protolaphystius* in having a coxal gill on the seventh leg. The rostral configuration and first urosomal segment do not, however, match with the only described species in the genus, *Protolaphystius madillae* Bousfield 1987. In that paper he mentions a second (undescribed) species which belongs to the genus. It had been reported in the literature as *Laphystius*

*sturionis* (by Jensen et al 1982), but was not that species in Bousfield's estimation [he currently has it in MS as a new species, pers. comm. E. L. Bousfield 1999]. The earlier record was based on material collected by Brad Myers from *Sebastes paucispinis*, the Bocaccio. It is likely that our specimens belong to the same undescribed species as those Brad collected many years ago, but several species occur in the area, and the identity is not certain. The host of *Protolaphystius madillae* is *Parophrys vetulus*, the English Sole, a species quite common in southern California waters. In the sole the parasites are found on the gills, while on the rockfishes they inhabit the outer surface of the head. Many of the specimens taken from the Black Gill Rockfish were from the membrane covering the eye, and the sinus formed by that membrane as it lines first the orbit, and then the outer surface of the eye itself. Additional animals were plucked from small pits on the head of the fish, or freely crawling on the tissue covering the head. The animals ranged from translucent white through translucent pink with three dorsal opaque pinkish red longitudinal lines. A voucher sheet is in preparation for this species, which will become *Protolaphystius sp A* SCAMIT.

**My Life as a Biologist**

Donald J. Reish

Chapter 15: I establish a research program at Long Beach State

After a few years of teaching science to elementary teachers, the curriculum was changed in biology. Art Lockley had taught Invert Zoology as a 2 semester 3 unit course. We changed it to a one semester 4 unit class and I took over the teaching of Invert Zoology. It was a pleasure to be teaching it, and I made an effort to have a living animal in the lab each time. The source of most of my animals was Alamitos Bay which is located nearby. In a couple of years the enrollment became too large for one lab so we had 2 concurrent labs. Jack Anderson was my first TA for invert zoology. With the interest in invert zoology, we added invert systematics which I taught every other spring. At the same time we added algae which I alternated with invert systematics in the spring semester. Lloyd Finley was the only person to take all three of these classes from me and receive an A in all three. Years later I added Polychaete systematics which I taught 4 times. Still later I initiated the intern program in science and Ken Schiff was my TA for this. One final course that I taught was Oceanographic Techniques, through the Ocean Studies Consortium. Students from Fullerton, Northridge, Costa Mesa also joined the Long Beach Staters. It met all day on Friday and we spend a great deal of time on the Nautilus.

As I described earlier, I had conducted a survey of Alamitos Bay for California Fish and Game and had published a paper on this study. While still at USC, I used Alamitos Bay as a more or less clean area for comparison with conditions at LA-LB Harbors. A fortunate thing happened in that the City of Long Beach began to dredge and build the Alamitos Bay Marina. Again, I took advantage of the opportunity and while still at USC, and saw it as an opportunity to study succession in the subtidal environment. My first year at Long Beach State, I applied for an NSF grant to study succession not only in Alamitos Bay but also in the marinas being constructed in Marina del Rey, Oxnard, and Ventura. I obtained the grant - a sum total of $21,000, the largest single grant to Long Beach State at the time. Al Stone became my first graduate student. I published several papers as a result of this grant. Studies included community development on the subtidal benthos, settlement on boat floats, and settlement on rocky jetties in Marina del Rey and Oxnard. I had just completed my study of the subtidal benthos in Alamitos Bay when the bay was hit by a severe red tide. The dissolved oxygen dropped to near zero. Again, I took advantage of the situation and studied the effect of the red tide on boat floats and subtidal benthos. California Fish and Game Quarterly published the paper.

In the early 1960's I received a grant from the National Institutes of Health to study the effects of environmental variables on the species that I had used as indicators of pollution, namely *Capitella capitata, Dorvillea articulata, Neanthes arenaceodentata,* and *Nereis grubei*. My first attempt was unsuccessful, but in the meantime I had gone to New York to attend the First International Oceanographic Congress; I used the opportunity to stop at Washington, D.C. and meet the people at NIH and explain what I wanted to do. The second attempt was successful. One of my friends at USC (now at CalTech) had worked out a method of controlling the concentration of DO in an Erlenmeyer flask. I used over 1000 Erlenmeyer flasks, many of which I still have. Anybody want any of them? I established the culture of *Neanthes* from 6 worms collected in Los Angeles Inner Harbor in 1964. This was the beginning of my lab culture of this worm which has been in continuous culture since that time with no new bloodlines or genes added. Tom Richards and Jack Anderson helped me on this NIH grant. The technique of controlling the DO in the flask was used my many of my grad students. Not only did we measure survival, but sublethal effects, burrowing in *Limnoria*, amino acid compensation, hemoglobin compensation, and others. The use of this method was the beginning of our studies of sublethal effects of environmental variables which has continued to this day as growth rate of juvenile *Neanthes*. Next: I go to Europe.

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