The Status of Faunistic Information on Tropical Reef Bryozoans[1]

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The status of faunistic information concerning tropical reef bryozoans dwells at a very low level, virtually at alpha taxonomy, at the present time. Unless changes can occur in diversifying the approach and in supporting field studies, there is little likelihood that the situation will improve. Yet bryozoans play several important roles in at least some of the tropical reefs.

Bryozoans, particularly the encrusting Cheilostomata, are among the few invertebrate groups that contribute to the blastic rather than clastic processes of the reefs because of their mode of growth. The ancestrula and growing margins of a colony secrete a mucopolysaccharide bioadhesive (Lutaud, 1961; Soule, 1972, 1973) which is followed by epithelial deposition of calcium to form the basal walls of the individuals. Since bryozoans often appear to be among the first colonizers of dead or dying corals, the colonies form an important protective surface coating that retards coral skeleton degradation (Soule and Soule, 1974; Cuffey, 1972).

Reticulate reteporid bryozoans, cyclostomes, and erect cheilostomes, while not covering a significant area of surface with their basal attachments, serve to form a meshwork inhabited by tiny invertebrates such as molluscs, crustaceans, and worms. The erect bryozoans are not massive enough to serve as permanent reef builders but some skeletons contribute to the reef sands.

The role of living bryozoans in the reef ecosystem has not been clearly elucidated. It has been said that they are filter feeders or detritus feeders, but we have observed a colony of *Bugula californica* in the laboratory trap a caprellid shrimp and tear it apart with its large avicularia, apparently ingesting the fragments. A number of animals are known to feed upon the bryozoan polypides: nudibranchs, caprellids, and pycnogonids.

Some reef fish also browse on the bryozoan tissues and some bite off chunks of colonies. It can be seen that although these organisms are small in biomass, they are important to at least some reef communities.

Soule and Soule (1973) noted the extensive coverage and great diversity of bryozoans in Hawaiian patch and fringing reefs. Cuffey (1973) speculated that the

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greater diversity of bryozoans in Bermuda reefs as compared with Eniwetok might be due to the more optimum growth conditions and greater diversity of coral species at Eniwetok. Further collecting of coral reefs certainly will be necessary to verify that speculation. It may be that water temperature differences and microniche variations account for some of the differences.

Table 1. Tropical bryozoan taxonomic monographs.

Western Pacific, Mid-Pacific
Busk, (*Challenger*) circumtropical; 1884, 1886
Waters, (*Challenger*), 1889
Harmer, (*Siboga*), 1915, 1926, 1934, 1957
Canu and Bassler, (*Albatross*), Philippines, 1929; Hawaii, 1927
Soule and Soule, Hawaii, 1967, 1968, 1969 a,b, 1970, 1973, 1974
Australia
Hastings, Great Barrier Reef, 1932
Kirkpatrick, Torres Straits, 1890
Panamic, Eastern Pacific
Busk, Mexico, 1855
Hastings, (*St. George*), 1930
Canu and Bassler, (*Albatross*), Galapagos, 1930
Osburn, (*Velero*), Eastern Pacific, 1950, 1952, 1953
Soule, (*Puritan*), Gulf of California, 1959, 1960, 1961, 1963
Soule and Soule, (*Puritan*), Baja California, 1964, 1973
Powell, Panama, 1971
West Indies, Caribbean
Smitt 1872, 1873
Busk, 1884, 1886
Osburn, 1914, 1927, 1940, 1947, 1954
Canu and Bassler, (*Albatross*), Gulf of Mexico, 1928a
Marcus, Brazil, 1937, 1938, 1939, 1941, 1942, 1949, 1953
Canu and Bassler, (*Norseman, Rathbun, Albatross*), Brazil, 1928b
Atlantic, West Africa
O'Donoghue, 1924, 1956
Cook, (*Calypso, Atlantide, Galathea*), 1964a,b, 1965, 1967, 1968a,b
Redier, ((Guinean Trawling Survey), 1965
South Africa
O'Donoghue, 1924; S.S. *Pickle,* 1956
Red Sea, East Africa
Savigny, 1817(?), illustrations only, localities unknown, no types
Audouin, 1826, names for Savigny's figures, Red Sea, or Mediterranean Waters, 1909, 1910, 1913, 1914
Hastings, 1927
Powell, 1967, 1969
Harmer, (*Siboga*), 1957
Indian Ocean, East Africa
Hincks, Burma, 1884
Kirkpatrick, Mauritius, 1888
Thornely, Ceylon, 1905
Thornely, (Sealark), 1912
Cook, Indian Ocean, 1966

In attempting to study tropical reef bryozoans, the systematist-ecologist finds a dearth of taxonomic literature available to him. Extensive, well-illustrated monographs are most useful in orienting an investigator to a fauna from a newly collected area. Yet the major references available are largely the results of the expeditions of the 1800's and early 1900's (Table 1).

Collecting methods of ship-based expeditions involved dredging, a method virtually impossible in coral reef areas and probably the poorest method of obtaining bryozoans, since few species are found on bottom substrates, especially where sediments are moved about. While the old expeditions travelled many thousands of miles, sampling stations and time on location were greatly restricted in any given area. The taxonomy of most oldest works is quite out of date and may be difficult or impossible to trace on the basis of scanty descriptions and/or poor illustrations. Little ecological information can be gained from these compendia.

The publication of large monographs has virtually halted, because of the pressures on researchers to publish frequently and to the burgeoning costs in time and money to produce such works. Thus, useful, well illustrated works like Harmer's *Siboga* volumes are not forthcoming under existing conditions.

Much information is no doubt contained in journals published around the world, but the difficulty of locating papers and journals is compounded by the slowness with which Zoological Record is compiled. It is unfortunate that catalogues of species descriptions such as those published on the Foraminifera (Ellis and Messina, 1940, *cf.*) were not initiated for all invertebrate groups, for they would be invaluable resources.

The approach to field studies has changed greatly with the advent of scuba diving, for the areas of prolific bryozoan growth on the reefs from 5 to 50 meters are now open to collecting. Whether sampling methods are designed as permanent transects, random quadrats, qualitative niches or whatever, the techniques should involve longer periods of field time in a given area. Greater opportunity is thus provided to gather ecological data and to determine whether sampling has been representative.

This was well demonstrated by personal experience in the Hawaiian Islands between 1966 and 1971. Previously known bryozoans numbered less than 40 species altogether, from the *Challenger* (Busk, 1884, 1886), *Albatross* (Canu and Brassler, 1927) and Edmondson's work (1946). The species list now numbers more than 200; in one family alone, the Smittinidae, 19 new species were described (Soule and Soule, 1973). This was the first documentation of niche isolation of bryozoans in an island group.

Scanning electron microscopy represents a great advance in technology for studying bryozoans, because of the magnification limits of the dissecting optical microscope, and the difficulty in light photomicrography. Yet the disadvantages found in some groups are not seen, where SEM magnifications reveal structures not visible at all in optical microscopes. The lower SEM range (X20–X100) yield definitive convincing images of patterns or structures that are equivocably viewed in optical instruments.

In spite of the encouraging picture in field and laboratory methods, the scene is less encouraging in terms of present or future faunistic workers. There are few full time bryozoan systematists, with both time and capability of tackling a large faunal study. The trend in recent years, among full time American and British researchers, has been an emphasis on developmental biology and functional morphology. The direction is much needed, in order to develop an understanding of the relationships between higher categories and to attempt projection of the biology of recent forms to an understanding of functional morphology in paleontological forms. The prospective job market for graduate students in systematics has been very limited for the last 10 or 15 years during the phase of the molecular biology orientation of most academic biology departments. Now, with the impetus of the National Environmental Protection Act and local environmental regulations, taxonomists are in great demand for impact studies. Unfortunately, few trained workers are available as researchers and as teachers for the interested students coming in.

The tropical Pacific Basin, in particular the mid-Pacific Island groups other than Hawaii, have had virtually no bryozoan systematic studies published whatever. When one considers the paramount importance of healthy coral-algal reef communities in the tropics, the lack of studies is distressing. The physical role of barrier reefs as protection from coastal erosion in Australia and island groups is also of great importance.

The question is, of course, how can the problems of deficiencies in data, information, and understanding be remedied? It is too simplistic to assume that a massive input of money for field inventories can solve the problem. The Antarctic collections from the *Eltanin* voyages lying unsorted and unidentified in the Smithsonian Sorting Center furnish ample testimony that, if field monies are not followed by adequate long-term support for laboratory and taxonomic studies, the field effort has been wasted. The collection methods in some cases were not suitable, and the sorting methods impossible in other cases.

In our laboratory we have had some success in the "cartoon" method of sorting. Since workable keys to most of the families of bryozoans do not exist, elaborate keys to species are generally a waste of time. Furthermore, keys inevitably are based on characters which may not be discernible to the inexperienced faunal worker. If some sort of Xerox cut-and-paste catalogue with simple illustrations could be assembled for species already identified from the Indo-Pacific, it is possible that progress on identifying local faunas could be made without the lengthy apprenticeships usually employed.

The services available from computers have been largely unused, except by the small group of advocates of numerical taxonomy. One of the most pressing needs around the world is to get existing collections on computer inventory, cross-referenced both taxonomically and geographically. If the additional step could be taken of entering species descriptions according to characters, some of the sorting of new collections might be expedited. In fact, new light might be shed on the nature of some bryozoan families, which now seem to be mostly artificial.

Some taxonomists are presently using multivariate computer analysis on their systematics research, representing an additional service which computers can render where scientists are acquainted with computer capabilities.

A concerted effort by the international community of reef biologists, if funded, could attack many of the island and reef areas in cooperative field ventures, much as was done at Eniwetok by the United States. The International Coral Reef Symposium members who have met for a short period for two successive years, at the Great Barrier Reef and at Guam and Palau, might well consider organizing field work sessions, which could be followed by the systematics-ecology studies if funds were made available. The manpower (person-power?) situation might well be alleviated if the pressure of international scientific opinion were brought to bear.

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