Florida Scientist

QUARTERLY JOURNAL OF THE FLORIDA ACADEMY OF SCIENCES

WALTER K. TAYLOR, *Editor* HENRY O. WHITTIER, *Editor*

Volume 43 Spring 1980 No. 2

Biological Sciences

BRYOZOAN-ALGAL ASSOCIATIONS IN COASTAL AND CONTINENTAL SHELF WATERS OF EASTERN FLORIDA

JUDITH E. WINSTON (1) AND NATHANIEL J. EISEMAN (2)

(1) Department of Earth and Planetary Sciences, The Johns Hopkins University, Baltimore, Maryland 21218; (2) Harbor Branch Foundation, Inc., RR 1, Box 196, Ft. Pierce, Florida 33450

ABSTRACT: *Surveys of Bryozoa occurring on algal substrata were carried out in the shallow subtidal and deep (30-90 m) continental shelf waters of the Florida East Coast. Twenty-eight species of bryozoans were found on 12 species of algae in the shallow subtidal. Thirty-six species of bryozoans were found on 12 species of algae at the continental shelf stations.* Membranipora tuberculata *and* Thalamoporella gothica floridana *were the most common bryozoan species in the coastal collections, and* Aetea sica *and* Microporella ciliata *in the continental shelf collections. No bryozoans were found on noncalcified Chlorophyta. The calcified Chlorophyta and the more massive species of Phaeophyta and Rhodophyta were the preferred substrata.**

ASSOCIATIONS between bryozoans and algae have been noted since Darwin (1845). Other early workers on these associations include Busk (1852), Joliet (1877), and Hincks (1880). More recent work (Ryland, 1959; Crisp and Williams, 1960; Ryland and Stebbing, 1971; Hayward, 1973; Hayward and Harvey, 1974) has increased our understanding of the ecological bases of these relationships (e.g., the role of the larvae in substratum selection). Only 3 studies have described ectoproct-algal associations in specific regions. Rogick and Croasdale (1949) described bryozoan species found on algae in localities ranging from New Hampshire to Buzzards Bay, collected from intertidal to 18 m depths. Ryland (1962) has listed such associations for the coast of Wales in the intertidal and shallow subtidal zones. Pinter (1969) has discussed bryozoan-algal associations in intertidal habitats of southern California.

No one has made a study of bryozoan-algal associations *per se* in warm

* The costs of publication of this article were defrayed in part by the payment of charges from funds made available in support of the research which is the subject of this article. In accordance with 18 U.S.C. § 1734, this article must therefore be hereby marked "*advertisement*" solely to indicate this fact.

water regions, although observations of the occurrence of particular species of bryozoans on algae is found in taxonomic works on these regions, e.g., Maturo (1957) notes 14 species of Bryozoa occurring on algae in the Beaufort, N.C. region. We examine ectoproct-algal associations in a subtropical region, the Atlantic coast of Florida. Previous studies have concentrated on intertidal habitats. We compare collections made from the intertidal and shallow subtidal waters with collections taken from deeper continental shelf waters (30-90 m).

METHODS—Algae and bryozoans were collected at 4 coastal localities along the Atlantic coast of Florida and at 8 stations on the East Florida Continental Shelf (Fig. 1). The coastal collections were made in 1975 as part of a larger survey (Winston, in prep.) and were carried out opportunistically. Two collections (27-III-75, 24-IV-75), were made in the Indian River in a seagrass bed located on the north side of Sebastian Inlet (Station 1). Several species of algae grow as detached clumps tumbling among the seagrasses (Eiseman and Benz, 1975). Only *Solieria tenera* supported bryozoans. The other collections were made along the open coast. Six collections of drift *Sargassum* were made at 3 locations: North Beach, Fort Pierce (Station 2); Walton Rocks (Station 3) and Seminole Shores (Station 4), Hutchinson Island (11-II-75, 24-VI-75, 25-VI-75, 4-VII-75, 8-IX-75, 6-X-75). These locations are all stretches of sandy barrier beach where drift algae were abundant after several days of onshore winds. Both eupelagic and attached species were examined, grouped here as *Sargassum* spp. because of the difficulties in determining the species of fragmentary plants. The attached species *Sargassum filipendula* and the pelagic *S. natans* and *S. fluitans* are most commonly encountered in this area. After a storm in late June one large collection containing many algal species was made just north of the North Beach breakwater in Fort Pierce. This sample consisted of attached algae washed loose from the subtidal beach-rock ledges (to 10 m) and sub- and intertidal rocks of the breakwater itself.

Continental shelf algae and bryozoans were collected by lockout divers from the JOHNSON-SEA-LINK (JSL) submersibles in September and November, 1977. Locations of each station are shown in Fig. 1. JSL I-442 (6 Sept.; 90 m; 15.6°C) and JSL II-292 (18 Nov.; 89.7 m; 16.0°C) (Station 5) were on a large rocky mound east of St. Lucie Inlet, Martin County, Florida. The area is subject to upwelling and high turbidity (nepheloid layers). The temperatures at the time of sampling are typical for the station, but temperatures as high as 26.7°C and as low as 8°C have been recorded. Currents on the mound are usually less than 10 cm/sec, but slow shifting of water masses seems to be a common occurrence. At a nearby station water temperatures on one occasion changed 12°C in 9 hr (J. Reed, pers. comm.). *Oculina* coral with its associated community and hydroids, bryozoans and echinoids are the dominant invertebrates.

Stations 6-10 (JSL I-444; 7 Sept.; 71.5 m; 20.0°C; JSL I-445; 7 Sept.; 49.4 m; 27.0°C; JSL I-447; 8 Sept.; 42.4 m; 26.8°C; JSL I-448; 8 Sept.; 58.0

m; 15.1°C; JSL 1-450; 9 Sept.; 27.3 m; 28.0°C) are east of Singer Island, Palm Beach County, Florida. These are in a rubble zone with very little bottom relief. Nepheloid layers have not been observed here, and upwelling is much less common than at the St. Lucie Inlet Stations. Prevailing temperatures are 22-28°C, but temperatures as low as 9°C have been recorded. Prevailing currents in this area are 20-45 cm/sec. Currents up to 165 cm/sec have been observed. Sponges, hydroids and bryozoans are the

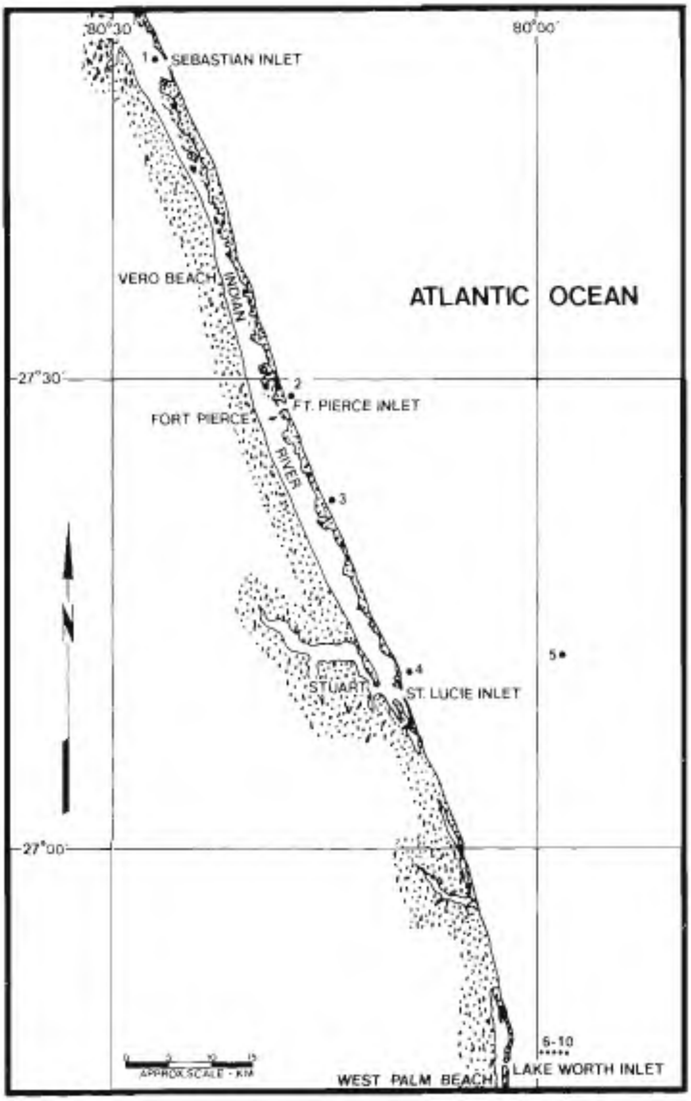

FIG. 1. The Indian River and Singer Island region of Florida, showing the locations of Stations 1-10. Station 1, Sebastian Inlet; 2, North Beach, Ft. Pierce; 3, Walton Rocks; 4, Seminole Shores; 5, St. Lucie Mound; 6-10 Singer Island, Transect.

primary sessile invertebrates at these stations. Small amphipods, decapods and polychaetes are common among the fronds of the larger algae and in the crevices of the rubble.

Algae and bryozoans from the coastal stations were examined while alive. Those from the continental shelf stations were preserved in 5% seawater-formalin and returned to the laboratory for subsequent study. Voucher specimens for the algae species are in the Harbor Branch Foundation Herbarium (HBFH).

Results and Discussion—The results of the coastal collections are in Table 1. Twenty-eight species of bryozoans were recorded from 12 species of algae: 2 species of cyclostomes, 6 ctenostomes and 20 cheilostomes. No bryo-

Table 1. Coastal Bryozoans associated with algae.

	PHAEOPHYTA				RHODOPHYTA							
	Sargassum spp.	*Spatoglossum schroederi*	*Dictyopteris delicatula*	*Turbinaria turbinata*	*Solieria tenera*	*Gracilaria mammillaris*	*Gracilaria armata*	*Cryptonemia crenulata*	*Bryothamnion seaforthii f. disticha*	*Bryothamnion triquetrum*	*Laurencia* sp.	undetermined red alga
CYCLOSTOMATA												
Crisia micra					X							
Tubulipora lunata	X											
CTENOSTOMATA												
Amathia distans					X							X
Bowerbankia sp. A					X							
Bowerbankia gracilis					X							
Bowerbankia imbricata					X			X				
Nolella stipata					X							
Zoobotryon verticillatum	X											
CHEILOSTOMATA												
Aetea sica	X										X	
Beania hirtissima									X	X		
Beania intermedia			X		X							X
Bugula sp. B.					X							
Bugula neritina					X							
Bugula minima	X										X	
Electra bellula	X	X										
Escharoides costifer	X											
Hippothoa hyalina	X											
Lagenicella marginata	X											
Membranipora tuberculata	X			X		X		X				
Microporella ciliata	X											
Pasythea tulipifera								X	X			
Savignyella lafontii					X							
Scrupocellaria regularis					X							
Synnotum aegyptiacum											X	
Thalamoporella falcifera	X											
Thalamoporella gothica		X					X		X	X		
Vittaticella contei	X										X	
Watersipora subovoidea					X							

zoans were recorded on Chlorophyta. Fourteen bryozoan species occurred on 4 species of Phaeophyta and 20 bryozoan species were found on 8 species of Rhodophyta.

The greatest number of bryozoan species were found on *Solieria tenera* (Rhodophyta) (12 bryozoan species) and *Sargassum* spp. (Phaeophyta) (12 bryozoan species). Four species of bryozoans were recorded from *Laurencia* sp. (Rhodophyta) and 3 each from *Cryptonemia crenulata* and *Bryothamnion seaforthii f. disticha* (Rhodophyta).

The most abundant bryozoan in the coastal collections was *Membranipora tuberculata* which was found on *Sargassum* spp. most commonly, but occurred on 3 other species of algae (1 Phaeophyta and 2 Rhodophyta). *Thalamoporella gothica floridana* was also abundant, occurring on 4 algal species (3 Rhodophyta, 1 Phaeophyta) and *Beania intermedia* was found on 3 species (2 Rhodophyta and 1 Phaeophyta).

Table 2 lists the results of the continental shelf collections. Thirty-six species of bryozoans were recorded from 12 species of algae: 3 species of cyclostomes, 3 species of ctenostomes and 30 species of cheilostomes. Sixteen species of bryozoans occurred on 2 species of Phaeophyta and 30 species of Rhodophyta.

The greatest number of bryozoan species was found on Rhodophyta. Eighteen species of bryozoans were found on *Rhodymenia pseudopalmata* and 12 species occurred on *Petroglossum undulatum*. The calcareous green alga *Udotea flabellum* supported 14 species. Of the bryozoans reported, *Aetea sica* and *Microporella ciliata* were both found on 6 species of algae. *Mimosella verticillata* and *Escharoides costifer* each occurred on 4 algal species.

Table 3 gives the numbers of species of bryozoans recorded from algae in 4 different geographic areas: the New England Coast (Rogick and Croasdale, 1949), the coast of Wales (Ryland, 1962), the coast of southern California (Pinter, 1969) and the Atlantic coast of Florida (this paper). It is evident that algae do provide a substratum for a considerable number of bryozoan species. In temperate regions where intertidal and subtidal rocks are commonly covered by large algae this is not surprising. Rogick and Croasdale (1949) found 29 of the 84 ectoproct species known at the time from the Woods Hole area to occur on algae. Ryland (1959) notes that most of the bryozoan species found in the intertidal regions of the British Isles are found on algae. In subtropical Florida waters, the intertidal algae are much smaller. However, the number of bryozoan species found on algal substrata is similar, though very few epiphytic Bryozoa are found in the intertidal zone. They occur on a few species of algae.

Only this study records bryozoans associated with algae from water deeper than 40 m. Thirty-six species were found on algae from deeper water (42-90 m), slightly more than in shallow water of the same region. When the species lists from the 2 collections are examined, however, (Tables 1 and 2) it can be seen that there is little similarity. Only 6 species of cheilostomes:

Aetea sica, *Escharoides costifer*, *Microporella ciliata*, *Scrupocellaria regularis*, *Synnotum aegyptiacum* and *Thalamoporella falcifera* and 2 species of ctenostomes: *Amathia distans* and *Nolella stipata* occur in both collections. Thus, the total number of species for both deep and shallow waters off the Florida East Coast is relatively large (56 species).

TABLE 2. Continental shelf Bryozoans associated with algae.

	CHLOROPHYTA				PHAEO-PHYTA		RHODOPHYTA					
	Halimeda discoidea	*Udotea flabellum*	*Dictyota dichotoma*	*Botryocladia occidentalis*	*Champia parvula*	*Maripelta* sp.	*Petroglossum undulatum*	*Peysonnelia rubra*	*Rhodymenia pseudopalmata*	*Scarlesia subtropica*	*Waldoia antillana*	CALCAREOUS NODULES
CYCLOSTOMATA												
Diaperoecia sp.		X	X				X		X			
Disporella sp.		X	X				X		X		X	
Tubulipora sp.		X							X			
CTENOSTOMATA												
Amathia distans		X					X	X				
Mimosella verticillatum				X	X				X		X	
Nolella stipata		X						X				
CHEILOSTOMATA												
Aetea anguina								X	X	X		
Aetea sica	X	X		X			X	X	X			
Antropora sp.							X		X			
Bracebridgia subsulcata		X					X		X			
Caberea boryi						X						
Celleporaria albirostris							X	X	X			
Chorizopora brogniarti								X	X			
Cleidachasma contractum								X				
Cleidochasma porcellanum	X	X						X				
Escharoides costifer	X	X					X		X			
Floridina antigua												X
Gemelliporella glabra				X					X			
Halophila johnstoniae	X	X										
Hippoporina sp.												X
Hippothoa flagellum									X			
Lagenicella marginata									X			
Margaretta buski	X											
Microporella ciliata	X	X					X		X	X	X	
Parasmittina sp.							X					
Parellisina curvirostris								X				
Parellisina latirostris								X				
Petraliella bisinuata		X										
Reptadeonella costulata								X				
Rhynchozoon spicatum		X										
Scrupocellaria regularis									X			
Smittina smittiella							X		X			
Synnotum aegyptiacum	X											
Thalamoporella falcifera		X					X				X	
Trematooecia aviculifera												X
Tremoschizodina lata												X

TABLE 3. Number of species of Bryozoans recorded from algae in 4 geographic areas.

LOCATION	CHLOROPHYTA	PHAEOPHYTA	RHODOPHYTA	ALL GROUPS COMBINED
New England Coast (Rogick & Croasdale 1949)*[1] Intertidal-subtidal	4/3[3]	25/11	26/23	29/27
Welsh Coast (Ryland, 1962) Intertidal-subtidal	4/2	21/10	16/11	21/23
S. California Coast (Pinter, 1969)[2] Intertidal-subtidal	7/4	8/11	10/30	17/45
E. Florida Coast (Total)	16/2	16/5 +	41/17	46/24
– Coastal (Intertidal-subtidal)	0/0	14/4 +	20/9	28/12
– Continental Shelf	16/2	2/1	30/9	36/12

[1]Entoproct excluded. [2]Only algae supporting bryozoans included. [3]No. of spp. of bryozoans/no. of spp. of algae.

There is an obvious difference in number of species of bryozoans on non-calcified Chlorophyta and on the other algal groups. Rogick and Croasdale (1949) recorded 4 bryozoans from 3 species of green algae. These were chiefly represented by colonies only a few zooids in size. Pinter (1969) listed 7 species of bryozoans encrusting 4 species of green algae from California. These Bryozoa were branching forms attached by only a few basal zooids or rhizoids and very small colonies of *Cryptosula pallasiana* encrusting *Ulva lobata*. We found no bryozoans on non-calcified green algae, though these algae were present in the collections.

There could be several reasons for the lack of bryozoans on green algae. The body forms of green algae are less robust than those of most red and brown algae. These green algae are filamentous or delicate (1 or 2 cell layers thick) sheets and lack of strength and rigidity to support large bryozoan colonies. Surface texture and chemical nature of the algal cell walls are other possible explanations. When the walls of green algae are fortified with calcium carbonate, as in *Udotea flabellum* and *Halimeda discoidea* from the deep water Florida locations (Table 2) they can be a desirable substratum (7 species recorded from *Halimeda* and 14 from *Udotea*). Other massive Chlorophyta (*Caulerpa* spp. and *Codium* spp.) were common in our deep water collections but supported no bryozoans although hydroids are common on these species.

Red and brown algae seem about equal in the numbers of bryozoan species they support. From these data it is impossible to say that one or the other group is preferred by bryozoans. From this survey as well as the previous studies it appears that some species of brown and red algae are much more suitable than others as substrata for bryozoans and this suitability is probably due to a variety of factors, ranging from body form and persistence (length of life) to surface texture and chemistry.

Bryozoans occurring on algae could be put in 3 general categories with respect to substratum type (1) species limited to algal substrata; (2) species found on algae but also capable of living and reproducing on other substrata; (3) species usually found on other substrata ("accidental" on algae). Very few species fall into the first category. Morphologically these appear to be flexible sheet-like colonies covering a great deal of algal surface. *Membranipora membranacea* is found on kelps, chiefly *Laminaria* spp. in the Atlantic (Ryland, 1962) and the giant kelp *Macrocytsis* in the Pacific (Pinter, 1969; Woollacott and North, 1971). In the Florida collections 2 species of this type occurred, *Membranipora tuberculata* and *Thalamoporella falcifera*. These species were found on most drifting *Sargassum* plants examined and occurred only rarely on other algae and never on non-algal substrata.

The second category consists of species which show a strong algal "preference", but which are found on more than one species of algae and which may be found on other substrata as well. These are also species with flexible sheet-like colonies which encrust a large proportion of the algal surface. In New England *Electra pilosa* occurs on 17 algal species (Rogick and Croasdale, 1949) and in Wales on 19 algal species (Ryland, 1962). *Electra pilosa* can cover large areas of the algae, but it also occurs more rarely on other substrata such as shells, stones, hydroids and other bryozoans (Ryland, 1962). In the Florida collections *Thalamoporella gothica floridana* forms extensive unilaminar crusts over the fronds and stipes of red and brown algae in shallow water (Table 1), but may also occur as unilaminar crusts and bilaminar frills on hydroid stems and solid substrata.

A second morphological type of bryozoan common on algal substrata is characterized by a determinate or semideterminate growth pattern (spots or dots). These have a small colony size (2-5 mm dia) and a large ratio of reproductive units to total zooids of the colony. The round colonies of the lichenoporid cyclostomes are excellent examples, and they are common on algae, but the most abundant cheilostomes are often of this type also (e.g., *Escharoides costifer*, *Smittina smittiella* and the "deep water" form of *Microporella ciliata*). One colony of *Microporella ciliata* from the Florida continental shelf collections (JSL I-450) had 32 zooids of which 12 were ovicelled. Some of these species (e.g., *Escharoides costifer*) seem to have a life cycle characterized by small size and rapid reproduction. Other species, like *Microporella ciliata*, appear to have more than 1 morphology and/or reproductive pattern depending on whether they are growing on algae or another substratum. Only further study will tell whether life-histories are variable and substratum dependent or whether 2 separate species are involved.

Runner-like growth forms are also frequent on algal substrata. These include the cheilostomes (e.g., *Aetea* spp. and *Beania intermedia*) as well as the ctenostomes (e.g., *Bowerbankia* spp. and *Mimosella verticillata*). Runner-like growth forms may be a life-strategy adapted to unstable substrata, including many estuarine forms (Jackson, 1978; Winston, 1976; Buss, 1978).

The final category consists of species characteristic of other substrata (rocks, corals, shells, wood, etc.). Colonies of these species when found on algae may have their normal growth form, but are usually small and lack reproductive structures. In the Florida collections the occurrence of *Bracebridgia subsulcata* and *Gemelliporella glabra* on algae appear to be examples of this. These species are commonly found on sand and coral bottoms. Colonies found on algae were small, usually consisting of encrusting bases only. None of those in our collections had developed ovicells.

ACKNOWLEDGMENTS—We express our appreciation to Alan Cheetham and Jeremy Jackson for their helpful comments on the manuscript. Contribution No. 158, Harbor Branch Foundation, Inc.

LITERATURE CITED

BUSK, G. 1852. Catalogue of the Marine Polyzoa in the British Museum. Part 1. London.

BUSS, L.W. 1978. Habitat selection, directional growth and spatial refuges: why colonial animals have more hiding places. Pp. 459-497 *In:* Larwood, G.P., and B.R. Rosen (ed.). Biology and Systematics of Colonial Organisms. Academic Press, London.

CRISP, D. J., AND G. B. WILLIAMS. 1960. Effects of extracts from fucoids in promoting settlement of epiphytic Polyzoa. Nature. 188:1206-7.

DARWIN, C. R. 1845. Journal of Researches into the Natural History of the Countries Visited during the Voyage of H.M.S. Beagle Round the World. J. Murray, London.

EISEMAN, N. J., AND M. C. BENZ. 1975. Marine algae of the Indian River. I. Species of the algal drift community collected from April 1974 to April 1975. Tech. Rpt. No. 1., Harbor Branch Foundation, Inc., Ft. Pierce, Florida.

HAYWARD, P. L. 1973. Preliminary observations on settlement and growth in populations of *Alcyonidium hirsutum* (Fleming). Pp. 107-113 *In:* Larwood, G. P. (ed.). Living and Fossil Bryozoa. Academic Press, London.

———, AND P. H. HARVEY. 1974. The distribution of settled larvae of the bryozoans *Alcyonidium hirsutum* (Fleming) and *Alcyonidium polyoum* (Hassall) on *Fucus serratus* L. J. Mar. Biol. Assoc. U.K. 54:665-676.

HINCKS, T. 1880. A History of the British Marine Polyzoa. John van Voorst, London.

JACKSON, J. B. C. 1978. Morphological strategies of sessile animals. Pp. 491-555 *In:* Larwood, G. P., and B. R. Rosen. (ed.) Biology and Systematics of Colonial Organisms. Academic Press, London.

JOLIET, L. 1887. Contributions à l'histoire naturelle des Bryozoaires des côtes de France. Arch. Zool. Exp. Gén. 6:193-304.

MATURO, F. J. S. 1957. A study of the Bryozoa of Beaufort, North Carolina, and vicinity. J. Elisha Mitchell Sci. Soc. 73:1-68.

PINTER, P. 1969. Bryozoan-algal associations in southern California waters. Bull. S. California Acad. Sci. 68:199-218.

ROGICK, M. D. AND H. CROASDALE. 1949. Studies on marine Bryozoa, III. Woods Hole Region Bryozoa associated with algae. Biol. Bull. 96:32-69.

RYLAND, J. S. 1959. Experiments on the selection of algal substrata by polyzoan larvae. J. Exp. Biol. 36:613-631.

———, 1962. The association between Polyzoa and algal substrata. J. Anim. Ecol. 31:331-338.

RYLAND, J. S., AND A. R. D. STEBBING. 1971. Settlement and orientated growth in epiphytic and epizooic Bryozoans. Pp. 105-123. *In:* Crisp, D. J. (ed.). Fourth European Marine Biology Symposium. Cambridge Univ. Press, Cambridge.

WINSTON, J. E. 1976. Experimental culture of the estuarine ectoproct *Conopeum tenuissimum* from Chesapeake Bay. Biol. Bull. 150:318-335.

WOOLLACOTT, R. M., AND W. J. NORTH. 1971. Bryozoans of California and Northern Mexico kelp beds. Beihefte zur Nova Hedwigia. 32:455-479.

Florida Sci. 43(2):65-74. 1980.

Physical Sciences

HYDROGRAPHIC FEATURES OF FORT PIERCE INLET, FLORIDA

O. H. VON ZWECK AND D. B. RICHARDSON

Department of Oceanography and Ocean Engineering, Florida Institute of Technology, Melbourne, Florida 32901[1]

ABSTRACT: *Circulation of the Fort Pierce Inlet and adjacent portions of the Indian River on Florida's Central East Coast was investigated during a 2 yr period. The currents were predominantly tidally driven, with wind effects becoming more important in the shallower areas of the Indian River and with increasing distance from the Inlet area. Variations in the salinity structure of the waters in the inlet area occur largely with the tidal stage.**

THE inlet at Fort Pierce, Florida (27°28′N 80° 18′W) is 1 of 3 tidal inlets connecting the Atlantic Ocean with the southern portion of the Indian River. The latter is part of an extensive barrier island estuarine lagoonal system extending along the central east coast of Florida. Coastal oceanic water passing through the inlets of Fort Pierce, Sebastian and St. Lucie (41 km to the north, 37 km to the south of Fort Pierce, respectively) encounters fresh water from tributaries that empty into the Indian River on its western bank. The fresh water sources are near the inlets and flow into the adjoining parts of the Indian River.

A study of the circulation and waters encountered in sections of the Indian River adjoining the Fort Pierce Inlet, required an investigation of the currents and water structures in an area encompassing the Fort Pierce Inlet and harbor. Preliminary results and the salient hydrographic features observed during this 2 yr investigation (mostly during the summer months) are described.

DESCRIPTION OF STUDY AREA—The present inlet and main ship channel at Fort Pierce is man-made, replacing a natural, but ephemeral inlet and channel, which had been located about 2 mi further north (Walton, 1974). The main channel is maintained at a depth of 7 m and extends from the ocean through the inlet into the Indian River where it intersects and crosses the Intracoastal Waterway to end in a basin forming the Fort Pierce harbor. A

---

[1]Present Address: U.S. Naval Oceanographic Office, Bay St. Louis, Mississippi. 39522.

*The costs of publication of this article were defrayed in part by the payment of charges from funds made available in support of the research which is the subject of this article. In accordance with 18 U.S.C. § 1734, this article must therefore be hereby marked "*advertisement*" solely to indicate this fact.