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THE DISTRIBUTION OF THE LITTORAL ECHINODERMS OF THE WEST INDIES.

C. NASSIN

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INTRODUCTION.

Among the various groups of invertebrate animals which swarm on the reefs and along the shores of the West Indies none is more conspicuous than the Echinodermata and few are more abundant or diversified. Wherever conditions are at all favorable for the formation of coral reefs, and in many places where corals scarcely grow at all, echinoderms are found in greater or less abundance, and either by their size or color or both are sure to attract the attention of even a casual observer.

In April 1896 I first came into contact with this interesting fauna while I was enjoying the privileges of the Johns Hopkins University's Marine Laboratory at Port Henderson, Jamaica. The following summer my acquaintance with it was renewed at Port Antonio, Jamaica, under the same auspices.

In April 1899 I spent two weeks in Bermuda, most of my collecting being in the vicinity of Bailey Bay, Coney Island, and Castle Harbor. In the fall of 1902 I again visited Port Henderson, Jamaica, and in the spring of 1909 I was at Port Antonio again for a week. In the spring of 1912 I enjoyed the privileges of the Carnegie Institution's laboratory at Montego Bay, Jamaica, while in 1916, under the same auspices, I had the opportunity of spending five weeks at Pigeon Point, Tobago. Finally, the month of June 1917 was spent at the Tortugas Laboratory of the Carnegie Institution of Washington, where every facility was provided for the collection and study of echinoderms.

As a result of these unusual opportunities, I have accumulated a large part of the data presented in this report, my attention having been almost wholly given to the littoral echinoderms. The word *littoral* is used in the strictest sense, only those species being included which I have myself collected on the reefs or in very shallow water, or for whose occurrence there the records are indubitable. As a matter of fact, I have collected nine-tenths of these species. In compiling the list, I have been very arbitrary and have omitted a considerable number of species which might be expected in it. Further reference will be made to these under the respective groups into which the list is divided. The collections of the Museum of Comparative Zoölogy contain a large amount of West Indian material and this has been freely used and of invaluable assistance in the preparation of this paper. I have also made use of all available publications in search-

ing for records for the different islands, but no doubt scattered records have been overlooked, while many in which I have lacked confidence are ignored.

The purpose of this investigation and report is to see if the distribution of these very littoral species throws any light on the faunistic relations of the various islands. But it should be understood at the start that we have nowhere nearly enough data on which to base any important conclusions. Thus, while the littoral echinoderms of Florida and the Tortugas are quite completely known and those of Jamaica are almost equally well listed, our knowledge of the Cuban fauna is, in this group, very incomplete and nothing whatever is known of the Isle of Pines or of the Cayman Islands. Of the echinoderms occurring on the shores of Porto Rico and the United States Virgin Islands, we are fairly well cognizant, but passing eastward and southward we enter a region of which our knowledge is most superficial until Barbados and Tobago are reached. This report is therefore merely introductory to the subject, but it is hoped that it may serve as a useful beginning.

One word is necessary as to the geographical limits of the region here designated as "West Indies." It extends from Bermuda on the north and the Tortugas on the west to Tobago in the southeast. Perhaps, strictly speaking, these three extremes do not belong in the region at all, but as their littoral faunas are exceptionally well known it would be absurd to leave them out of account.

In concluding this introduction, I wish to express my thanks to those whose encouragement and aid have made my work possible. I desire particularly to record my great and lasting obligations to the late Professor William Keith Brooks, of the Johns Hopkins University, who first opened to me the fascinating field of marine zoölogy; to the late Dr. Alexander Agassiz and to Mr. Samuel Henshaw, of the Museum of Comparative Zoölogy; and to Dr. Alfred G. Mayor of the Carnegie Institution. At Tobago I had the privilege of the constant companionship and help of my honored colleague, Dr. Th. Mortensen, of Copenhagen; it is a pleasure to acknowledge here my debt to him. Another colleague, Dr. W. K. Fisher, of Leland Stanford Junior University, has put me under obligation by permitting me the use of certain field notes made by him during the summer of 1918 at Barbados and Antigua, where he was a member of the party sent out by the University of Iowa, under Professor C. C. Nutting. I am glad to thank Professor Nutting and Dr. Fisher for permitting me to use these notes.

There are many to whom my thanks are due for help in collecting, but I forbear attempting to name them. I must, however, offer my particular thanks to Mr. John W. Mills, chief engineer of the Tortugas laboratory, whose interest and help have been invaluable.

and 26 on the coasts of peninsular Florida. It is notable that all of the echini and brittle-stars occurring at Bermuda are found also at Tobago. It would be hard to bring out more clearly how distinctively West Indian the echinoderm fauna of Bermuda is. The only non-West-Indian elements in it are the sea-star, *Coscinasterias tenuispina*, of the Mediterranean, which was possibly introduced by means of ship-bottoms, and the northern synaptids, whose occurrence is difficult to explain.

JAMAICA.

The echinoderm fauna of Jamaica is rich and varied, including 62 species of the present list and more than a dozen as yet unidentified holothurians. Indeed, the holothurians form a very conspicuous feature of the fauna on the reefs and in shallow water. Intensive collecting of echinoderms has been carried on at three widely separated points on the Jamaican coast: Montego Bay and Port Antonio near the western and eastern ends respectively of the northern coast, and in the vicinity of Port Royal on the southern coast. The last is much the best region, the so-called "lakes" at Port Royal, the rocky coast across the harbor entrance and the outside cays, particularly Drunkenman Cay, affording a diversity of habitats that is very productive. Both Port Antonio and Montego Bay yielded species not taken elsewhere, but it is quite probable that they will be found in the Port Royal region when it is fully explored.

Of the 62 species, not a single one is endemic. More than half (33) belong to the general tropical Atlantic fauna, while 14 are characteristically West Indian. There are 6 tropicopolitan forms. Only a single species is indicative of southern affinities, but 8 are plainly northern. There are 52 species in common with the Tortugas, 47 in common with St. Thomas, and 42 in common with Tobago, but only 34 in common with Bermuda. More sea-stars and more holothurians are known from Jamaica than from any other place, but the number of brittle-stars is small, there being five other areas from which more brittle-stars are known. There is little doubt that the number of mud-inhabiting ophiurans known from Jamaica will be considerably increased by further collecting in suitable areas.

PORTO RICO.

The echinoderm fauna of Porto Rico is not rich either in number of species or (in most places) in number of individuals. It is remarkably like that of Jamaica, all of the sea-stars, all the echini, and all but one of the holothurians being common to the two islands, while all of the 6 brittle-stars recorded from Porto Rico but not yet known from Jamaica are mud-loving species which will very probably be found in suitable localities at the British island. With both St. Thomas and the Tortugas, Porto Rico has 43 species in common but with Tobago only 33 and with Bermuda only 28. Of the Bermudan

fauna, however, just two-thirds (66 per cent) occurs at Porto Rico, while of the Tobagoan fauna only a little more than half (53 per cent) is found there.

Of the 54 species, 2 are as yet known only from Porto Rico; 29 are common throughout the tropical Atlantic and 11 others are distinctively West Indian; 4 are tropicopolitan and 7 have a northern range; only 1 can be considered representative of a southern fauna. The number of sea-stars known from Porto Rico is exceptionally large, nearly one-fifth of the echinoderms belonging in that class, whereas only 12 per cent of the entire West Indian list is made up of sea-stars.

ST. THOMAS.

The United States Virgin Islands, so long known as the Danish West Indies, are classic ground for the student of echinoderms, as a very large proportion of the West Indian species were first recorded from there, thanks to the industry and great abilities of the celebrated Danish zoölogist, Lütken. In the present paper, I have not attempted to keep separate the records from the different islands, but have included them all under "St. Thomas," since the name Danish West Indies is no longer correct and the recently coined official name for the group is also open to misunderstanding.

None of the 56 species here listed from St. Thomas is endemic, but on the other hand 6 are tropicopolitan. There are 28 tropical Atlantic and 13 distinctly West Indian forms. The remaining 8 species all have northern affiliations. There are 44 species which occur in Porto Rico, or 81 per cent of that island's fauna; 47 which are found in Jamaica, 75 per cent of that fauna; 27 which are known at Bermuda, 64 per cent of that fauna; 48 which occur at the Tortugas, 63 per cent of that fauna; and only 38 which are found at Tobago, just 60 per cent of that fauna.

TOBAGO.

The echinoderm fauna of Tobago is largely confined to the vicinity of Pigeon Point on the southwestern part of the island, where extensive coral reefs protect the shallow waters of Buccoo Bay. Although we made brief visits to several points on the southeastern and northeastern sides of the island, we found very few echinoderms indeed in those places. But in Buccoo Bay and on Buccoo Reef, there is an exceedingly rich fauna, especially of brittle-stars, which constitute nearly 60 per cent of it.

The most notable member of this fauna is the comatulid, *Tropiometra carinata*, a conspicuous representative of a southern fauna, common on the coast of Brazil. Two other representatives are noteworthy—the little bright rose-colored holothurian *Psolidium brazilense* and the handsome brittle-star *Ophioderma januarii*. The latter is apparently rare at Tobago, but a number of specimens of *Psolidium* were taken, though all are very small.

Besides these 3 southern species, not found elsewhere in the West Indies, 7 other species are not yet known from any place but Tobago. One of these is the little *Thyone*, referred to on page 63, but the others are all brittle-stars. Of these, two are ophiodermas and deserve special attention. One, *Ophioderma squamosissimum*, has long been known from the unique holotype in the Copenhagen Museum, which is from an unknown locality in the West Indies, almost certainly not Tobago and very possibly St. Thomas. This brilliantly colored brittle-star (plate 3, fig. 2) is rare at Tobago, only 5 specimens being found on Buccoo Reef at extreme low-tide. None is as large as the holotype. The other notable *Ophioderma* at Tobago is *O. phænium* H. L. Clark (1918, Bull. M. C. Z., 62, p. 333), which seems to be a fairly common, endemic species. The coloration is conspicuous, sometimes all green, sometimes all red, but usually a red disk with green arms (plate 3, fig. 1). Another remarkable *Ophioderma*, *O. guttatum*, is common on Buccoo Reef and reaches a large size there. It is possible that this is a southern species, for while it was described from a single specimen taken at St. Thomas, and I have taken it twice in Jamaica, these three specimens are all small, only about half as large as the adults of Tobago. Associated with the ophiodermas on Buccoo Reef were great numbers of *Ophiomyxa flaccida*, of very diverse hues; olive-green either with or without white markings is a usual color for this species, but olive-yellow, passing into brilliant yellow (plate 1, fig. 2) or brown passing through red-brown into red of various shades (plate 1, fig. 1) are common. Another brilliant brittle-star found on Buccoo Reef was the unique type-specimen of *Ophiothrix ærstedii* var. *lutea* H. L. Clark (1918, Bull. M. C. Z., 62, p. 314), whose bright orange coloration (plate 2) is very distinctive.¹

All of the half-dozen tropicopolitan echinoderms of the West Indies are common at Tobago and there are two species which have northern rather than southern relationships. One of these is the sea-urchin, *Arbacia punctulata*, whose distribution from Tobago to Massachusetts (along the mainland coast?) is so puzzling. Of the remaining 45 species, three-fifths are typically West Indian.

No fewer than 32 species are common to Bermuda and Tobago; this is 76 per cent of the Bermudan fauna and is a very remarkable fact. It can be explained only on the ground that Tobago is the home of 45 tropical Atlantic and West Indian species, and it is from this wide-ranging group that the Bermudan littoral echinoderm fauna has been almost wholly derived. Of the Jamaican fauna, 43 species (69 per cent) occur at Tobago, and of the St. Thomas fauna, 38 (68 per cent). There are 45 species common to Tobago and the Tortugas, but this is only 59 per cent of the Tortugas fauna.

¹I am indebted to Dr. Mayor for making colored sketches from living specimens of these brilliant ophiurans. From these sketches and the preserved specimens, Mr. J. Henry Blake has made the beautiful drawings reproduced herewith.

Table showing distribution.

| Name. | Bermuda. | Bahamas. | U. S. Coast, north of Florida. | Florida. | Tortugas. | Gulf Coast of United States. | Cuba. | Jamaica. | Haiti. | Porto Rico. | St. Thomas. | St. Bartholomew. | St. Christopher. | Antigua. | Montserrat. | Guadeloupe. | Dominica. | Martinique. | St. Lucia. | Barbados. | St. Vincent. | Grenada. | Tobago. | Trinidad. | N. Coast of S. A. | E. Coast of C. A. and Mexico. | Swan Island. | Brazil. | Eastern Atlantic. | Indo-Pacific. | | | |
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| <i>Comatulida.</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Nemaeter iowensis</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Tropometra carinata</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Asteroides.</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Astropecten arctilatus</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Astropecten duplicatus</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Luidia alternata</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Luidia clathrata</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Luidia senegalensis</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Oreaster regularis</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Asterina folium</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Asterina minuta</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Stegaster westlii</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Ophidiaster guidingi</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Linckia guildingi</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Echinaster sentus</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Echinaster spinulosus</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Coccinasterias tenuispina</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Ophiuroidea.</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Ophiomyxa fasciata</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Astrophyton miraculum</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Ophiacantha oligacantha</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Ophiomitraella glabra</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Amphiura kukenthalii</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>palmeri</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>stimpsoni</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>vivipara</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Hemipholis elongata</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Ophiophragmus longirostris</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Ophiophragmus lylei</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>palcher</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>septus</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>verdermanni</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Ophiomphaps linnicola</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Ophiomena intricata</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Amphipholis gracillima</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Pachybractea</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>pacuata</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>pacuata</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Ophiostigma isacanthum</i> ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

+ indicates that an authentic specimen has been examined.

- indicates a reliable record.

? indicates a doubtful record.