

# **Survey of the Shallow-water Echinoderms of Nauru, Micronesia**

Results of a Survey Performed 28 July to 1 August 1998

by

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*Tubwa!*



## EXECUTIVE SUMMARY

The island of Nauru in eastern Micronesia potentially possesses a diverse array of echinoderms. I performed a small survey to explore echinoderm diversity in Nauru's shallow-water marine environments. In five days of surveying between 28 July to 1 August 1998, I surveyed 12 sites around the island on reef flats and forereef slopes to 20 m depth and found 18 species of echinoderms, most of them new records for the island. Including previous surveys, a total of 24 species of echinoderms have now been identified from Nauru's waters: six holothuroids (sea cucumbers), five echinoids (sea urchins), five asteroids (sea stars), five ophiuroids (brittle stars) and three crinoids (feather stars).



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## INTRODUCTION

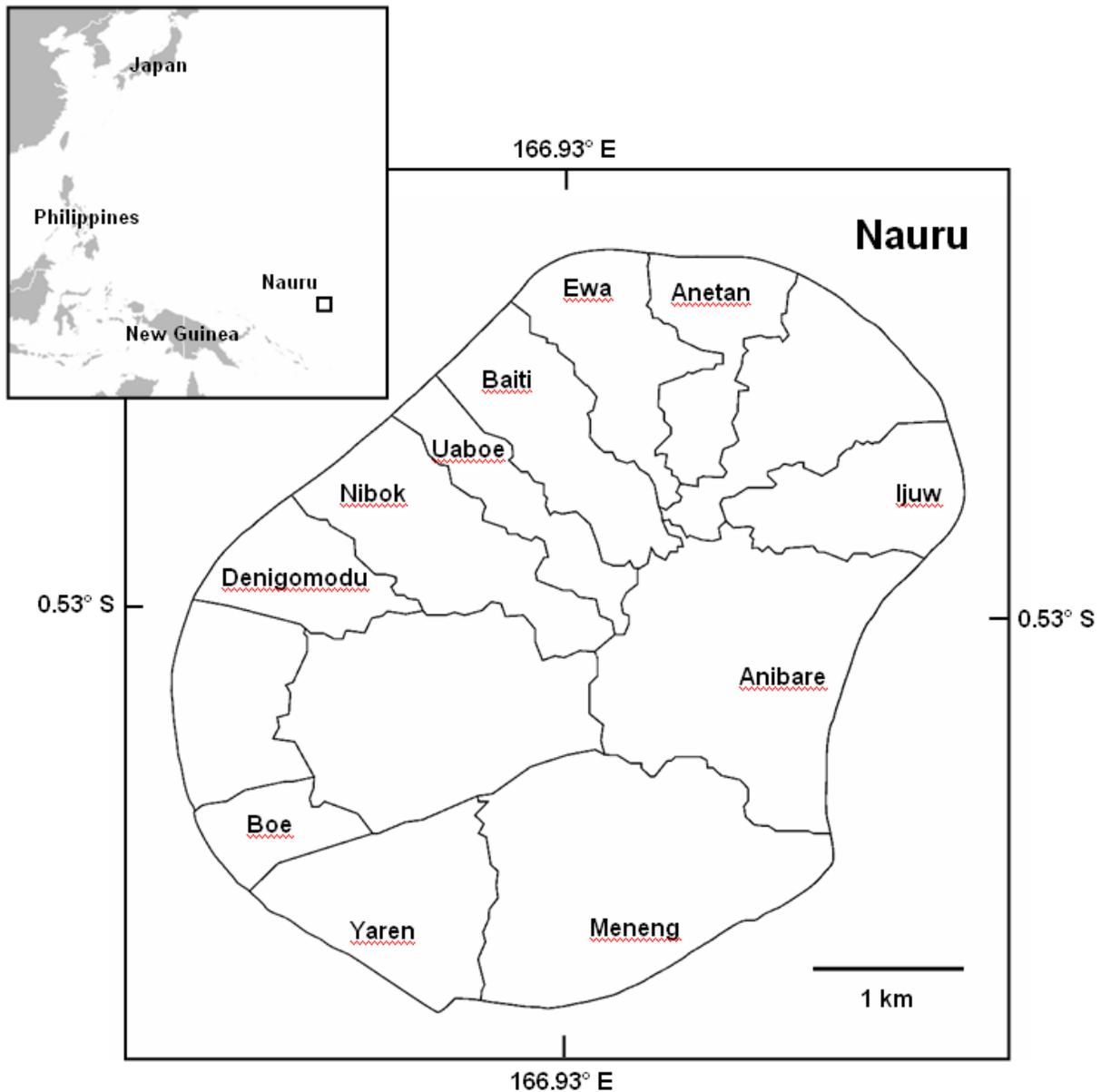
Our knowledge of the marine natural history of Nauru remains very poor. Because of the island's small size, age and location in the Pacific, Nauru is expected to be comprised of an abbreviated set of species having a wide Indo-western Pacific distribution. The earliest report of the natural history of Nauru appears to be that of Finsch (1881) who, during a stay of six hours, mentioned in addition to several birds and plants, a "giant clam" that he did not collect, but identified as *Tridacna gigas*. This species is considered extinct on Nauru, but the shells of large specimens are still kept near some residences (Jacob 2002). An early twentieth-century collection of terrestrial and marine material included 42 species of molluscs (Hedley 1903), 16 fishes (Waite 1903), plus 13 crustaceans and seven echinoderms (Whitelegge 1903). Later, Whitley and Colefax (1938) provided a short account of Nauruan fishes. Currently, the number of fish species stands at a modest 76 (Froese and Pauly 2011) with several suspicious absences, e.g., *Chaetodon* and all of Acanthuridae. The most comprehensive list of algae from Nauru (South and Yen 1992) is of only 40 species. There appears to be no faunistic account of Nauru's corals, but several species with high cover are mentioned in an environmental study by Lovell et al. (2004).

In this paper, I provide an annotated list of the echinoderms of Nauru. In July and August 1998, I surveyed the reef flats and fore-reef slopes around Nauru to 20 m depth during the day and night and found 18 species of echinoderms.

## METHODS

### *Site selection*

Collections were made around the island of Nauru (21 km<sup>2</sup>; 0°31'S, 166°E), a young (ca. 1 my), uplifted limestone island in the equatorial central Pacific Ocean (Figure 1). The geological history of Nauru is covered by Hill and Jacobson



**Figure 1.** Nauru, showing sampled districts around the island.

(1989). Fringing reefs surround the island, varying in width from about 200 to 600 m, the widest reef flats occupying the north-west side of the island and centered on the district Ewa. The fore-reef slopes are steeply sloping and terraced in places at about 15 m and again at 25 m depth. Shorelines are

generally sandy around the island. The inner reef flats are also sandy and to about 1 m depth on the north to western coasts, but can be rocky with tidepools and emergent karst on eastern coasts. Middle reef flats are shallower with coarser sediments and live coral. Outer reef flats have coarse rubble. A channel cuts through the reef flat on the east coast at Anibare, while on the south-eastern coast, a small artificial harbor and loading dock interrupts the coast and reef flat at Buada.

### *Survey and collections*

Collections were made at 12 stations around the island. Reef flats were investigated around the island at Anibare, Denigomodu, Ewa, Ijuw, Meneng, and Nibok. Because of high surf along eastern shores, the reef slope was only surveyed at western sites, Baiti, Boe (including Gabab Channel), Ewa, Nibok, and Uaboe. I noted the presence or absence of species at each site. I examined crevices, turned over rocks, and searched through stands of macroalgae. Catch per unit effort of the commercially valuable holothuroid *Actinopyga mauritiana* was also conducted. Low abundances of other commercially valuable species precluded additional catch estimates. Holothuroids were relaxed in seawater to which several drops of a tincture of chloretone (1, 1, 1,-trichloro-2-methyl-2-propanol) was added, then the animal was preserved in 70% ethanol or isopropanol. Asteroids, crinoids, echinoids and ophiuroids were fixed in ethanol, then dried. Specimens I could not identify were sent to experts for identification. As a result the specimens were ultimately deposited at the U.S. National Museum of Natural History, Western Australia Museum, Natural History Museum of Los Angeles County, and the California Academy of Sciences.

## RESULTS AND DISCUSSION

In a total of five days of surveying, 12 sites were visited around Nauru. There are now 24 species and subspecies of echinoderms reported from Nauru, including six holothuroids, five asteroids, five echinoids, three crinoids, and five ophiuroids. Seven echinoderms have been previously reported by Whitelegge (1903). This author reports these species as being collected in either Nauru or the nearby island of Banaba (Ocean Island). Of these specimens, only two echinoids (*Echinometra mathaei oblonga* and *Heterocentrotus mamillatus*) have not been seen on Nauru by later collectors, and so these may in fact count as vouchers from Banaba. Nevertheless, seventeen of the echinoderms reported here are new records for Nauru, including all of the island's reported crinoids and ophiuroids. Several technical reports (e.g., PROCFish Team. 2007) mention other species of echinoderms not listed here. We are confident that many of these are indeed to be found in Nauru, but we are reluctant to include them, as we have not seen these species, did not examine them closely enough, or no specimen or photo vouchers exist. These include such abundant and geographically widespread species as the asteroid *Culcita novaguineae* Müller & Troschel, 1842, the holothuroid *Pearsonothuria graeffei* (Semper, 1867), and the crinoid *Oxycomanthus bennetti* (Müller, 1841).

Most of the echinoderms so far reported from Nauru are common Indo-west Pacific species. The geographic range of *Ophiocoma cynthiae* is poorly known. It is a form recently described from northern Australia (Benavides-Serrato and O'Hara 2008) eastward to the Cook Islands (UF4130) and north to the Mariana Islands (UF11541). The species was previously placed with *O. erinaceus*, now recognised as being a complex of species. Perhaps the most interesting find was *Holothuria* (*Halodeima*) sp. aff. *edulis* found at one site on the fore-reef slope. Seven large grey specimens of this holothuroid were found

together on a patch of sand on the forereef slope with moderate coral cover at 20 m depth during the day. Large grey *edulis*-like holothuroids from this habitat and matching these specimens' descriptions are found at many localities throughout the western Pacific (O'Loughlin et al. 2007). At all of these reported locations, as well as in Kosrae, Caroline Islands (AMK, pers. obs.), the animal is hidden in reef crevices during the day, coming out only at night. The Nauruan exemplars differ in that they lay exposed on sand during the day. O'Loughlin et al. (2007) find that the grey form is distinct in mtDNA nucleotide sequence from closely allied consubgeneric species and, hence, may represent a new species. But, they also suggest that the lack of fixed sequence differences with *H. edulis* could indicate that the grey morph is an ecomorph of the latter species that is restricted to deeper water.

Several other species were also of interest. *Actinopyga palauensis* was uniformly dark brown or black with five distinct yellow calcareous anal papillae; dorsum covered with a fine layer of sand. When collected the approximately 30-cm long specimen immediately began inflating with water until in 1 h it had become spherical, the dermis stretching to a light brown. *Holothuria (Halodeima) atra* was the most common holothuroid on Nauru, occurring in abundance at nearly all reef-flat sites visited, sometimes at densities over 10 individuals per square meter. *Holothuria (Platyperona) difficilis* was a common holothuroid at Anibare, abundant in patches on the outer reef flat under rubble. These aggregations may have been the result of asexual reproduction, as many lacked either mouth or anus, a sign that the animal has recently undergone transverse binary fission, which is known to occur in this species (Lee et al. 2009). *Linckia laevigata* on Nauru were entirely orange. One uncollected specimen was positioned above the top of a small coralline knoll on its ray tips during late afternoon, perhaps in preparation to spawn. In most places in the western Pacific, this species is commonly an entirely bright cobalt blue and found in the

shallow water of the reef flat, but we saw no individuals of that colour or in that habitat on Nauru. *Lamprometra palmata* was one of the most common crinoids on Nauru. It remained hidden during the day and perched on a small prominence at night. Color was variable, sometimes pure white or the arms usually with chevrons of contrasting light and dark, often white and brown. *Ophiocoma scolopendrina* was the most common ophiuroid seen on the shallow inner reef flats of Nauru. Usually seen with only its arms extended from crevices and from under rubble, sometimes at densities of about 4-5 individuals per square meter.

There does not seem to be much potential for a sustainable beche-de-mer fishery on Nauru. The low-value species *Holothuria atra* (lolly fish) was relatively abundant at some sites to densities over 10 individuals per square meter. However, no medium- to high-value species occurred in any abundance. The most common high-value species *Actinopyga varians* (red surf fish) could be collected at about 10-30 individuals per man hour, but the total populations were very small at all sites. Only two individuals of *Thelenota ananas* (prickly fish) were seen in three days of surveying the reef slope. No other commercially valuable holothuroid species were seen.

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**Appendix 1.** Provisional Checklist of Shallow-water Echinoderms from Nauru, Micronesia. Asterisks indicate species not found in the 1998 survey and represent specimens in FLMNH and AMS.

Species	Habitat	Location								
		Anibare	Baiti	Boe	Denigomodu	Ewa	Ijuw	Menang	Nibok	Unrecorded
HOLOTHUROIDEA										
<i>Actinopyga varians</i>	Crest	X	X	X	X			X	X	X
<i>A. palauensis</i>	Slope		X							
<i>Holothuria (Halodeima) atra</i>	Flat	X	X		X	X	X	X	X	X
<i>H. (H.) sp. aff. edulis</i>	Slope		X						X	
<i>H. (Platyperona) difficilis</i>	Flat		X							
<i>Thelenotia ananas</i>	Slope		X	X						
ASTEROIDEA										
<i>Acanthaster planci</i>	Slope									X
<i>Fromia sp.*</i>	Flat	X								
<i>Leiaster leachi</i>	Slope		X							
<i>Linckia laevigata</i>	Slope			X						X
<i>Mithrodia clavigera</i>	Slope			X						
ECHINOIDEA										
<i>Echinothrix diadema</i>	Flat, Slope	X								X
<i>Echinometra mathaei</i>	Flat					X			X	X
<i>E. mathaei oblonga*</i>	Unrecorded									X

Species	Habitat	Location								
		Anibare	Baiti	Boe	Denigomodu	Ewa	Ijuw	Menang	Nibok	Unrecorded
<i>Heterocentrotus mamillatus</i> *	Crest									X
<i>H. trigonarius</i>	Crest	X				X	X			
CRINOIDEA										
<i>Alloeocomatella polycladia</i>	Slope		X							
<i>Lamprometra palmata</i>	Slope		X	X						
<i>Phanogenia gracilis</i>	Slope		X	X						
OPHIUROIDEA										
<i>Ophiactis savignyi</i> *	Flat			X						
<i>Ophiocoma cynthiae</i>	Slope		X							
<i>O. scolopendrina</i>	Flat	X	X		X	X			X	X
<i>Ophiomastix caryophyllata</i>	Slope								X	
<i>Ophiothrix (Acanthophiothrix)</i> <i>purpurea</i>	Slope								X	
Depth range (m)		0—1	0—20	2—20	0—1	0—1	0—1	0—1	0—25	
Dates (d.mo.1998)		28.07	01.08	31.07	29.07	30.07	31.07	28.07	29.07	
								02.08		

## Appendix 2: Authors' contact information

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