

Holothurians (Echinodermata: Holothuroidea) from the Intertidal Zone of Houbihu, Southern Taiwan

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Abstract. From January 2010 to December 2011, 21 species of holothurians were recorded from the intertidal zone of Houbihu, southern Taiwan. Two species (*Labidodemas semperianum* and *Polyplectana kallipeplos*) are new records for Taiwan. Holothurians recorded at Houbihu represent 63.6% of the 33 species found in southern Taiwan. The species composition, abundance, and commercial value of these 33 species are presented. Color figures of the 21 species from Houbihu are included.

Key words: sea cucumber, holothurians, echinoderm, fauna, Kenting National Park.

INTRODUCTION

Houbihu (120°44'50.83"E, 21°56'49.43"N) is located at the tip of southern Taiwan. It is a coral reef area inside Kenting National Park. In 2003, Houbihu was classified by the national park as a "Fishery Resource Conservation Demonstration Area" due to its high diversity of marine life (Chao, 2005, 2006).

Holothurians (sea cucumbers) are common macrobenthos with ecological value because of their deposit-feeding characteristic. Some species have commercial value (e.g., Beche-de-mer). Only a few papers (Applegate, 1984; Chao et al., 1988, 1989; Chao and Chang, 1990; Chao and Alexander, 1991; Chao, 1998, 2002) have dealt with the holothurians of Taiwan, even though they are common coastal animals here.

In 2009~2010, shallow-water echinoderms were investigated in the Houbihu area, and diverse holothurians were photographed. From January 2010 to December 2011, intertidal holothurians were investigated. This paper is the

first survey of holothurians living on the reef platform at Houbihu. The species composition, abundance, and commercial value of holothurians from Houbihu and southern Taiwan are presented in this paper.

MATERIALS AND METHODS

From January 2010 to December 2011, we investigated holothurians in the intertidal zone of Houbihu twice each month during low tide. The intertidal zone of Houbihu is a reef platform with a coastline of about 500 m. The width of this intertidal platform between the low- and high-tide lines is about 50 m. Abundant tidal pools on the platform provide habitats for holothurians.

As Houbihu is a protected area, no collection of animals is allowed. Digital photographs replaced animal collection, except for those animals that could not be identified by photographs. Most holothurians are nocturnal, making it more effective to do fieldwork at night. Animals were identified by the senior author.

We measured the relative abundances of

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holothurians by defining abundant species (A) as > 100 individuals seen in 2 years, common species (C) as 5~100 individuals seen in 2 years, and rare species (R) as < 5 individuals seen in 2 years.

RESULTS AND DISCUSSION

In this investigation, 21 species in six holothurian families were identified (Table 1). Two species, *Labidodemas semperianum* and *Polyplektana kallipectos*, are new records for Taiwan. Table 1 also presents the relative abundance of each species. Color figures (Figs. 1-21) show live animals in their natural habitats. In total, 33 revised species in seven holothurian families have been recorded from reef areas of southern Taiwan (Table 2).

In total, 31 species of holothurians were recorded from southern Taiwan according to previous studies (Applegate, 1984; Chao et al., 1988; Chao and Chang, 1989; Chao and Alexander, 1991; Chao, 1998, 2002). In this study, we added two new records. To date, 33 species are recorded from southern Taiwan. Twenty-one species (63.6%) were found at Houbihu, indicating a diverse holothurian fauna. As holothurians have commercial value, the diversity of this fauna is probably a result of the protection afforded the Houbihu area by Kenting National Park.

Ten species (*Bohadschia argus*, *Holothuria rigida*, *H. nobilis*, *H. sinica*, *H. moebii*, *H. arenicola*, *Patinapta taiwaniensis*, *Pearsonothuria graeffei*, *Stichopus variegates*, and *Thelenota ananas*) recorded elsewhere in Kenting National Park were not found at Houbihu. This is despite the fact that *B. argus*, *H. nobilis*, *P. graeffei* and *T. ananas* usually inhabit the subtidal zone at depths of 3~10 m (Chao and Chang, 1989).

Abundant species

Of the 21 species, 6 (*H. atra*, *H. leucospilota*, *H. difficilis*, *H. cinerascens*, *A. africana*, and *Polycheira fusca*) were abundant at Houbihu (Table 1). We observed *H. atra* and *H. difficilis* to frequently be undergoing binary fission.

Common species

Eight species (Table 1) were common at

Houbihu. Chao and Chang (1989) considered *Stichopus horrens*, *H. fuscocinerea*, and *H. perviata* to be rare in southern Taiwan. They stated that "it is likely these species come from South China Sea or Philippine Islands as planktonic larvae". These species, however, were common at Houbihu. Both juveniles and adults were commonly seen, indicating they reproduce in southern Taiwan.

Rare species

Seven species were rare (Table 1). Two individuals of *Labidodemas semperianum* (Fig. 13) were found under slabs at a 1-m depth at Houbihu. This species is widely distributed in the Indo-West Pacific (Clark and Rowe, 1971). Massin (1999) and Rowe and Doty (1977) recorded this species from subtidal zones at 1.5~5 m in depth in Indonesia and Guam, where it lives under slabs and rocks. Shallow subtidal zones could be its habitat. As *L. semperianum* was always hidden under slabs, it was hard to find it unless the slabs were moved. This could explain the rarity of this species.

Holothuria hilla (Fig. 10) is rare in southern Taiwan, but is abundant in the intertidal zone of the Pescadore Islands off western Taiwan (Chao and Chang, 1989). *Holothuria hilla*, *B. marmorata*, *Euapta godeffroyi*, and *Polyplektana kallipectos* are nocturnal. These species usually hide under slabs or rocks in the daytime and come out to feed at night. *Phyrella fragilis* was always found buried in the sand in tidal pools. This species was rare at Houbihu, but abundant at nearby Nanwan (Chao et al., 1993).

Clark (1907), Domantay (1953), and Cherbonnier and Féral (1984) considered *P. kallipectos* conspecific with *P. kefersteini*, but Massin (1999) considered them to be different species. The branched miliary granules in the tentacles of *P. kallipectos* are distinctive, but have never been described in *P. kefersteini*. Our specimens had branched miliary granules in their tentacles. Therefore, we identified them as *P. kallipectos* (Fig. 19). This is a new record for Taiwan.

Commercial species

Although seven species of holothurians from Houbihu have commercial value, numbers of three species (*Actinopyga mauritiana*, *Holothuria impatiens*, and *Stichopus horrens*) were limited. Fewer than 20 individuals of each

Table 1. Records of sea cucumbers from Houbihu

Taxa	Abundance
HOLOTHUROIDEA	
ASPIDOCHIROTIDS	
Holothuriidae	
<i>Actinopyga echinites</i> (Jaeger, 1833)	A
<i>Actinopyga mauritiana</i> (Quoy & Gaimard, 1833)	C
<i>Bohadschia marmorata</i> (Jaeger, 1833)	R
<i>Holothuria (Halodeima) atra</i> Jaeger, 1833	A
<i>Holothuria (Lessonothuria) pardalis</i> Selenka, 1867	R
<i>Holothuria (Mertensiothuria) fuscocinerea</i> Jaeger, 1833	C
<i>Holothuria (Mertensiothuria) leucospilota</i> (Brandt, 1835)	A
<i>Holothuria (Mertensiothuria) pervicax</i> Selenka, 1867	C
<i>Holothuria (Platyperona) difficilis</i> Semper, 1868	A
<i>Holothuria (Semperothuria) cinerascens</i> (Brandt, 1835)	A
<i>Holothuria (Thymiosycia) hilla</i> Lesson, 1830	R
<i>Holothuria (Thymiosycia) impatiens</i> (Forskaal, 1775)	C
* <i>Labidodemas semperianum</i> Selenka, 1867	R
Stichopodidae	
<i>Stichopus horrens</i> Selenka, 1867	C
DENDROCHIROTIDA	
Sclerodactylidae	
<i>Afrocucumis africana</i> (Semper, 1868)	A
Phyllophoridae	
<i>Phyrella fragilis</i> (Ohshima, 1912)	R
APODIDA	
Synaptidae	
<i>Euapta godeffroyi</i> (Semper, 1868)	R
<i>Opheodesoma grisea</i> (Semper, 1868)	C
* <i>Polyplectana kallipeplos</i> (Sluiter, 1887)	R
<i>Synapta maculata</i> (Chamisso & Eysenhardt, 1821)	C
Chiridotidae	
<i>Polycheira fusca</i> (Quoy & Gaimard, 1833)	A

An asterisk (*) indicates a new record from Taiwan. A, abundant, >100 individuals recorded; R, rare, fewer than 5 individuals recorded; C, common, 5~100 individuals recorded.



Fig. 1 *Actinopyga echinites*

F.g. 3 *Bohadschia marmorata*

Fig. 5 *Holothuria fuscocinerea*

Fig. 7 *Holothuria pervicax*

Fig. 2 *Actinopyga mauritiana*

F.g. 4 *Holothuria atra*

Fig. 6 *Holothuria leucospilota*

Fig. 8 *Holothuria difficilis*



Fig. 9 *Holothuria cinerascens*

F.g. 11 *Holothuria pardalis*

Fig. 13 *Labidodemas semperianum*

Fig. 15 *Afrocucumis africana*

Fig. 10 *Holothuria hilla*

F.g. 11 *Holothuria impatiens*

Fig. 14 *Stichopus horrens*

Fig. 16 *Phyrella fragilis*

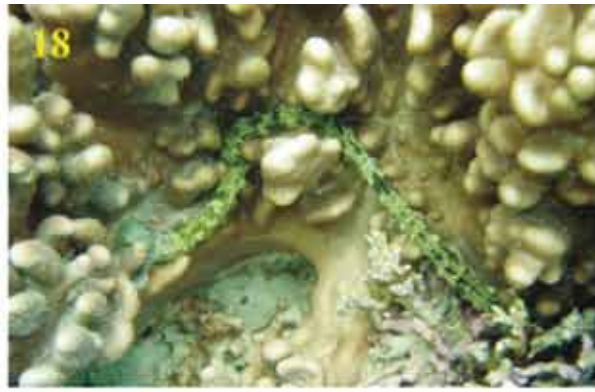


Fig. 17 *Euapta godeffroyi*

F.g. 19 *Polyplectana kallipeplos*

Fig. 21 *Polycheira fusca*

Fig. 18 *Opheodesoma grisea*

F.g. 20 *Synapta maculata*

Table 2. Records of sea cucumbers from southern Taiwan

Taxa	Habitat and depth (m)	Reference
HOLOTHUROIDEA		
ASPIDOCHIROTIDS		
Holothuriidae		
<i>Actinopyga echinites</i> (Jaeger, 1833)	r (0~3)	3
<i>Actinopyga mauritiana</i> (Quoy & Gaimard, 1833)	r (0~3)	3
<i>Bohadschia argus</i> (Jaeger, 1833)	r (0~2)	4
<i>Bohadschia marmorata</i> (Jaeger, 1833)	r (0~1)	5

<i>Holothuria (Cystipus) rigida</i> (Selenka, 1867)	r (2)	1
<i>Holothuria (Halodeima) atra</i> Jaeger, 1833	r (0~1)	3
<i>Holothuria (Lessonothuria) pardalis</i> Selenka, 1867	r (2~5)	3
<i>Holothuria (Mertensiothuria) fuscocinerea</i> Jaeger, 1833	r (0~1)	3
<i>Holothuria (Mertensiothuria) leucospilota</i> (Brandt, 1835)	r (0~1)	3
<i>Holothuria (Mertensiothuria) pervicax</i> Selenka, 1867	r (0~1)	3
<i>Holothuria (Microthele) nobilis</i> (Selenka, 1867)	r (1~5)	3
<i>Holothuria (Platyperona) difficilis</i> Semper, 1868	r (1~2)	3
<i>Holothuria (Semperothuria) cinerascens</i> (Brandt, 1835)	r (0~3)	3
<i>Holothuria (Selenkothuria) sinica</i> Liao, 1980	r (0~1)	6
<i>Holothuria (Selenkothuria) moebii</i> Ludwig, 1883	r (0~1)	6
<i>Holothuria (Thymiosycia) arenicola</i> Semper, 1868	r (0~1)	3
<i>Holothuria (Thymiosycia) hilla</i> Lesson, 1830	r (0~1)	3
<i>Holothuria (Thymiosycia) impatiens</i> (Forskaal, 1775)	r (0~2)	3
<i>Labidodemas semperianum</i> Selenka, 1867	r (2~5)	t
<i>Pearsonothuria graeffei</i> (Semper, 1868)	r (5~10)	4
Stichopodidae		
<i>Stichopus horrens</i> Selenka, 1867	r (0~3)	3
<i>Stichopus variegatus</i> Semper, 1868	r (1~4)	3
<i>Thelenota ananas</i> (Jaeger, 1833)	r (3~10)	3
DENDROCHIROTIDA		
Sclerodactylidae		
<i>Afrocucumis africana</i> (Semper, 1868)	r (0~3)	3
Phyllophoridae		
<i>Phyrella fragilis</i> (Ohshima, 1912)	r (0~1)	3
APODIDA		
Synaptidae		
<i>Euapta godeffroyi</i> (Semper, 1868)	r (1~5)	5
<i>Opheodesoma grisea</i> (Semper, 1868)	r (0~2)	3
<i>Patinapta taiwaniensis</i> Chao et al. 1988	r (0~1)	2
<i>Polyplectana kallipeplos</i> (Sluiter, 1887)	r (0~2)	t
<i>Polyplectana kefersteini</i> (Selenka, 1867)	r (0~5)	3
<i>Synapta maculata</i> (Chamisso & Eysenhardt, 1821)	r (0~3)	3
Chiridotidae		
<i>Chiridota rigida</i> Semper, 1868	r (0~3)	3
<i>Polycheira fusca</i> (Quoy & Gaimard, 1833)	r (0~1)	3

r, reef; 1, Applegate (1984); 2, Chao et al. (1988); 3, Chao and Chang (1989); 4, Chao and Chang (1990); 5, Chao and Alexander (1991); 6, Chao (1998); t, this paper.

species were recorded in the current study. The other four species (*Actinopyga echinites*, *H. atra*, *H. cinerascens*, and *H. leucospilota*) were common, but they were not abundant in number. As the locals do not collect holothurians to eat or sell, the limited numbers could be a result of biological factors rather than anthropogenic factors. The narrow intertidal zone at Houbihu provides limited habitat for these commercial holothurians. In addition, the gastropod, *Tonna perdis* (Prosobranchia: Tonnoidea), a highly specialized predator of holothurians is common at the study site. Biological and environmental factors probably result in limited numbers of these commercial holothurians. Fortunately, as Houbihu is a protected area, these diverse holothurians can avoid most anthropogenic interference.

Species composition

Analysis of the holothurian composition of southern Taiwan indicates that most species are Indo-West Pacific coral-reef dwellers. One exception is *Patinapta taiwaniensis*: it is only distributed in southern Taiwan (Chao et al., 1988) and Hainan Island, China (Liao, 1997). Three species (*H. impatiens*, *H. arenicola*, and *H. leucospilota*) are distributed in both Pacific and Atlantic waters, and 19 species are found throughout the Indo-West Pacific region (Chao and Chang, 1989). The remaining 10 species (*Actinopyga echinites*, *Afroccumis africana*, *H. rigida*, *H. fuscocinerea*, *H. rigida*, *Phyrella fragilis*, *Polycheira fusca*, *Stichopus variegates*, *Synapta maculate*, and *Thelenota ananas*) occur throughout the Indo-West Pacific area, but are not yet recorded from Hawaii (Chao and Chang, 1989). Taiwan has no endemic holothurians.

The Malayan region is a hot spot for echinoderm diversity in the world (Mortensen, 1934). The warm Kuroshio Current from the Philippines passes southern and eastern Taiwan on its way to Japan. As the holothurian fauna of southern Taiwan is similar to that of the Philippines, their origins could be from the Philippines. They could have traveled to Taiwan by the Kuroshio Current.

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台灣南部後壁湖地區潮間帶的海參

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本文記錄自2010年1月到2011年12月於墾丁後壁湖潮間帶記錄到的21種海參。*Labidodemas semperianum* 及 *Polyplectana kallipeplos* 是臺灣新記錄種。此區海參種類豐富，佔墾丁海域海參種類（33種）的63.6%。本文除了分析墾丁海域海參33種海參的種類組成外，並討論其豐富度和經濟性。後壁湖潮間帶的21種海參的生態圖亦包含在本文中。

關鍵詞：海參、棘皮動物、動物相、墾丁國家公園。