

Species and abundance of the edible Turban Snails *Turbo* spp. in intertidal areas of Hengchun Peninsula, southern Taiwan

Ming-Hui Chen^{1,5}, Yuh-Wen Chiu², Axel Alf³, Keryea Soong⁴, and Jan-Jung Li¹

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ABSTRACT : The species and abundance of turban snails, *Turbo* spp., were seasonally surveyed in the intertidal areas of Hengchun Peninsula, southern Taiwan from July 2001 to October 2002. Nine survey sites were chosen in this study. Two sites, site 7 and 8, are located at Lungkeng Ecological Protection Area (LEPA). Besides the surveys of intertidal areas, the snorkel diving, SCUBA diving and visits of local restaurants also were used to survey the species of turban snails. A total of seven species was recorded in this study. Five species of turban snails, i.e. *Turbo argyrostomus*, *T. chrysostomus*, *T. setosus*, *T. sparverius* and *T. stenogyrus*, were found for density estimation. The rough turban, *T. setosus*, is the most common species in the intertidal area of Hengchun Peninsula; it represented 86.7% ($n=120$) of all the individuals caught in this investigation. Another two species, *T. petholatus* was found in SCUBA diving and *T. marmoratus* was only found in local seafood restaurants. The species, *T. reevei*, was not found in this study, but a living specimen was recorded by the author, Yuh-Wen Chiu, at Site 2 in July 1999. The density of turban snails ranged between 0-25 individuals/100 m² in the intertidal area of Hengchun Peninsula. The densities are significantly different among sites ($P=0.001$), and there were significantly more turban snails in site 7 and 8 at LEPA ($P=0.001$).

KEYWORDS: abundance, edible snail, marine protected area, *Turbo*

Introduction

Turban snails are conspicuous members of shallow coral reef habitats where they graze on algae (Chan and Hung 2000, Worthington and Fairweather 1989, Yamaguchi

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1. National Museum of Marine Biology & Aquarium, Checheng, Pingtung, Taiwan 944, Republic of China.
 2. Shu-Zen College of Medicine and Management, Luju Shiang, Kaohsiung, Taiwan 821, Republic of China.
 3. University of Applied Sciences Weihenstephan, 91746 Triesdorf, Germany
 4. Institute of Marine Biology, National Sun Yat-sen University, Kaohsiung, Taiwan 804, Republic of China.
 5. Corresponding author

1993). They were valued as food and ornamental items in the Indo-Pacific region (Appukuttan 1979, Yamaguchi 1993). Recently, the resources of some species of turban snails have been considerably diminished, and the need to restore these resources has been proposed in some regions (Appukuttan 1979, Foster and Hodgson 2000, Yamaguchi 1993).

A total of 14 species of turban snails have been recorded in Taiwan (Lai 1979, Ozawa and Tomida 1995). People utilized these turban snails as food, ornament and tools. The history of exploitation can be traced back to three thousand years in Hengchun Peninsula, southern Taiwan (Li 1989). During 1950-1960, residents built factories to produce canned meat and ornaments from these snails (Guo 1964). During that period, 30-40 tons of snails were collected each year and a fisherman could collect up to 200-300 kg of turban snails in a day. However, these factories stopped operation after 1960 because no more snails were available. Afterward, collecting turban snails became a side job of some fishermen who supplied turban snails to local seafood restaurants on an irregular basis.

In order to provide information for managing and conserving turban snail resource, the species and abundance of these snails were surveyed in this study.

Materials and Methods

The species and abundance of turban snails were seasonally surveyed in the intertidal areas of Hengchun Peninsula, southern Taiwan from July 2001 to October 2002. Nine survey sites were chosen in this study (Fig. 1). Two sites, site 7 and 8, are located at Lungkeng Ecological Protection Area (LEPA), and other sites at the open coast. The survey area is 100 m², i.e. 20 m along the coastline and 5 m from low tidal level to land, in each site. All turban snails were collected and counted before releasing to the same site. The species of snails were identified as the Axel & Kreipl (2003). The number of snails in different seasons, i.e. the data of six surveys, was used for comparison between sites.

Besides the surveys of intertidal area, the snorkel diving, SCUBA diving and visits to local restaurants were also used to survey the species of turban snails.

Results and Discussion

Chang and Jeng (1989) recorded eight species belonging to genus *Turbo* in Hengchun Peninsula of which only seven species were found in this study (Plate 1). Five species of turban snails, i.e. *Turbo argyrostomus*, *T. chrysostomus*, *T. setosus*, *T. sparverius* and *T. stenogyrus* were found for density estimation. The rough turban, *T.*

setosus, is the most common species in the intertidal area of Hengchun Peninsula; it represented 86.7% ($n=120$) of all the individuals caught in this investigation. Besides the above five species, *T. petholatus* was found with SCUBA diving and *T. marmoratus* was only found in local seafood restaurants. The species, *T. reevei*, was not found in this study, but a living specimen was recorded by the author, Yuh-Wen Chiu, at site 2 (Wanlton) in July 1999.

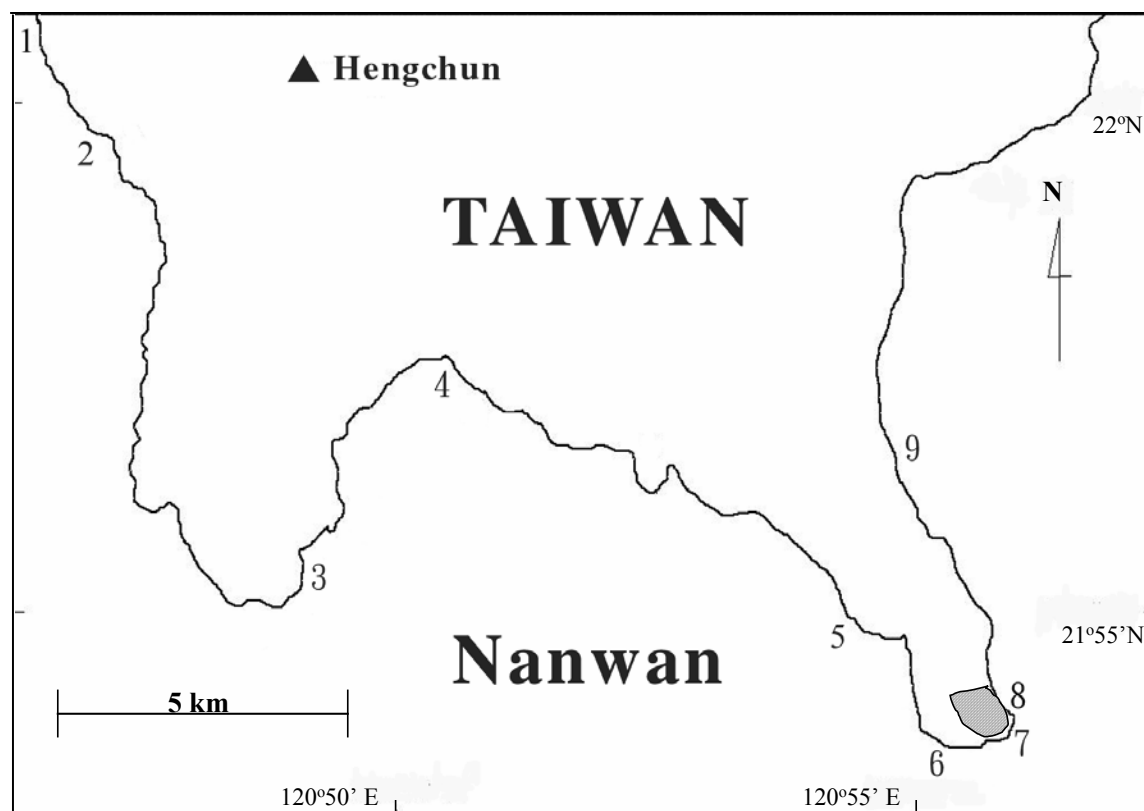


Fig. 1. Survey sites in Hengchuen Peninsula, southern Taiwan. The sites 7 and 8 are located at Lungkeng Ecological Protection Area which is marked with streaks on the map. Site 1 Houwan (後灣), Site 2 Wanlitung (萬里桐), Site 3 Hobihu (後壁湖), Site 4 Tiaoshi (眺石), Site 5 Hsiangchiaowab (香蕉灣), Site 6 The Southernmost of Taiwan (台灣最南端), Site 7 Lungkeng (龍坑), Site 8 North of Lungkeng (龍坑北), Site 9 Fengchueisha (風吹沙).

The density of turban snails ranged between 0-25 individuals/100 m² in the intertidal area of Hengchuen Peninsula. The densities are significantly different among sites (Fig. 2, $F=6.37$, $df=8,45$, $P=0.001$, ANOVA), and there were significantly more turban snails in site 7 and 8 ($P=0.001$, Fisher's LSD) than other sites.

The site 7 and 8 are located at Lungkeng Ecological Protection Area (LEPA). The access of LEPA is regulated by security guards and restricted by rough seas. Permission for entering the area is issued only for educational and scientific purposes. The significantly higher densities of turban snails in site 7 and 8 may well have been the effect of reduced fishing activities in the protected area.

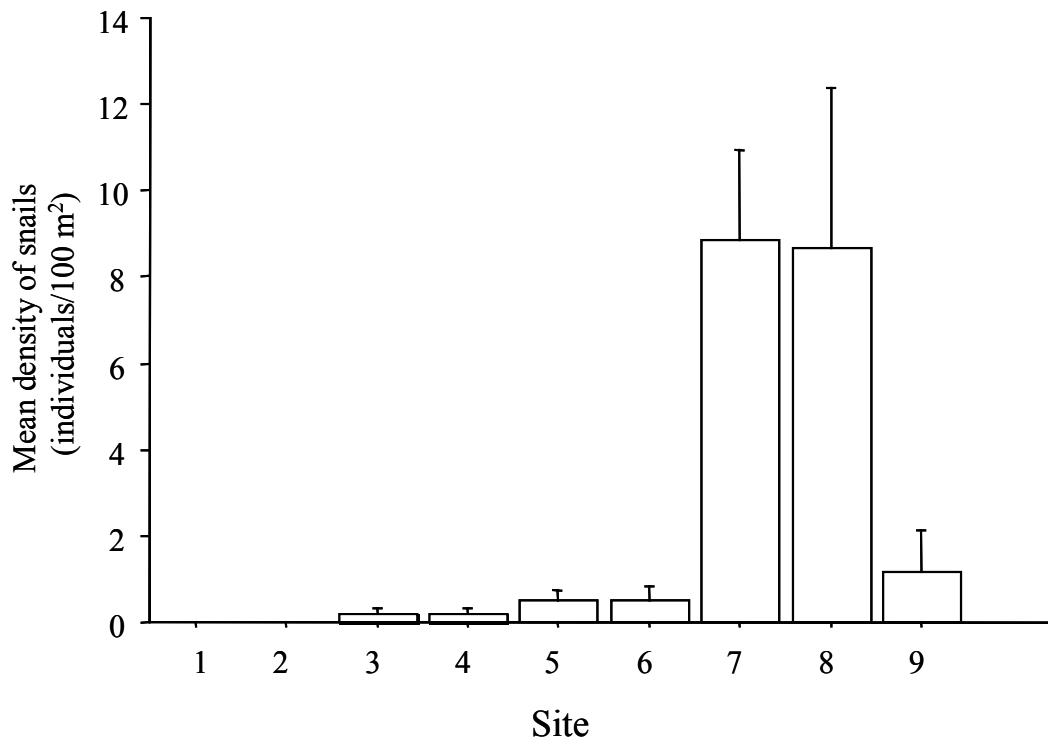


Fig. 2. The mean densities of turban snails in the intertidal area of 9 sites in Hengchuen Peninsula, southern Taiwan. The mean is an average of six surveys from July 2001 to October 2002. Error bars indicate one standard error of the means.

The number of turban snails showed seasonal pattern in both site 7 and 8, higher densities occurred in October and lower densities in July (Fig. 3) and other site were not analysis due to the density of snail were low. The turban snails grazed on algae (Chan and Hung 2000, Worthington and Fairweather 1989, Yamaguchi 1993) and the abundance of algae is low in the intertidal area in summer (personal observation). The low density of turban snails in summer may be correlated with less food, i.e. the cover area of algae.

Compared with other areas, the densities of turban snails in southern Taiwan are low. For example, the densities of *T. sarmaticus* were 20-120 individuals/100 m² along the coast of the Eastern Cape Province, South Africa (Foster and Hodgson 2000). On the other hand, the densities of *T. brunneus* were 50-250 individuals/100 m² in North Sulawesi, Indonesia (Ompi 1994).

Over-exploitation of a number of mollusk fisheries has happened in many regions and resulted in the breakdown of their populations (Poulsen 1995). To manage and conserve these resources, there are many potential management tools, including the issuing of a limited number of licences and permits, closed seasons, quotas, and minimum size limits (Evans *et al.* 1977, Poulsen 1995). However, the effectiveness of these management tools is often dependent on many factors. Marine protected areas (MPAs) is another one opinion being used to protect exploited species from

over-fishing. MPAs have been suggested to serve as effective sites for sheltering targeted populations. Furthermore, populations can experience increased abundance in such areas (Trexler and Travis 2000, Tuya *et al.* 2000). The positive effect of protected area shown by the significantly higher density of turban snails in LEPA points a direction of future effort to conserve the snail populations in Taiwan.

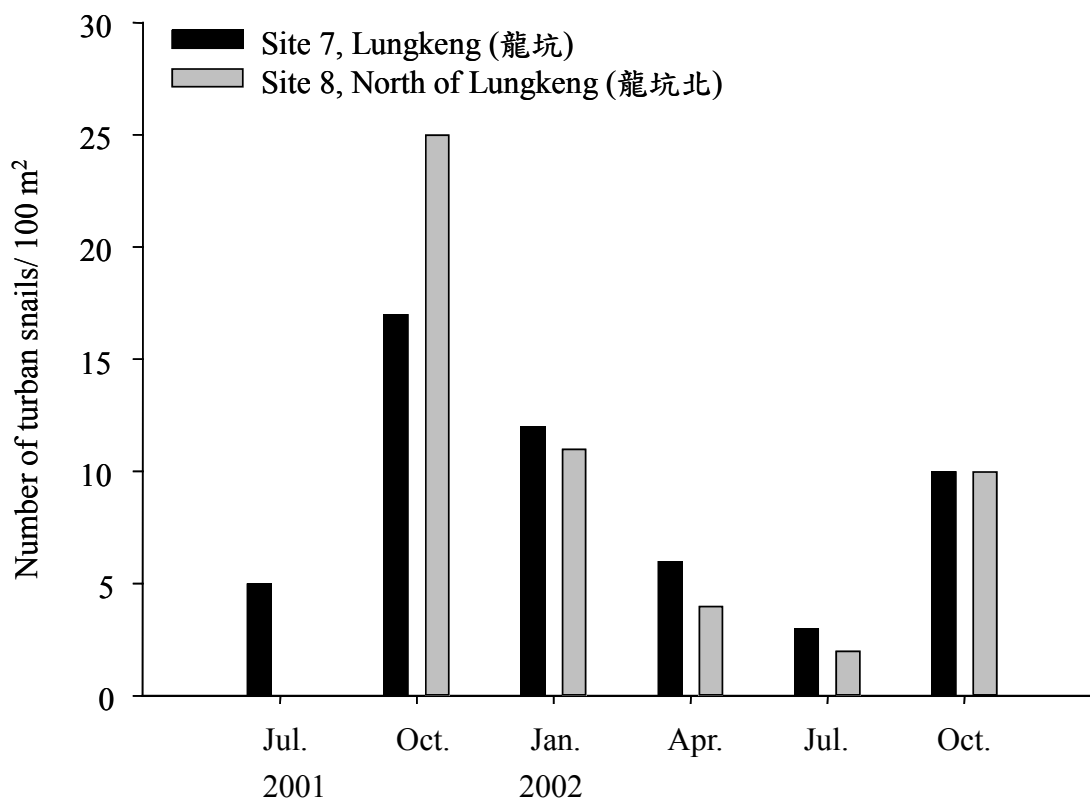


Fig. 3. The seasonal change of the densities of turban snails in Site 7 and 8 in Henchuen Peninsula, southern Taiwan.

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恆春半島潮間帶產之蝾螺種類與豐度

陳明輝^{1,5}、邱郁文²、Axel Alf³、宋克義⁴、李展榮¹

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摘要

作者於2001年7月至2002年10月間，每季在恆春半島九個測站之潮間帶進行蝾螺的種類與豐度的調查。這九個測站中，其中測站七和八位於龍坑保護區。此外，除了潮間帶的調查外，還利用浮潛、水肺潛水和訪查當地海產店以增加種類紀錄之完整性。本研究期間共紀錄到七種蝾螺。在密度調查中共紀錄到五種，分別為銀口蝾螺 (*Turbo argyrostomus*)、金口蝾螺 (*T. chrysostomus*)、圓蝾螺 (*T. setosus*)、台灣蝾螺 (*T. sparverius*) 和高腰蝾螺 (*T. stenogyrus*)，其中以圓蝾螺數量最多，佔所調查個體數之86.7% (n=120)。另外二個種類，其中貓眼蝾螺 (*T. petholatus*) 在潛水調查中有觀察到，而夜光蝾螺 (*T. marmoratus*) 則僅在海產店中發現。此外，芮氏蝾螺 (*T. reevei*) 在本研究調查期間並未紀錄到，但作者曾於1999年7月於測站二(萬里桐)紀錄到此種類。恆春半島潮間帶的蝾螺密度為0-25隻/100平方公尺，不同測站間密度有顯著差異 ($P=0.001$)，其中以位於龍坑保護區的測站七和八顯著高於其它各測站 ($P=0.001$)。

關鍵詞：豐度，食用性貝類，保護區，蝾螺

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1. 國立海洋生物博物館生物馴養組。
 2. 樹人醫護管理專科學校通識教育中心。
 3. University of Applied Sciences Weihenstephan, 91746 Triesdorf, Germany.
 4. 國立中山大學海洋生物研究所。
 5. 通訊作者。

Plate 1.

- 1a, 1b. *Turbo petholatus* Linnaeus, 1758 貓眼蝾螺
- 2a, 2b, 2c. *Turbo chrysostomus* Linnaeus, 1758 金口蝾螺
3. *Turbo stenogyrus* Fisher, 1873 高腰蝾螺
4. *Turbo reevei* Philippi, 1847 芮氏蝾螺
5. *Turbo argyrostomus* Linnaeus, 1758 銀口蝾螺
6. *Turbo setosus* Gmelin, 1791 圓蝾螺
7. *Turbo sparverius* Gmelin, 1791 台灣蝾螺
- 8a, 8b. *Turbo marmoratus* Linnaeus, 1758 夜光蝾螺

