

Sexual Reproduction in the Soft Coral *Lobophytum* sp. in Tung Ping Chau Marine Park, Hong Kong SAR, China

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Abstract. The reproductive biology of soft corals in Hong Kong has never been investigated. The soft coral genus *Lobophytum* is a carpet-like encrusting coral and is commonly found in Tung Ping Chau Marine Park, Hong Kong SAR. Three samples from five marked *Lobophytum* sp. aggregations were collected monthly from 16 Aug 2006 to 7 Jul 2007. Histological sections of each sample were prepared and their gonadal development was observed under the microscope. From the histological analysis of the samples, all colonies bore only eggs. As *Lobophytum* was reported to be gonochoric, all the colonies sampled were therefore female. Male colonies may be missed during sampling. Oocytes from the samples measured increased in mean (\pm SD) diameter from 116.5 \pm 18.8 μ m in Aug 2006 to 239.3 \pm 82.2 μ m in Jun 2007, and dropped back to 93.0 \pm 23.2 μ m in Jul 2007. This indicates that spawning of *Lobophytum* probably occurred in or before Jul 2007. The oocyte development appeared synchronized as shown in the simultaneous increase in their sizes. However, new oocytes likely developed before the release of the mature ones so that each cycle of development took more than one year to complete. Additional samples will be processed in order to confirm this initial observation.

Key words: *Lobophytum*, Reproductive Biology, soft coral, Hong Kong SAR, .

Introduction

Soft corals are one of the major components in coral reef worldwide aside from hard corals. They can increase the spatial heterogeneity in the reefs, which provide shelter to many other organisms (Jordan-Dahlgren 2002). Soft corals are rich in natural products (Blunt et al. 2005). They can protect and attack their neighbors and their bioactive compounds can be extracted for pharmaceutical and antifouling use. The structure of cemented large sclerites, called spiculate, at the basal part of *Sinularia polydactyla* can also contribute to reef-building (Schuhmacher 1997). Therefore, conservation of soft coral is an important issue, and studying its reproductive biology is one of the major steps to better understand its biology.

There are 29 species in 14 genera of soft corals in Hong Kong. They are mainly found in water from 3 to 20 m depth (Lee 2007). The number of investigations on soft corals in Hong Kong was limited. Previous studies examined their terpenoid contents (Zhang et al 1997; Zhang 2001), associated bacterial communities (Harder et al 2003; Dobretsov and Quan 2003) and distributions (Clark 1997; Fabricius and McCorry 2005; Lee 2007). No information on soft coral reproductive biology was available in Hong Kong.

The living range of soft corals is very wide. They are found from tropical to temperate regions and even

in the poles, as well as from shallow water down to the deep sea (Fabricius and Alderslade 2001). There are very few studies about the biology and ecology of soft corals in the sub-tropical region, where Hong Kong is located. Having quite a high diversity of soft corals in such a small place like Hong Kong, it is worthy to investigate Hong Kong soft corals to help fill the information gap in this region.

The reproductive biology of the soft coral *Lobophytum* was the focus of this study. There were some previous studies on *Lobophytum* reproduction in Japan, Australia and Taiwan (Yamazato et al. 1981; Michalek-Wagner and Willis 2001; Fan et al. 2005). Such being the case, the results in this experiment can be compared with those from the other areas in order to help us understand more about the potential inducing factor of spawning in soft corals. This project also provided baseline information about the reproductive cycle of soft corals in Hong Kong, which is essential for their conservation.

Material and Methods

Site and species descriptions

The study site, Lung Lok Shui, is located in Tung Ping Chau Marine Park, Hong Kong SAR. Tung Ping Chau is a relatively remote island in NE Hong Kong. It was designated as a marine park in 2001 to protect the high richness of coral communities around the

island (Lee 2007). On the Northeastern side of Tung Ping Chau Marine Park, the shore is sheltered so that hard corals are abundant. In contrast, the southeastern side is more exposed such that soft corals and gorgonians are more common. Nine species of soft corals were found in Lung Lok Shui (Lee 2007).

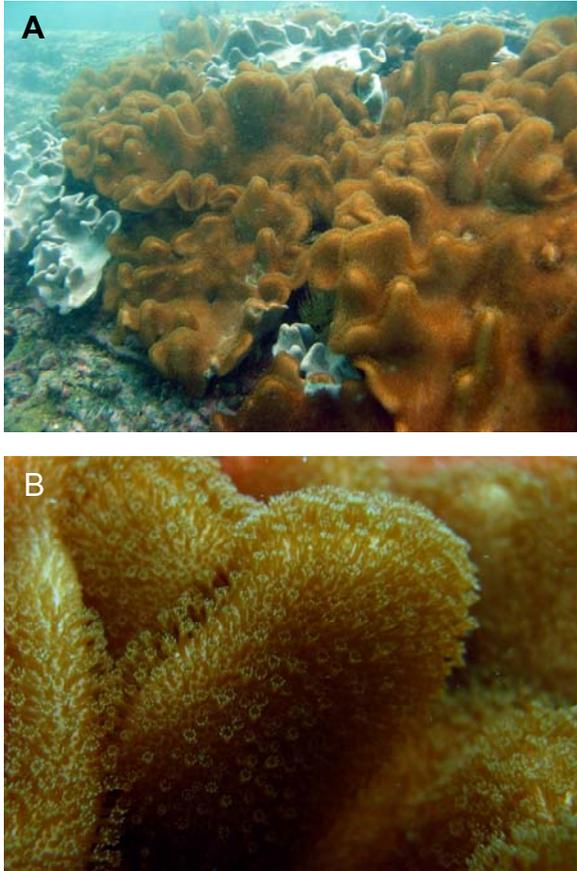


Figure 1: *Lobophytum*.sp. in Hong Kong: A. The thick-encrusting capitulum with lobes is yellowish-brown in color. B. Closed-up of capitulum showing the dimorphic polyps, in which only the autozooids bear gonads.

The genus *Lobophytum* is low-encrusting with a capitulum which bears polyps above its stalk (Verseveldt 1983). *Lobophytum* sp. is one of the most commonly found soft corals in Tung Ping Chau Marine Park. It is thick-encrusting with lobes and is yellowish-brown in color (Fig. 1). Being a zooxanthellate coral, it grows in shallower water, i.e., 6-11 m in Lung Lok Shui (Lee 2007). Sexual and asexual fissions were reported in *Lobophytum* (Fan et al 2005). It has dimorphic polyps, in which only autozooids but not siphonozooids bear gonads. They were reported to be gonochoric broadcaster (Yamazato et al 1981). Due to its relatively high abundance in the Marine Park, *Lobophytum* sp. was chosen to be the first soft coral in Hong Kong to be examined for its reproductive biology.

Collection and processing of the samples

Monthly sampling was done on *Lobophytum* aggregations in Lung Lok Shui. Five aggregations of *Lobophytum* were located in the site at 5-7 m depth. Assuming the colonies in the same aggregation to be derived from fission of a single colony, three small samples were cut from each aggregation each time. The samples were fixed in 10% formalin for 1 week and preserved in 75% ethanol afterwards. They were then decalcified and mounted in paraffin wax blocks. Thereafter, 7 μ m thick microtome sections were prepared for gonad examination. Hematoxylin and eosin were applied to stain the samples.

The sections mounted on slides were observed under light microscope. Photos were taken for the six largest oocytes in each sample. Their longest diameter and the corresponding perpendicular diameter were measured using a computer program Image-Pro Plus 5.0©. The geometric diameter of each oocyte was calculated by the square root of the product of the two diameters. The monthly variation in the oocyte size was plotted with temperature to investigate if the spawning time is correlated with the temperature increase in summer.

Results

Only female gonads were found in the samples (Fig. 2a). This did not contradict with the previous reports that *Lobophytum* is gonochoric (Michalek-Wagner and Willis 2001), yet could not be supported by this result firmly. No planulae were observed in the coelenteron of the samples investigated. Therefore, *Lobophytum* sp. in Hong Kong should be a broadcaster. This is consistent with the previous studies on *Lobophytum* reported in other places.

The color of the oocytes changed from white to pale yellow as they matured (Fig. 2b). The oocyte sizes increased from $116.5 \pm 18.8 \mu$ m in Aug 2006 to $239.3 \pm 82.2 \mu$ m in Jun 2007, and dropped back to $93.0 \pm 23.2 \mu$ m in Jul 2007 as shown in Fig. 3. Corresponding water temperature in each sampling date plotted in the same figure illustrates the relationship between temperature and gonadal development. Spawning likely occurred between June and July 2007, at a time when the water temperature was possibly the highest in the year.

Discussion

Spawning of *Lobophytum* sp. in Hong Kong likely occurred in Jun-Jul 2007. Long day-light and high seawater temperature in summer may be the inducing factors for *Lobophytum* sp. to spawn. Previous studies on the reproductive biology of *Lobophytum* in other areas showed the spawning period to be in July to September for *L. pauciflorum* in Nanwan Bay, Taiwan (Fan et al. 2005), June for *L. crassum* in

Okinawa, Japan (Yamazato et al. 1981), and November for *L. compactum* and *L. crassum* in the Great Barrier Reef, Australia (Bowden et al. 1985; Michalek-Wagner and Willis 2001). All these reported spawning events worldwide occurred during summer and were probably related to the longer daylight time and/or the higher water temperature in this period. It may be an adaptive feature for the genus *Lobophytum* to spawn during summer. Warmer water temperature in summer may be more favorable for increasing the survivorship of the recruiting new coral larvae.

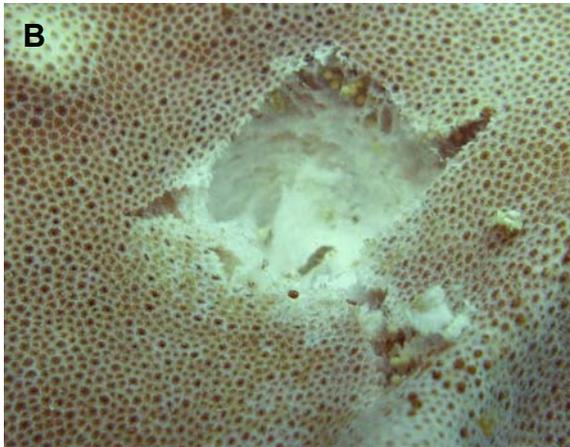


Figure 2: **A.** Section of the capitulum showing the female gonads and eggs. **B.** Color of the oocytes changed from white to pale yellow as they became mature.

Studies on reproduction pattern of hard corals in Hong Kong showed that *Platygyra acuta* (as *P. sinensis*) spawned in May (Liu and Ang 2002), *Favia speciosa* and *Favites abdita* in May-June, and *Leptastrea purpurea* in June-July (Lin 2003). All of these investigated hard corals also spawned in summer. The synchronized pattern of oocyte development of these soft and hard corals in Hong Kong appears to be under the control of these similar

factors. Hong Kong is located near the northern limit of coral distribution. Low water temperature in winter (14°C) is not favorable for coral growth. It is thus likely that most soft and hard corals have adapted to spawn in summer to avoid the cold winter water temperature which may also be unfavorable for the early development of their recruits. More investigations are needed to confirm that this is indeed the general trend for other soft coral species in Hong Kong.

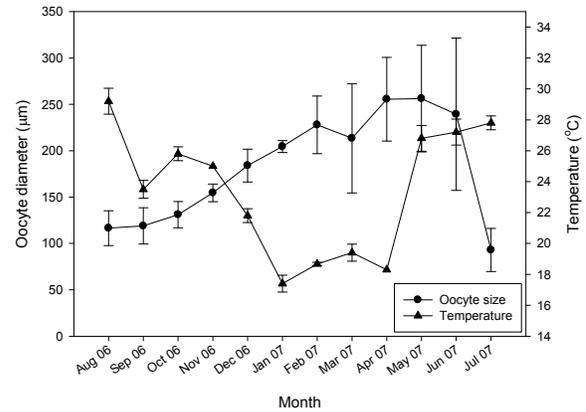


Figure 3: Changes in the mean size (\pm SD) of the oocyte over the sampling period. The corresponding mean (\pm SD) seawater temperature at each sampling date is also shown. Spawning of *Lobophytum* sp. likely occurred in Jun-Jul 2007.

The aggregations of *Lobophytum* sp. in Lung Lok Shui were sparsely distributed although there were plenty of uncolonized spaces in the substratum. In our study, only female colonies were found in this site. We hypothesize that some of these aggregated colonies were recruited from outside larval sources at the beginning, but the absence of male colonies would not allow more sexual recruits to be produced. Hence, there was no subsequent colonization of these free spaces by new recruitment. Asexual reproduction by fragmentation or fission becomes more important in forming separate dense aggregations to colonize the surrounding space. This hypothesis remains to be tested while we continue to search for the presence of male colonies in Lung Lok Shui as well as in other surrounding areas.

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