

Phenology of *Sargassum* spp. in Tung Ping Chau Marine Park, Hong Kong SAR, China

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Abstract

Eight species of the brown alga *Sargassum* have been recorded from Tung Ping Chau Marine Park in Hong Kong and the phenology of four of these was monitored from 1996 to 2000. All four species followed a typical growth cycle of *Sargassum* species reported elsewhere but with some annual variations. For *S. hemiphyllum*, the maximum mean (\pm SD) plant length, ranging from 38.5 ± 10.5 to 61.9 ± 19.9 cm, was recorded in January to March. The peak reproductive season was also mainly in February to March with up to 89% of the plants being reproductive. Some plants, however, remained reproductive until May. For *S. henslowianum*, the maximum mean plant length, ranging from 45.5 ± 25.5 to 77 ± 24.8 cm, was recorded mainly in November to January. The peak reproductive season was in November to February with up to 100% of the plants being reproductive. For *S. siliquastrum*, the maximum mean plant length, ranging from 48.2 ± 29.9 to 63.4 ± 22.1 cm, was also recorded mainly in January. The reproductive plants were found mainly between late December and mid February with up to 98% of the plants being reproductive. For *S. patens*, the maximum mean plant length ranging from 87.6 ± 62.4 to 118.7 ± 41.3 cm was recorded in January to March. Reproduction of this species was not monitored. Changes in water temperature over seasons were likely to be critical in affecting the phenological patterns of these species.

Introduction

Hong Kong is located on the southern coast of China. About 200 species of marine macrobenthic algae have been reported from this area (Ang, 2005). These algae are mainly distributed on the eastern shore and are characterized by both temperate as well as tropical species. Hong Kong algae were reported to exhibit a strong seasonality in their abundance (Hodgkiss, 1984). Most algae grow during the colder months from October to May, and disappear completely during the hot summer of June to September. This pattern is particularly true for the intertidal species. Information on subtidal algae, however, is very limited or almost non-existent. Until recently, there have been no detailed studies on the phenology of any algal populations within Hong Kong waters. This is partly because many of the areas where algal species are found are not readily accessible,

and partly because the interest in algal studies has been limited.

On tropical and subtropical coasts exposed to strong or moderately strong waves, brown algae of the genus *Sargassum* are usually dominant in terms of algal cover and standing crop. The coast around Hong Kong is no exception. This study is an initial attempt to examine the phenology of *Sargassum* populations in Hong Kong water in greater detail, to contribute to our general understanding of the Hong Kong marine environment. Many of the coastal areas in Hong Kong where *Sargassum* spp. are dominant are currently threatened by marine pollution and coastal reclamation projects. An understanding of the dynamics of these algal species is essential in providing baseline information to assess environmental impacts caused by coastal developments.

Most studies undertaken elsewhere have indicated that *Sargassum* populations have a seasonal cycle of

growth, reproduction, senescence and die-back (e.g. De Wreede, 1976; Ang, 1985; Largo & Ohno, 1992; Kendrick 1993). The timing of die-back, however, appears to vary according to species and locality. Tide has been suggested to be a critical factor in structuring the phenological patterns of two *Sargassum* populations from the Philippines (Ang, 1985). *Sargassum* died back at the time when lowest low tide of the year exposed the plants for a prolonged period. It is, however, not clear if the influence of tide plays a similar critical role in other *Sargassum* populations. Many *Sargassum* populations are found in the subtidal, i.e. they are never exposed to air. Questions remain as to whether these plants also exhibit seasonal die-back, just like their intertidal counterparts.

Materials and methods

This study was carried out in Long Lok Shui, on the western side of the island of Tung Ping Chau (114°26'E, 22°33'N), on the northeastern part of New Territories, Hong Kong (Figure 1). This island and the surrounding sea area are now a marine park. The study site is characterized by the presence of outcrops of sedimentary rocks, mainly shale, to which the marine algae are attached. Most of the algae are confined within the intertidal and shallow subtidal areas, extending to a depth of 10 m below Chart Datum. At least eight species of *Sargassum*, *S. angustifolium* (Turn.) Ag., *S. enerve* Ag., *S. fusiforme* (Harv.) Setch., *S. glaucescens* J. Ag., *S. hemiphyllum* (Turn.) Ag., *S. henslowianum* C. Ag., *S. patens* Ag. and *S. siliquastrum* (Turn.) Ag., may be found in the low intertidal to shallow subtidal, with the latter four species, *S. hemiphyllum*, *S. henslowianum*, *S. patens* and *S. siliquastrum*, being the most dominant.

The phenology of these four dominant *Sargassum* species was monitored. Biweekly to monthly visits to the site were conducted over the period of three and a half years, from November 1996 to June 2000, to study *S. hemiphyllum*, *S. henslowianum* and *S. siliquastrum* and from November 1997 to May 2000 to study *S. patens*. On each visit, 100 individuals of each of these four *Sargassum* species were haphazardly selected and measured. The maximum length was measured as the distance between the holdfast and the longest branch. For each individual, the presence or absence of reproductive structures (receptacles) was also noted. The peak reproductive season was considered to be the time when the highest percentage of the plants bore receptacles. All measurements

were done *in situ* by snorkelling or SCUBA diving.

Results

Over the three and a half year sampling period, *S. hemiphyllum* attained a maximum mean plant length (\pm SD), ranging from 38.5 ± 10.5 to 61.9 ± 19.9 cm, mainly in January to March (Figure 2A). The longest mean plant length was recorded in February 28 1999 and the longest plant recorded at this same time was 109 cm in length. The peak reproductive season was recorded also mainly in February to March with up to 89% of the plants being reproductive (Figure 2B). Some individuals may remain reproductive until May. The plants died back very quickly from March to May after releasing their gametes. New laterals started to emerge from the holdfast and grew very slowly from May to September, before starting their rapid growth phase in November. There is evidence to indicate that some individuals survived only for one year.

Based on monitoring of tagged individuals, *Sargassum henslowianum* was shown to be a perennial species (Ang, unpublished). Individuals of this species attained their maximum mean plant length (\pm SD), ranging from 45.5 ± 25.5 to 78.36 ± 27.63 cm, mainly in November to January (Figure 3A). The longest mean plant length was recorded in Nov 28 1998 with the longest plant of 169.9 cm also recorded then. The peak reproductive season was in November to February, with up to 100% of the plants being reproductive (Figure 3B). Die-back occurred from February to April, and new laterals from the holdfast grew slowly from May to September. Rapid growth took place from September onward. There were some annual variations in the time the plants attained their maximum size and their peak reproductive period. Individuals of this species attained their maximum length in January 1997 and January 1998, whereas they attained their maximum length much earlier in November 1998 and November 1999 in the subsequent annual growth cycles. The rapid growth period in both 1998 and 1999 appeared to be shorter by two months than that in 1997 (and presumably also in 1996). This variation was not obvious in other species. The reproductive period was also earlier and longer in 1999. There were apparently two peaks of reproduction and some plants were found to be reproductive in May to September 1999. There was also a shift in the onset of reproductive period with some plants becoming reproductive earlier in October