Chasing crayfish and bothering kelp in Otago Harbour.

Chris Hepburn, winner of the BSO prize for best student talk, Botany Sympsium 2002.

This talk was based on a section of my PhD research that was carried out in a kelp bed at the narrow entrance to Otago Harbour at Harington Point. The original aim of this work was to investigate the influence of suspension-feeding animals on the seaweed they live on, and to enjoy the occasional crayfish meal. Unfortunately not one crayfish was found at the study site throughout the study period (despite exhaustive investigations), instead we had to entertain ourselves tagging and collecting seaweed

The giant kelp *Macrocystis pyrifera* was chosen as the subject of this study primarily because of its abundant and diverse epifaunal community. *Macrocystis* is the dominant kelp found at Harington Point and is probably the most ecologically important seaweed in southern New Zealand. It is found in both southern and northern hemispheres and is probably the most widely studied of all seaweed species. *Macrocystis*, perhaps best known for forming the offshore kelp forests of California, is the largest (greater than 30 metres long), and one of the fastest growing of all seaweeds. Large brown seaweeds (kelp) like *Macrocystis* are the most important primary producers of temperate inshore areas. Through detrital pathways (kelp are rarely eaten directly) they provide the base to many inshore ecosystems. The presence of *Macrocystis* on a solid substratum in shallow water results in the formation of a unique and highly productive ecosystem, the kelp forest. This ecosystem provides both food and shelter to juvenile fish and provides a habitat for economically important species like crayfish and paua.

Analogous to the large numbers of animals found on trees in a tropical rainforest, *Macrocystis pyrifera* forms an extensive canopy that is colonised by a wide range of sessile and mobile epifauna. Animals such as copepods, hydroids, bryozoans, clingfish, anemones, pipefish etc. all gain advantages from their association with seaweed. These animals spend the majority of their life either attached to or closely associated with a seaweed substratum. Probably the dominant group found on the surface of *Macrocystis* in Otago Harbour are sessile suspension feeders, the most common being the bryozoans and the hydroids. These animals gain many benefits from their close association with the giant kelp including kelp-derived, dissolved organic matter as a supplement to their diet, a more favourable feeding environment (higher flow rates than on substrate) and a refuge from the high sedimentation rates and competition of the benthos.

Many authors have commented on the effect of epifauna on seaweeds, most assuming that high numbers of sessile animals living on the surface of seaweeds have a negative effect on their substratum. Costs to algae as a result of colonisation by encrusting epifauna can include shading, providing a barrier to nutrient uptake, damage and weakening of tissue, and damage as a result of the feeding activity of carnivorous fishes (eating attached epifauna). There is, however, some compelling evidence to suggest that epifauna can have a positive influence on their substratum in some environments. One important fact about epifauna is that they excrete ammonium. Ammonium is an important, easily assimilated source of nitrogen and during certain times of year growth of kelp like *Macrocystis pyrifera* is often nitrogen limited. It has

been suggested that ammonium from epifauna may help reduce the effects of nitrogen limitation by providing a back up source of nitrogen when ambient levels decline.

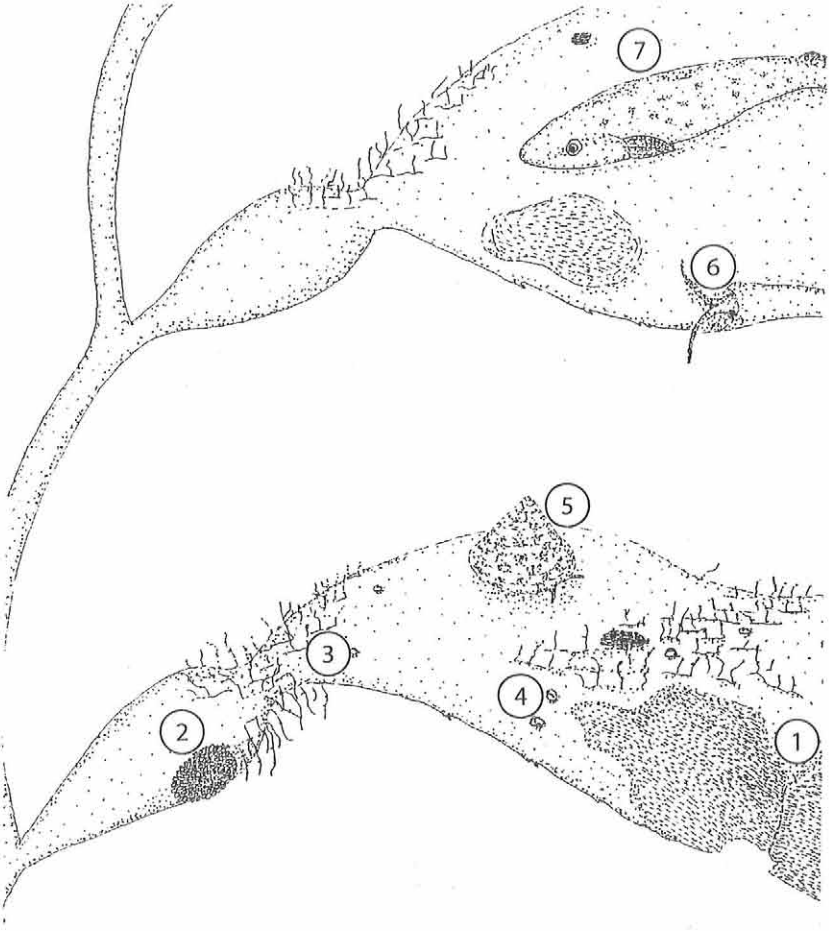

Fig. Common animals found on *Macrocystis pyrifera* at Harington Point.

1 *Membranipora membranacea* (Bryozoan). **2** *Celleporella bathamae* (Bryozoan). **3** *Obelia geniculata* (Hydroid). **4** Spirorbid polychaete. **5** Top Shell. **6** Isopod **7** Clingfish...

Drawn by *Chris Hepburn*

The main objective of this work was to weigh up the possible benefits, against the potential costs, of colonisation by the two dominant suspension feeders groups, bryozoans and hydroids, that live on *Macrocystis* in Otago Harbour.

In Otago Harbour *Macrocystis pyrifera*'s growth is nitrogen limited during the summer and light limited during winter as is typical for kelp at higher latitudes. During winter ambient nitrogen concentrations are high so ammonium provision by epifauna could be predicted to be unimportant, and negative effects of colonisation in particular shading could be more pronounced. From patterns of colonisation it became clear that hydroid colonies were much more likely to provide *Macrocystis* with benefits than bryozoans predominantly due to differing patterns of seasonal colonisation. Bryozoans just were not common during summer while hydroids, although numbers were highly variable, were sometimes found in very high numbers during summer. Low numbers of bryozoan colonies on *Macrocystis* during summer were attributed to low recruitment rates during periods of warmer water temperatures. This is suggested to be a result of avoidance of warm surface water by the larvae of the dominant bryozoan species (*Membranipora membranacea*) by maintaining themselves in cooler deep water beneath the seasonal thermocline. Bryozoans were also rarely found on apical sections of fronds where the most rapid uptake of nitrogen and the majority of growth occur while hydroid colonies were found all along the frond.

By determining natural abundances of the nitrogen isotopes ^{14}N and ^{15}N in algal tissue beneath bryozoan colonies, it became clear that bryozoan colonies present during summer did appear to be providing nitrogen to *Macrocystis*. The isotopic signature of nitrogen beneath bryozoan colonies was quite different to adjacent bryozoan-free kelp tissue, a clear indication of a different nitrogen source for colonised tissue. However, due to the low levels of bryozoan colonisation at this time it is unlikely that this nitrogen had any significant effect on *Macrocystis* growth at this site.

Despite evidence that bryozoans provide nitrogen to *Macrocystis pyrifera*, their seasonal distribution patterns at Harington Point over the study period makes it unlikely that they provide enough ammonium to have any effect on nitrogen limitation. During years when summer seawater surface temperatures are low or at sites where summer water temperatures are lower than Otago Harbour, bryozoans could still be an important nitrogen source. Hydroids are much more likely to be a nitrogen source to *Macrocystis* during nitrogen limitation in Otago Harbour. Evidence from seasonal growth patterns of *Macrocystis* at Harington Point supports this idea. During January 2000 a growth response was detected as a result of a large colonisation event when hydroid colonies covered on average 61% of *Macrocystis* blade tissue. It can be concluded that it is important to determine both seasonal and spatial patterns of colonisation, and when periods of nitrogen limitation occur, before making assumptions about what influence an epifaunal animal will have on its algal substratum.

Note –Abstracts of the other contributors to the Botany Student Symposium will be published in the Feb-March newsletter. – *ed.*