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A round-up of activities on research collaboration and technology transfer at the National University of Singapore

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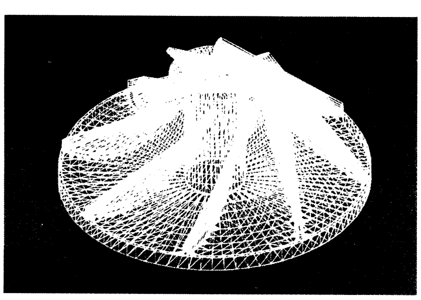
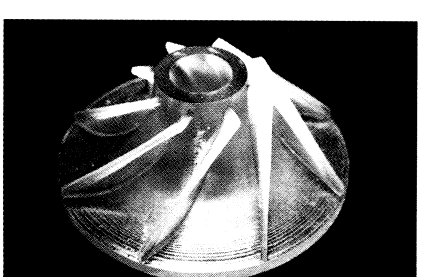


Triangulated CAD model of Impeller Blade



Rapid Prototype of Impeller Blade

Bringing Life Back to the Ocean

Environmental pollution and offshore reclamation are just two of Man's activities which have resulted in a constant erosion of natural reefs around the world. Reefs are the habitat of a variety of fish and other marine life and are important in maintaining the overall ecological balance.

Singapore has lost an estimated 60% of its coral reefs and still risks losing the remainder. Man-made artificial reefs are designed to encourage growth of naturally occurring reef organisms when placed in suitable sites. If successful, these reefs would provide a substitute habitat for such organisms and thus would encourage the aggregation of fish and other marine life in the area.

Artificial reefs may be made of tyres or of concrete.

Fig. 1. Variation of percentage cover of sessile organisms at the concrete artificial reef between 1989 and 1994

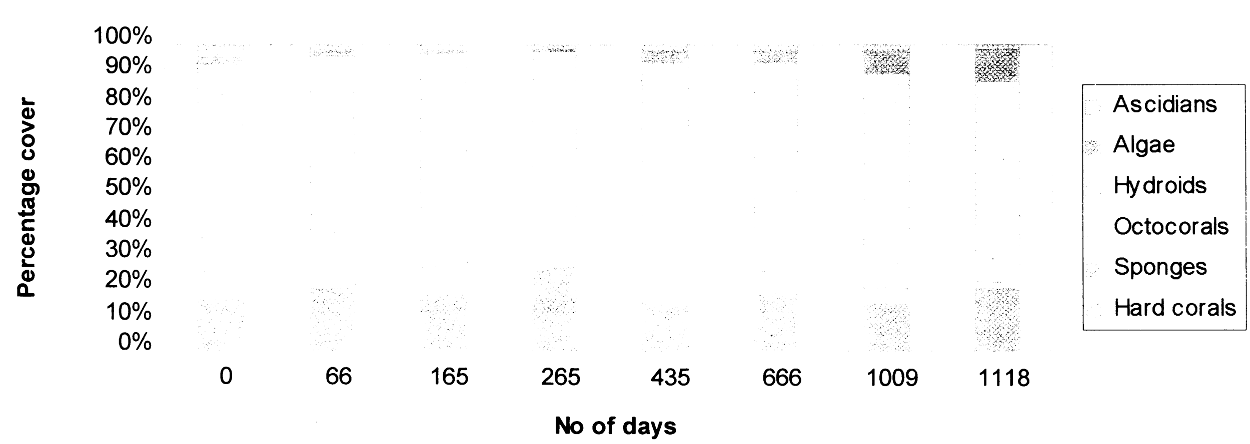
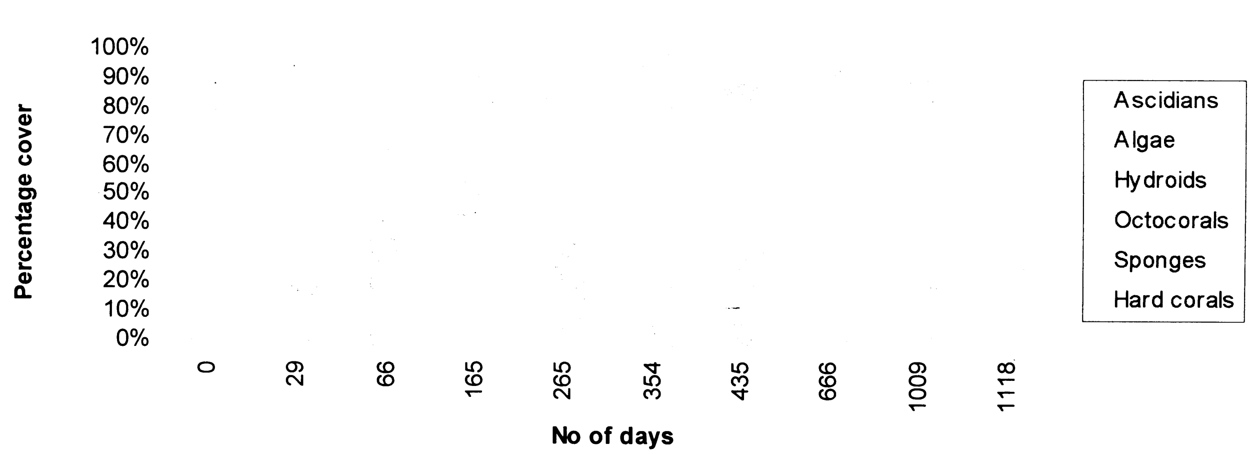


Fig. 2. Variation of percentage cover of sessile organisms at the tyre artificial reef between 1989 and 1994



A pilot artificial reef programme was established on the seabed off Pulau Hantu in 1989, to study the effectiveness in enhancing the environment in sedimented waters. The objectives were to compare between two materials (tyre and concrete) in encouraging growth of encrusting organisms; to assess the changes in biodiversity and abundance at the two types of reefs; and to compare development of fish populations between the artificial reef and the natural reef.

The development of encrusting organisms was monitored through close-up photography of sections of the artificial reefs. The transparencies were then projected onto a grid screen and the number of species and their frequency were recorded. The sessile organisms were categorised into major phyla (e.g. polychaete, algae). The fish community was monitored using a visual census technique (English *et al.*, 1994). All the fish observed at the artificial reefs were identified to species and their numbers recorded. These surveys were conducted on a three-monthly basis.

Sessile organisms were observed to favour the concrete substrata over the tyres. Up to 25% of the tyre substratum remained uncolonised in 1994, while the concrete substratum was 100% colonised. 10 groups of colonisers were recorded from the concrete substratum, with only 5 from the tyre substratum. The 5 groups of sessile organisms common on both substrata were the hydroids, sponges, octocorals, algae and ascidians. Bryozoans, molluscs, polychaete tube worms and ahermatypic and hermatypic corals were recorded at only the concrete substratum, but areal cover was low.

Hydroids showed consistently high cover on both substrata (Figs. 1 and 2). Sponges occupied 47% on the concrete and 19% on the tyre. Initial cover of concrete by hydroids was high, but percentage cover decreased in later surveys to 40%. Octocoral growth was variable, ranging from 1% on the tyre, to 42% on the concrete. Algal cover was also variable, averaging 4% at each substratum. Ascidian cover was low, averaging 13.9% at the concrete and 2.9% at the tyre. Hard coral cover was less than 1%. No seasonal or temporal variation in cover was apparent.

A total of 68 fish species from 26 families were recorded at both artificial reefs - 55 species from 22 families at the concrete and 49 species from 24 families at the tyre reef. 36 species from 18 families were common to both structures, while 19 species from 11 families were unique to the concrete reef and 13 species from 10 families were unique to the tyre reef. Linear regression analysis of abundance and richness showed significant increases ($p<0.05$) at both reefs (Table 1). Fish densities were significantly higher at the concrete reef than the tyre reef ($p<0.05$), as with species density.

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Table 1 Summary of fish abundance and diversity at the artificial reefs (September 1989 to January 1996)

Reef	Mean density (abundance/m^2)	Linear regression coefficient	Mean species density (species/m^2)	Linear regression coefficient
Concrete	2.13*	0.108	0.59*	6.04×10^{-5}
Tyre	0.67*	0.0508	0.29*	3.44×10^{-5}

* indicates significant differences between reefs

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Resident species accounted for 33% of the fish population at both reefs. Most of the resident species were common to both reefs. A damselfish, *Neopomacentrus azysron*, was the most abundant at both reefs. Species prominent at the concrete reef were *Selaroides leptolepis* and *Apogon fucata*, while at the tyre reef, *Pempheris* spp. and *Sphyraena flavicauda*.

The artificial reefs have increased the diversity and abundance of fishes at this once barren sea floor within a few years. Fish species richness was similar to the lower reef slope of the adjacent natural reef. There is evidence to suggest that the artificial reef community is reaching a state of equilibrium and further surveys will ascertain this.

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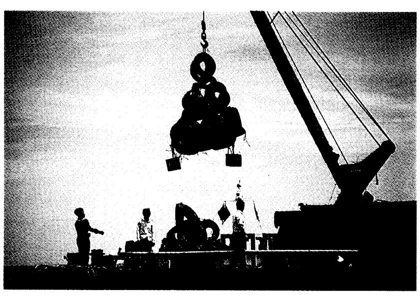
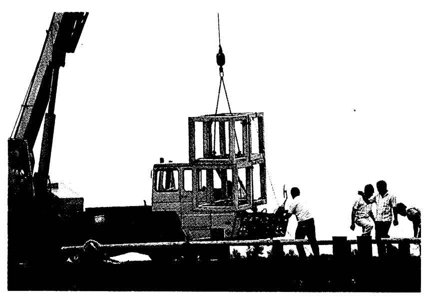
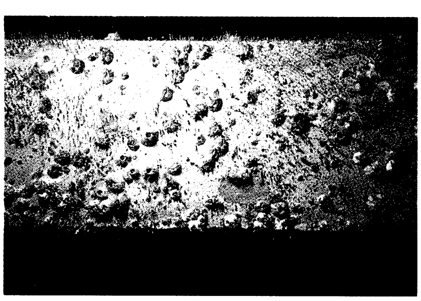
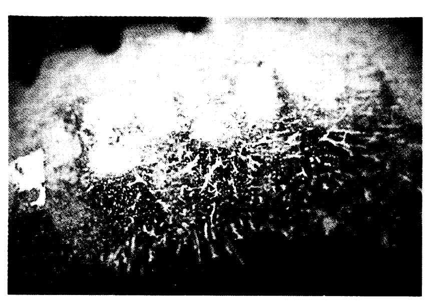
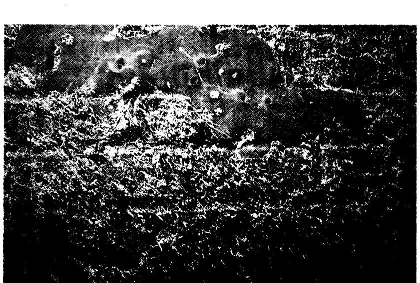
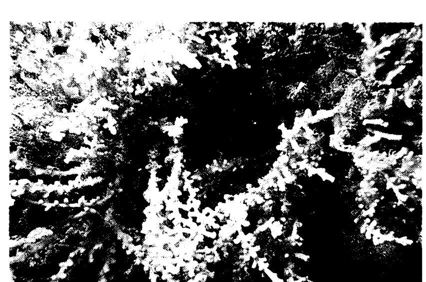



The tyre or concrete modules are brought to the site and lowered into position.

Within a few months, barnacles and algae have started to establish themselves.

In the space of a few years, there was prolific growth on the artificial reefs.

INTROLinks is published by the Industry and Technology Relations Office, the University's one-stop information and service centre for industry and organisations seeking collaboration in research and technology transfer.

Contributions from readers in the form of articles, comments, letters or suggestions are welcome.

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