Great Barrier Reef Marine Park Authority

Reef HQ Aquarium Intern Report

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Curatorial and Research Intern, April 2012

GENERAL INTRODUCTION AND ACKNOWLEDGMENTS

I commenced my internship here at Reef HQ Aquarium six months ago and knew little about tropical marine biology, having come from the much cooler temperate waters of southern New South Wales. During my time at Reef HQ Aquarium, I have had the opportunity to immerse myself in tropical marine biology and learn some of the techniques used to research, monitor and conserve the Great Barrier Reef. My skills and confidence in diving and animal handling have also grown rapidly over my time here. Some of the highlights have been presenting a predator dive show, turtle releases, feeding the elusive baby hammerhead and attaining strong results in the coral feeding experiment - an experiment that was almost scrapped after six-months because of vague results.

I had three core experiments over the course of the internship. The first two – the coral feeding experiment and the zooplankton concentration experiment – gave useful and comparable results; these experiments form the rest of this report. The third experiment was a coral propagation experiment (Fig.1a), conducted as part of a PhD project for an AIMS student, Sebastian Schmidt-Roach. The aim was to obtain brooding coral planulae (Fig. 1b), and eggs/sperm from the cauliflower coral *Pocillopora damicornis*. After five-months, brooded coral planulae of Type B were finally collected (novel research has suggested that *P. damicornis* has a variety of morphologies and breeding patterns and should perhaps be considered more than one species (Jokiel, Ito & Liu 1985)), which coincided with the new-moon phase of the lunar cycle. Previous failures in this experiment were probably due to reabsorption of larvae from coral stress, and settlement of larvae in response to algal cues before the morning-check of the larval traps.

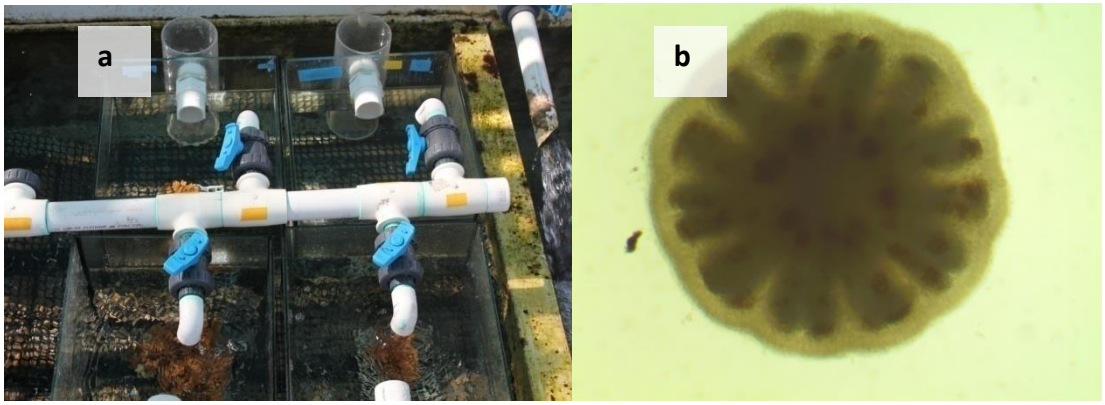

Fig. 1 a) The initial experimental set-up for the coral propagation experiment and b) a brooded coral larva of *P. damicornis* under a compound microscope (4 ×).

Additionally, I had many smaller projects, many of these unsuccessful or provided non-results. These included capturing broadcast spawned egg/sperm bundles for assisted propagation experiments, a time series of coral feeding on *Artemia salida* and *Artemia* replacement feed, and the initial design of an experiment of a JCU PhD student which aimed to identify the trophic transfer of the ciguatera toxin from dinoflagelates to copepods and fish.

I would like to give a sincere thankyou to all the Reef HQ staff that have been very supportive during my time here. In particular I would like to thank Mike Shanahan who has been quick to help with resources that I have needed for the research projects and for advice on career prospects in the tropical north. Also I'd like to thank Craig Mcgrogan for giving me opportunities outside of my role as intern.

Feeding Highly Unsaturated Fatty Acid *Artemia* Replacement Diet on the Growth Rates of Three Scleractinian Coral Species

Fig 1. Differences in size between the unfed (left) and fed (right) colonies of *P. damicornis*

ABSTRACT: The relative role heterotrophic nutrition plays in the diet of scleractinian corals remains unclear, as most of their dietary needs are met through autotrophy via their symbiotic zooxanthellae. Three species of coral, *Pocillopora damicornis*, *Acropora valida* and *Acropora millepora* were fed with highly unsaturated fatty acid (HUFA) *Artemia* replacement diet once a day for 9-months. There was a marked and significant increase in the skeletal growth rate in the fed group compared to the unfed (control) group after the first 6-months of feeding, particularly in the growth rate of *Pocillopora damicornis*. Supplemental feeding in aquaria may, therefore, assist coral in meeting their metabolic demands and contribute to the health and husbandry of their colonies.

INTRODUCTION

Corals are polytrophic consumers with nutrients and energy obtained through a symbiotic relationship with zooxanthellae and by heterotrophic feeding ingested via their polyps. Although nourishment through symbiosis has been well researched, the degree which species depend on heterotrophic feeding for their metabolic needs remain uncertain and vary among species. Food ingested through heterotrophic feeding is acquired from numerous sources including phytoplankton (Fabricus, Yahel & Genin 1995), bacteria (Sorokin 1973), particulate organic matter and zooplankton (Sorokin, Sorokin 2010).

In aquariums, maintaining healthy organisms support one of the main objectives of aquariums world-wide: to endeavour to be self-sufficient, therefore reducing collection trips. However, the husbandry of coral presents various challenges, including but not limited to, algal fouling, translocation stress and water-temperature bleaching; and supplementing their diet may buffer against such detrimental effects. Further, aquaria often have a paucity of zooplankton, removed from the water from operational filters and voracious foraging of fish (Bondarenko 2010).

Reef HQ Aquarium, the world's largest coral aquarium (Anthony, Thomas 2008), was established as an education centre to mirror some of the marine diversity found on the Great Barrier Reef. Successful husbandry of the coral in this large *ex situ* system is imperative to the operation of the centre and presents a complex challenge because of the careful regulation of water quality parameters involved. Part of the challenge is maintaining plankton abundance levels similar to that which occurs on the Great Barrier Reef. Despite successful husbandry of many coral, and propagation of some coral species, collection trips are still required to sustain colony numbers in the tanks. Since zooplankton concentrations in the main coral tank have been recorded as continually low, supplementing the tank with feed may increase the growth and health of coral, and therefore assist the facility in achieving its goal of being self-contained.

The overall objective of this study was to determine if coral health benefits from supplementary feeding. Specifically, I aim to determine if there is difference in the rate of growth between corals fed with HUFA *Artemia* replacement diet and those that are kept unfed.

MATERIALS AND METHODS

Coral specimens

The coral colonies were collected from Bramble Reef, Great Barrier Reef (18° 25' 0 S, 146° 41' 60 E). Coral species were selected based on their relative success in husbandry at Reef HQ Aquarium, or their response to supplemented feeding in previous research. Three common species of hermatypic corals were chosen for the project which included: *Acropora valida*, a species that has been kept successfully at Reef HQ Aquarium but is unknown in its response to coral feeding experiments; *Acropora millepora*, which has had little husbandry success at Reef HQ Aquarium and it is unknown how it reacts to supplemented food; and finally *Pocillopora damicornis*, which has become a reference species for coral feeding experiments and had successful husbandry at Reef HQ Aquarium (Table 1).

Table 1. Previous husbandry success and response to supplemental feeding for the selected corals

Coral species	Husbandry success	Response to supplemental feeding
Acropora valida	Successful	Unknown
Acropora millepora	Unsuccessful	Unknown
Pocillopora damicornis	Successful	Strong response

Experimental Design

Two refugia tanks (2.8 meters length × 0.9 meters width × 0.7 meters depth) were used for the experiment. Each tank was subject to the same environmental and physical factors (Table 2), with the water pumped through the refugia recirculated through the 2.5×10^6 l coral tank.

Table 2. Water quality parameters in the two refugia.

Water quality parameter	Range
Temperature(°C)	20.7 – 28.0
Salinity (ppm)	33.0 – 37.4
pH	7.82 – 8.10

Nubbins were tied to nylon fishing line and suspended individually from plastic tubes that ran the length of the tanks. Both tanks contained 20 nubbins of each species that were assorted randomly along the plastic tubes. Suspension of the nubbins was selected over other techniques (such as substrate attachment) in an effort to reduce biofouling. Nevertheless, filamentous algae quickly fouled the line and occasionally the coral, and had to be consequently the lines were cleaned every second day. Each nubbin sat ~ 10cm deep in water and ~ 3cm apart.

In one tank, coral were fed 7.6g of HUFU *Artemia* replacement diet (ArteMac, Bio-Marine©), an amount estimated suitable to reach saturation of the nubbins for the feeding period. Half the weight of dried feed was of the particle size (20 - 60 µm) and the other half were of the particle size (80 - 120 µm). The feed was mixed with 1l of saltwater. The inlet of water into the tanks was closed 10 minutes prior to feeding of the coral until 10 minutes after feeding. The remaining tank served as a control tank where no coral were fed.

Buoyant Weight Technique

The buoyant weight technique, as described by (Jokiel, Maragos & Franzisket 1978) is an accurate technique to measure the skeletal weight (aragonite) of coral. In *Pocillopora damicornis*, skeletal material consists of 99.9% aragonite (Wainwright 1963). The technique employs Archimedes' Principle that the weight of an object in air is equal to the object's weight in a liquid medium plus the weight of the liquid medium plus the weight of the liquid displaced by the object.

$$W_a = \frac{W_W}{1(D_W * D_a{}^{-1})}$$

D_w= density of the buoyant fluid used in weighing (sea water)

D_a= density of the skeletal material (aragonite) = 2.93 g/cc

W_a= total dry weight of skeletal material (aragonite)

W_w= measured buoyant weight of specimen

To determine the sea water density, the State of Seawater equation was used (UNESCO 1994). The seawater density was similar for each date the coral were weighed (Table 3). Measuring skeletal weight is more accurate than other methods (such as colony size estimates); a pilot study revealed 60% of the net weight is composed of living coral tissue, water and mucus (*personal observation*).

Table 3. Salinity, temperature and water density during the dates of coral weighing.

Date	Salinity (ppt)	Temperature (˚C)	Density (g cm^{-3})
01/04/2011	33.5	25.4	1.022
01/07/2011	33.8	21.7	1.023
01/10/2011	36.6	28.3	1.023
01/01/2012	35.4	27.5	1.023

All nubbins were weighed with a modified *Sartorius* analytic balance before the commencement of the experiment, and weighed every 3-months thereafter. Nubbins were weighed three times to calculate the mean.

Statistical Analyses

A simple analysis of variance (ANOVA) was used to determine if the was differences between the fed group and control group at every 3-months. To ensure there was no significant difference between the fed group and control group at the commencement of the experiment, some nubbin weight data was not included in the analyses. Additionally, since mortality of some colonies occurred throughout the course of the experiment which often resulted in unequal numbers of nubbins in each tank, individual nubbins were randomly selected and their weight data was not analysed to ensure a balanced design.

RESULTS

Growth rates of Pocillopora damicornis

Pocillopora damicornis showed a striking increase in skeletal growth between the fed and the unfed group; growth rates in the fed group increased at over twice the rate of the unfed group (Table 4, Fig.2). The fed group was ~11 times greater than its original weight over the nine-month period, whereas the unfed group was only ~4.5 greater than its original baseline weight. Most of the increase in skeletal growth occurred after 6-months from the commencement of the experiment.

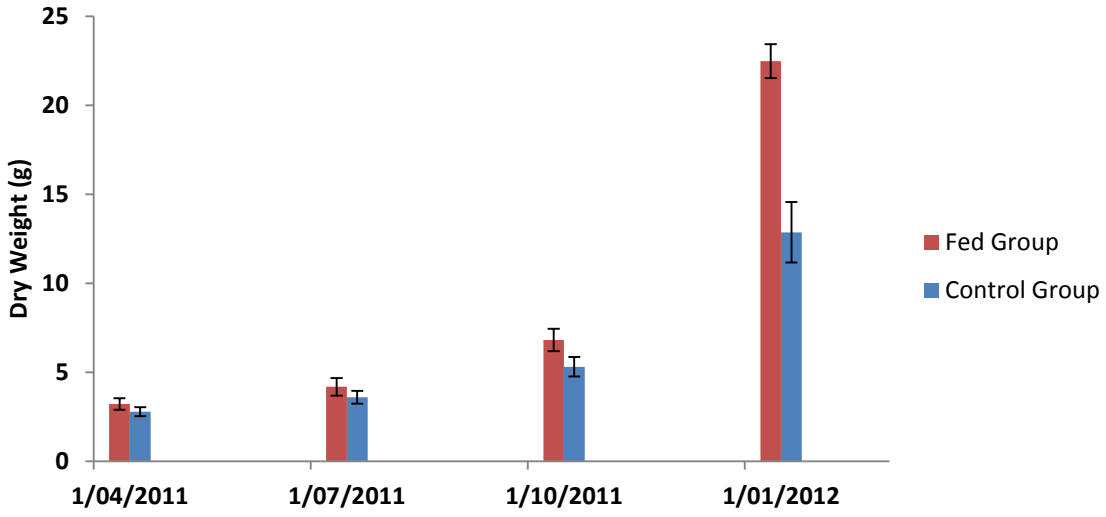

Fig. 2. Dry weight of the fed group and the unfed group of *Pocillopora damicornis* during nine-months.

Growth rates of Acropora millepora

There was statistically significant difference between the fed group and the unfed (control) group in *Acropora millepora* (Table 4, Fig. 3). Similar *to P. damicornis*, most of the increase in skeletal growth occurred within the last 3-months of feeding with the fed group accelerating at ~1.5 times faster than the unfed group. *A. millepora* grew at a similar rate to the fed *A. valida* colonies but not as rapidly to *P. damicornis*.

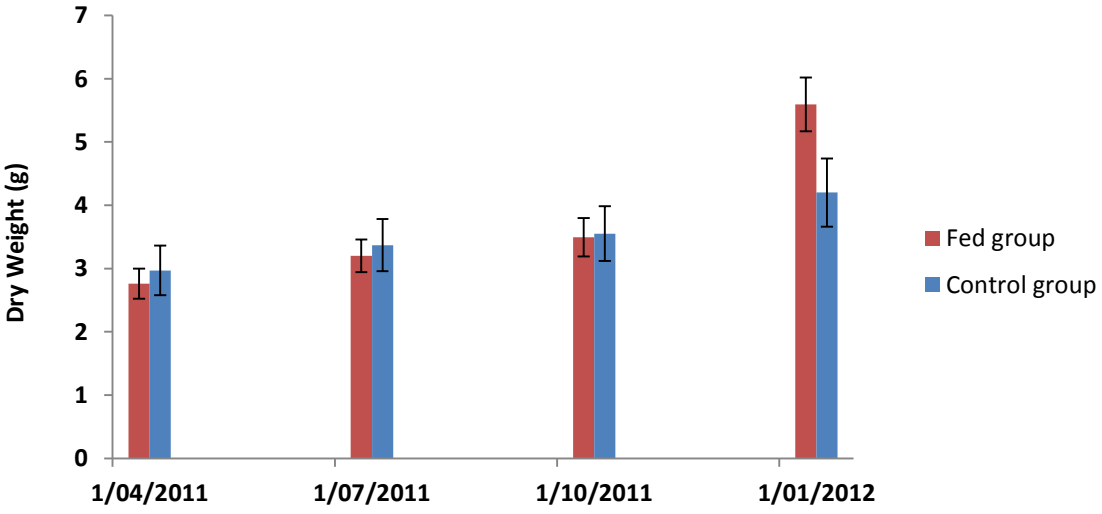

Fig 3. Dry weight of the fed group and the unfed group of *Acropora millepora* during nine-months.

Growth rates of Acropora valida

Fed *Acropora valida* were significantly greater in skeletal weight than the control group after the 9-months of feeding (Table 4, Fig. 4). The fed group accelerated at ~1.25 the speed of growth of the unfed group. *A. valida* had a similar rate of growth to the other *Acropora* spp., *A. millepora*, but both had a modest growth rate in comparison to *P. damicornis*.

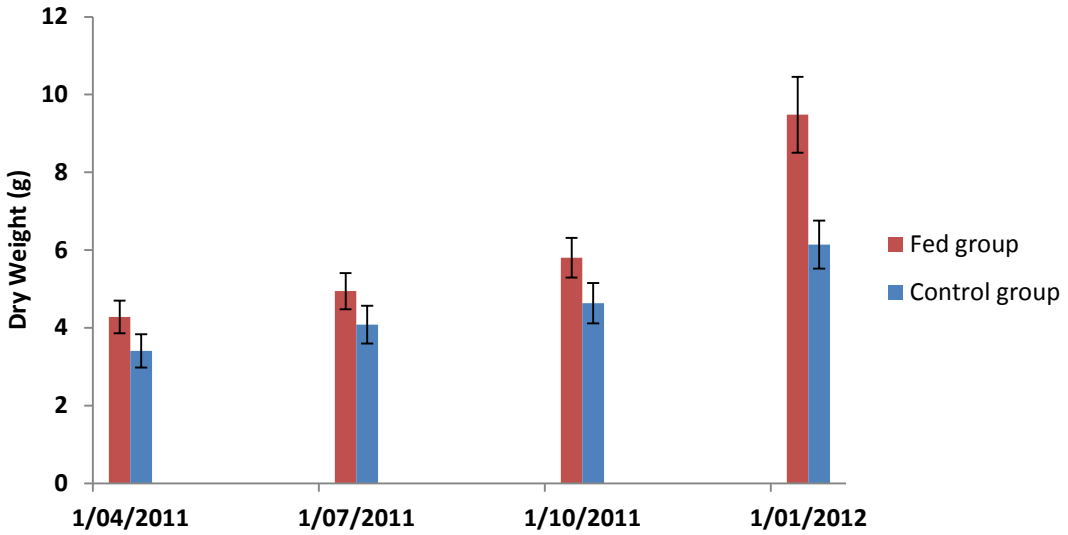

Fig. 4 Dry weight of the fed group and the unfed group of *Acropora valida* during nine-months.

Table 4. The effects of feeding on the skeletal weight of *P. damicornis*, *A. millepora* and *A. valida* after three, six and nine months.

		After 3-months		After 6-months		After 9-months	
	d.f.	F	P	F	P	F	P
P. damicornis	1	1.04	0.32	2.09	0.16	12.28	<0.01
A. millepora	1	0.12	0.73	0.07	0.79	5.38	0.03
A. valida	1	1.65	0.21	2.57	0.12	8.36	<0.01

d.f., degrees of freedom; F, F-ratio; P, P-value.

DISCUSSION

All of the fed groups of each species of coral showed considerable growth compared to the unfed control groups, particularly after 6-months from the commencement for the experiment. Unlike *P. damicornis*, which has been shown to respond well to assisted feeding (Lavorano 2008), there has been no known experiment of *A. millepora* and *A. valida* response to assisted feeding and thus I assume these findings are novel. However, *P. damicornis* grew at a striking rate compared to the *Acropora* spp. It is likely that the morphology of *P.* damicornis by its network of branches may have helped to contribute to this growth, since increased surface area would provide more space for polyps. In contrast, the *Acropora* spp. lacked braches thus their number of polyps would be fewer.

Increased polyp numbers in the fed group could form a possible feedback mechanism on colony growth rates. In the contrary, unfed coral with less growth would develop fewer polyps thus limiting their growth rate. Therefore, it is expected the fed group would accelerate in growth at a more rapid rate than the unfed group, just from differences in polyp numbers once initial growth occurs.

The increase in growth rates is supported by previous work conducted on coral feeding experiments; differences between the fed group and the control groups were not pronounced until after ~4 months (Lavorano et al. 2008). Indeed, most of the growth occurred in the last 3-months of the experiment. Had the experiment been continued, it is expected the fed group would continue to increase.

Greater mortality of colonies occurred in the unfed group compared to the fed group (*personal observation*); indicating fed groups are more resilient to environmental, competition and predation pressures. A clear example was that the unfed group suffered from biofouling of algae more regularly than the fed group.

A final observation was noted during this experiment. In the refugium of the fed coral group, nubbins of *P. damicornis* were found on the refugium walls. The nubbins indicated planulation of the fed colonies; subsequently the fed corals were used for coral propagation experiments, releasing high concentrations of planulae. It would be interesting to determine if there is a link between heterotrophic feeding and planulation rate in brooding corals. Heterotrophic feeding may increase the essential nutrients or energy required for the highly intensive exercise of planulation.

The use of HUFA *Artemia* replacement feed presented a convenient and cost-effective alternative to other feeds such as *Artemia*, rotifers and copepods. Other feeds often require greater than one day preparation to hatch and are bought at a greater price. Further studies could compare growth rates between HUFA *Artemia* replacement feed and other feeds to determine which feed yields the most rapid growth and supports maximum health of coral colonies.

In conclusion, the use of HUFA *Artemia* replacement feed provided accelerated growth rates in all coral colonies. The benefit of supplemental feeding during the most vulnerable stages of colony growth ultimately increases the resilience and health of colonies, and could play an important role in husbandry of corals in aquaria systems.

Diel and Depth Patterns of Plankton Concentrations during a Summer Creek-water Intake Cycle at Reef HQ Aquarium Aquarium

Fig 1. A planktonic crustacean found in the Coral Reef Exhibit tank of the class Ostracoda

ABSTRACT: Despite the limited volume size of water in aquarium tanks, zooplankton abundances in large tanks are expected to reflect the highly variable nature of planktonic assemblages occurring in the wild. At Reef HQ Aquarium, the world's largest coral aquarium, zooplankton numbers are likely to be regulated by the same forces present in the adjacent Ross Creek and to some extent, the Great Barrier Reef. To determine a quantitative representation of daily depth and seasonal patterns of plankton concentrations, I added to existing preliminary data by sampling during the night, at depth, and during the summer months. Preliminary zooplankton sampling did not show any clear diel or depth patterns. However, sampling during a creek water intake cycle showed zooplankton concentrations in summer were similar to previous concentration found during winter months, with great numbers of copepods and nauplii in the samples in the holding tank during recirculation. Comparatively, zooplankton numbers during the creek water intake were very great compared with nearby wild population and more importantly, zooplankton concentrations within the main aquaria tank, the Coral Reef Exhibit, were comparable to at least the lower ranges of concentrations that occur on the Great Barrier Reef. This preliminary study added to previous data to describe temporal and spatial zooplankton patterns at Reef HQ Aquarium; however, more thorough and detailed

sapling is required to investigate and accurately quantify zooplankton dynamics at Reef HQ Aquarium in the future.

INTRODUCTION

Phytoplankton and zooplankton constitute the lower trophic levels of marine food-webs. Through secondary production, zooplankton relay important organic compounds and nutrients to higher-order organisms and therefore assist in sustaining the overall health of marine ecosystems. Evidence of a feeding of plankton has been observed among other planktors (Frost 1972), fish (Pratchett et al. 2001) and coral (Ferrier-Pages et al. 2011).

The husbandry of marine organisms in aquaria, such as coral, invertebrates and fish, rely directly and indirectly on plankton to meet their metabolic nutrition requirements. At Reef HQ Aquarium, the world's largest living coral aquarium, Bondarenko (2010) reported relatively low plankton concentrations compared with the nearby Ross Creek during winter months. This initial survey provided some baseline data and consequently insight into plankton abundances and assemblages in the main tanks. However, plankton concentrations are spatially and temporally variable in the wild because of a myriad of factors and some of these factors are predicted to impact on plankton concentrations within the main coral tank. Environmental conditions and predation are the predominant causes of variations in plankton concentrations. For example, diel vertical-migration occurs where zooplankton regulate their position in the water column during the time of the day (Lampert 1989), with surface waters having the highest concentrations of plankton during the nocturnal phase, and inversely lowest concentrations during the diurnal phase.

This study aims to build-on previous data from Bondarenko (2010) in two ways. First, I will sample plankton concentrations during summer months and compare the results with winter plankton sampling data.

Second, I aim to determine if low plankton concentrations in the Coral Reef Exhibit tank are due to diel vertical migration. If this is the case, plankton are expected to be at the deepest levels in the tank during the diurnal phase. Similarly, at night during the nocturnal phase, greater densities of plankton are expected to be near the surface of the tank. Therefore, plankton concentrations will be sampled at depth during the diurnal phase of the day, and at the surface during the nocturnal phase of the day.

MATERIALS AND METHODS

Study site and equipment

Plankton concentrations in Ross Creek adjacent to Reef HQ Aquarium (19°15'27.87"S, 146°49'27.27"E) and the main coral reef tank (CRE) were sampled with 2-litre a Niskin bottle. Previously, Niskin bottles were selected because of they are capable of sampling at variable depths and are suitable for phytoplankton sampling (Bondarenko 2010, Kingsford, Battershill 1998).

Diel patterns in zooplankton abundances

Zooplankton were sampled using the Niskin bottle at ~1m depth until 5l of water was collected. Samples were collected during the diurnal phase (daytime) and nocturnal phase (night-time). Each sample was filtered with a 50µm mesh and washed into a 100ml container with a buffered solution of saltwater and 10% formalin. Rose Bengal was added to stain the plankton.

Depth patterns in zooplankton abundances

Zooplankton were sampled in a similar methodology to the sampling methods outlined previously. However, samples were taken during the day in surface water (~1m depth) and at benthic water (~4.5m depth). Again, plankton samples were filtered, fixed and stained identical manner as above.

Summer plankton sampling during a creek water intake

The methodology was conducted in a similar to manner to previous work (Bondarenko 2010), to allow the results to be comparable between summer and winter samples. There was three types of sampling; plankton were sampled during the intake of new saltwater, after the new saltwater has passed through the sandfilters, and in the main aquarium (CRE).

Sampling was conducted over a two-week period during the summer months over the course of an intake cycle (the period of one intake to the next). The CRE was sampled just prior to the creek water intake (Fig. 2). During the creek water intake, 5 l of water was sampled. Next, the intake water was sampled for two days after the intake during filtrations by the sandfilters. Further sampling in the CRE was conducted three days after the intake, when the new water is assumed to be fully mixed.

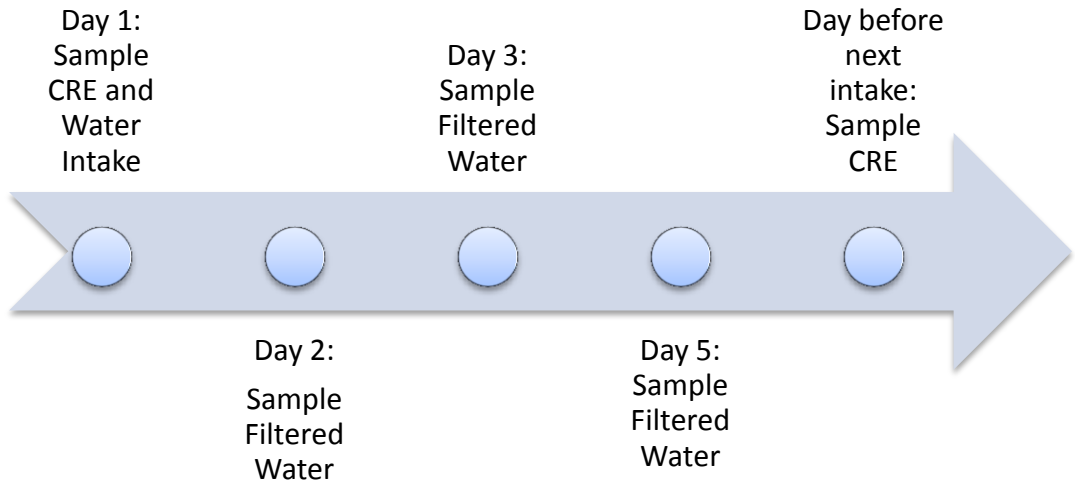

Fig. 2 Time-series of sampling during creek water intakes.

A 50µm mesh concentrated the plankton into 100ml containers and then was mixed with 10% buffered formaldehyde for fixation. Total zooplankton numbers were enumerated using Bogorov trays under a dissection microscope and then assigned to a taxonomic group. The data was not analysed because of the few zooplankton numbers of each taxonomic group in each sample and therefore the assumptions of parametric analyses could not be met.

RESULTS

Overall zooplankton concentrations appeared very low during nocturnal periods and at depth. In contrast, high concentrations of zooplankton were observed during the creek-water intake, with the concentrations decreasing during recirculation in the holding tanks.

Diel patterns in zooplankton concentrations

No clear difference between diurnal and nocturnal zooplankton concentrations occurred for the periods sampled. Zooplankton concentrations for all groups of taxa were very low (mean < 5 individuals l). Generally, planktonic assemblages remain similar throughout the course of the day (Fig. 3).

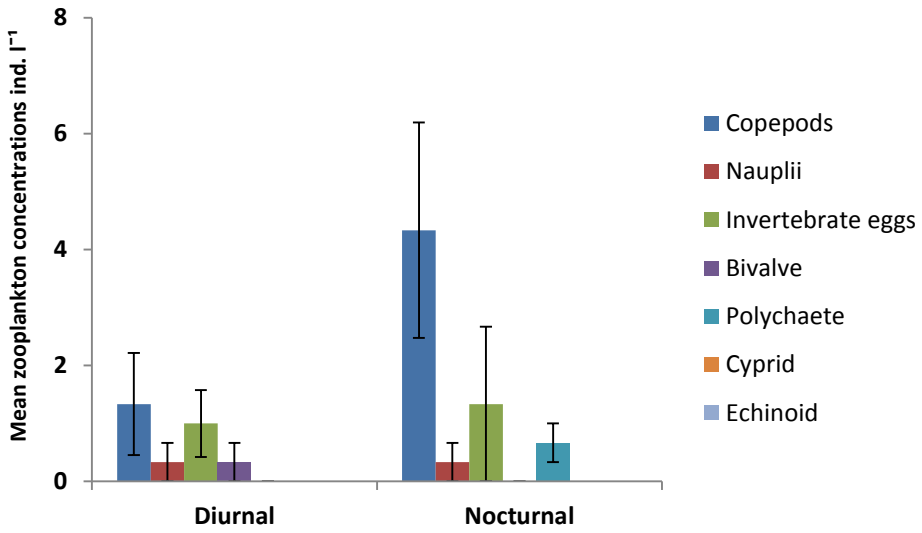

Fig 3. Mean diurnal and nocturnal zooplankton concentrations (±SE) in the CRE during February 2012.

Vertical patterns of zooplankton concentrations

There was no difference in zooplankton concentrations between surface waters and benthic waters in the CRE (Fig. 4). Zooplankton abundances of in all taxonomic groups were again very low.

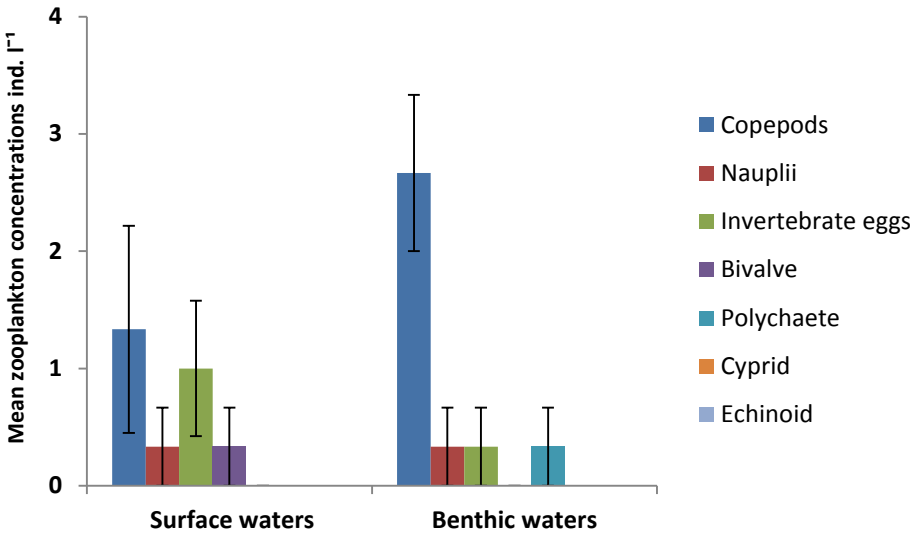

Fig.4 Mean zooplankton concentrations (±SE) in surface and benthic waters in the CRE during February 2012.

Seasonal variation in zooplankton concentrations in the CRE and during Creek Water Intakes

Compared with samples from the CRE, zooplankton concentrations during the creek water intake were very high for copepods and copepod nauplii (Fig. 5a, b). During summer, zooplankton concentrations appeared to decrease with time as the intake of creek water circulated between the holding tank and the sand-filters (Fig. 5a). In contrast, during winter, only copepods decreased in concentration whereas copepod nauplii appeared to increase. Invertebrate eggs, suspected to be copepod eggs, were observed at high concentrations in the CRE prior to mixing.

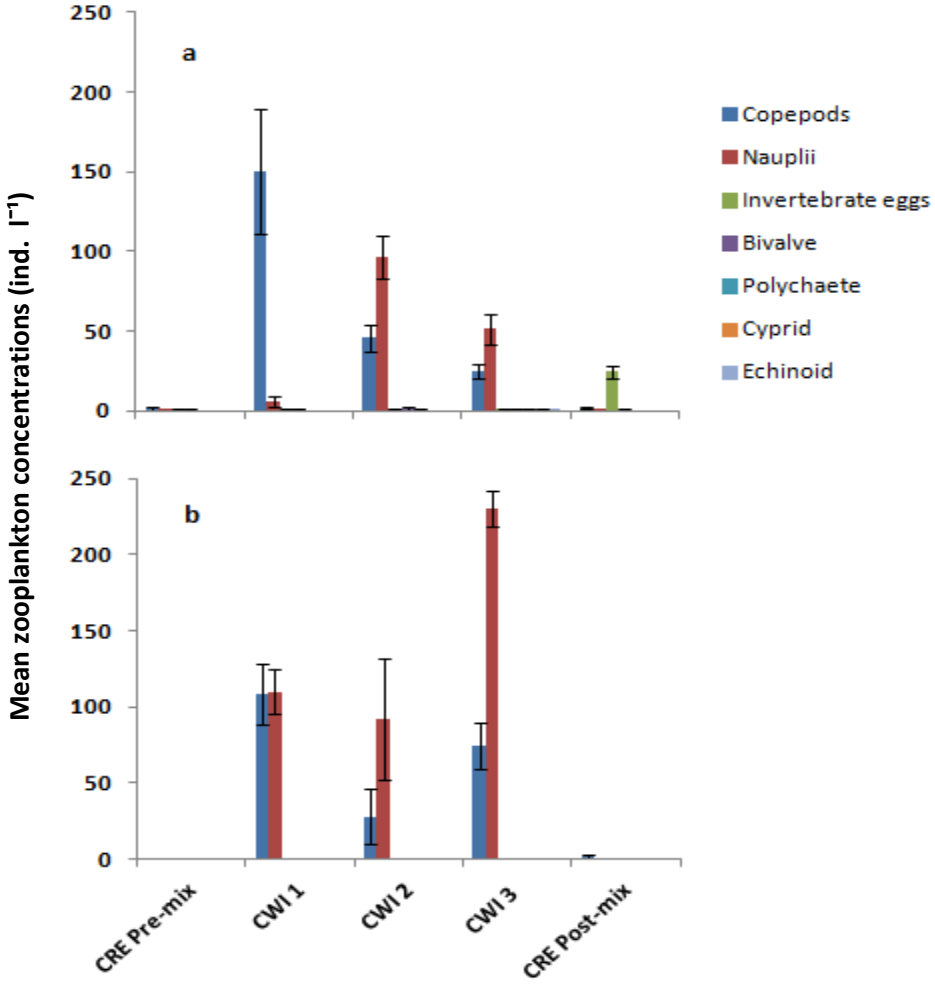

Fig. 5 Mean zooplankton concentrations (±SE) in the Coral Reef Exhibit (CRE tank) and during the Creek Water Intake (CWI) in a) summer and b) winter.

DISCUSSION

Surprisingly, there were little differences between diurnal and nocturnal zooplankton concentrations in the Coral Reef Exhibit, with very few numbers observed at both times of the day. Many zooplankton undergo vertical diel migration whereby they rise to upper water depths during the night (Barans & Stender 1997). However, in the CRE, there was no evidence of this behaviour, probably because zooplankton abundances were too low to show any notable patterns. In addition, the CRE is relatively shallow (4.5m) and there may be little change in environmental conditions between surfical and benthic water, therefore zooplankton may not react as clearly compared with deeper waters where these patterns have been observed. Further, Sorokin & Sorokin (2010) found great abundances of bentho-planktonic demersals residing in the substrate during the day; therefore further sampling of the benthos substrate is needed to portray the complete planktonic assemblage in the CRE. Indeed, bentho-planktors could help assist some predators meet their metabolic requirements in the CRE satisfactorily. Despite the numbers of zooplankton in the CRE occurring in concentration too low to determine differences between diel phases, zooplankton concentrations were, in fact, comparable with the lower ranges of zooplankton concentrations found in the wild (Roberston et al. 1988).

There were two notable exceptions to the general low concentrations of zooplankton in the CRE. First, a pilot study in October 2011 revealed ostracods and fish eggs at high concentrations during the night. These planktors likely originated from within the aquarium. Nevertheless, they could contribute to the diet of predators, such as fish and coral. Another exception occurred during the summer creek-water intake cycle; high concentrations of suspected copepod eggs were found floating in the CRE during the day. Considering copepod eggs only occur briefly before hatching, it is likely the eggs were brooded within the tank.

In comparison to wild populations, if zooplankton abundances in the CRE were extrapolated to a volume of one m^{-3}, they occurred at comparable abundances to the Great Barrier Reef during the day, but comparably low abundances at night. Sorokin & Sorokin (2010) recorded concentrations of 1 000 - 2 000 individuals m^{-3} during the day in Great Barrier Reef waters near Mosman River compared with the ~800 individuals m^{-3} found in this survey in the CRE. At night, however, concentrations in the CRE remained similar to the daytime abundances but concentrations on the reef increased 8 - 47 times that of diurnal concentrations (Sorokin & Sorokin 2010).

In contrast, water sampled during the creek water intake had great zooplankton abundances (sometimes occurring at abundances > 60 000 individuals m^{-3}!). For comparison, Robertson et al. (1988) found average zooplankton numbers ranged at much lower concentrations between 11 000 – 19 500 individuals m^{-3} at Alligator Creek estuary, 15km's east of Ross Creek.

Niskin Bottles and 5 l buckets were used to allow data to be compared to previous zooplankton sampling in the aquarium (Bondarenko 2010), but was limited by the volume of water sampled and therefore should only be used as an indicator of zooplankton concentrations rather than a quantitative survey. Niskin bottles can grossly over-estimate or under-estimate plankton concentrations (Kingsford & Battershill 1998), for example, if a rare plankta occurred once in a 5 l sample, this would indicate a moderate concentration of the species based on zooplankton concentrations found in nearby wild populations. On the contrary, and perhaps more plausibly, this species only might have occurred once. Further, Niskin Bottles don't account for patchiness of plankton concentrations, which occur spatially (both horizontally and at depth).

In conclusion, there is no apparent relationship between zooplankton concentrations at depth or during the time of the day. During creek water intakes, summer zooplankton abundances are similar to the great zooplankton abundances occurring in winter and are composed primarily of copepods and their nauplii. However, further sampling is recommended to ascertain a more complete assessment of zooplankton dynamics with the aquarium, an important undertaking to determine whether concentrations are sufficient to support the metabolic requirements of animals in husbandry.

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