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Chapter 2

Nutrition in juvenile corals – a case study at Rotterdam Zoo

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INTRODUCTION

It is well known that nutrition plays an important role for corals (Sorokin 1995); however, the importance of organic food sources for early post-settlement life stages so far has been hardly studied. Coral larvae of zooxanthellate corals often prefer to settle in a cryptic microhabitat, which might offer less optimum light conditions for the photosynthesis of their symbiotic algae compared to the light exposed areas into which they grow with increasing size. Therefore early settlers might be highly dependent on alternative energy sources such as live plankton and organic substances (particulate organic matter POM, dissolved organic matter DOM).

At Rotterdam Zoo, techniques have been developed in the past 6 years to control sexual reproduction of scleractinian corals in captivity. Larvae may be collected from aquarium colonies (Petersen *et al*., 2006) or reared from field collected gametes (Petersen *et al*., 2007). Specific settlement tiles help optimizing settlement for aquarium purposes and lead to high settlement rates (Petersen *et al.,* 2005). Nevertheless, it remained a challenge to obtain early juveniles through the first few months after settlement. Although surviving, juveniles often showed retarded development, with no significant growth, which often resulted in slow tissue necrosis (Petersen, 2005). In order to enhance growth of early settlers, the influence of different food sources was examined in a recent study at Rotterdam Zoo (Petersen *et al*., 2008), which is summarized in this paper.

MATERIALS AND METHODS

Larvae of the brooding coral *Favia fragum* and the broadcast spawner *Acropora tenuis* are regularly available at Rotterdam Zoo. Aquarium colonies of *F. fragum* may release larvae all year long which may be easily collected by aquarium staff or students. As part of SECORE (Petersen *et al.*, 2006; see also Chapter 42), Dr. Masayuki Hatta (Okanomizu University Tokyo, Japan) supplies the zoo every year in May/June with larvae of different *Acropora* species such as *A. tenuis* when mass spawning occurs in Okinawa. A total of 960 primary polyps of *F. fragum* and a total of 2400 primary polyps of *A. tenuis* were settled on specific settlement tiles prior to the experiment (Petersen *et al*., 2005). Primary polyps were then placed in 2-liter aquaria with aeration and T5 lighting (Aquamedic, 80 W, 10,000K).

Different food sources were applied in different concentrations: 2hr-old nauplii of the brine shrimp *Artemia salina*, the micro alga *Phaeodactylum tricornutum* and a commercially available dry food (Nori Micro, Zoolife®). The recruits were daily fed following the feeding regime shown in Table 1. All of these food items were previously applied in the multi-species coral exhibits at Rotterdam Zoo. For a duration of 5 months, growth and survival were measured regularly to analyse the influence of the applied food on the development of both coral species. In order to identify growth, a digital picture of every recruit was taken under the microscope to measure the surface area using digital image analysing software (AxioVision 3.1, Carl Zeiss Vision GmbH Germany).

RESULTS AND DISCUSSION

The study clearly showed that *Artemia* nauplii may greatly enhance growth in both coral species with increasing food concentration.

Table 1: Amount of food applied per liter for Acropora tenuis *and* Favia fragum *following Petersen* et al. *(2008).*

Food	***Favia fragum***	***Acropora tenuis***
Artemia salina	50 nauplii	600 nauplii
	150 nauplii	1,800 nauplii
	300 nauplii	3,750 nauplii
Phaeodactylum tricornutum	2 x 10^5 cells	-
	2 x 10^6 cells	-
	2 x 10^7 cells	-
Nori Mirco ®	-	1 mg
	-	5 mg
	-	10 mg

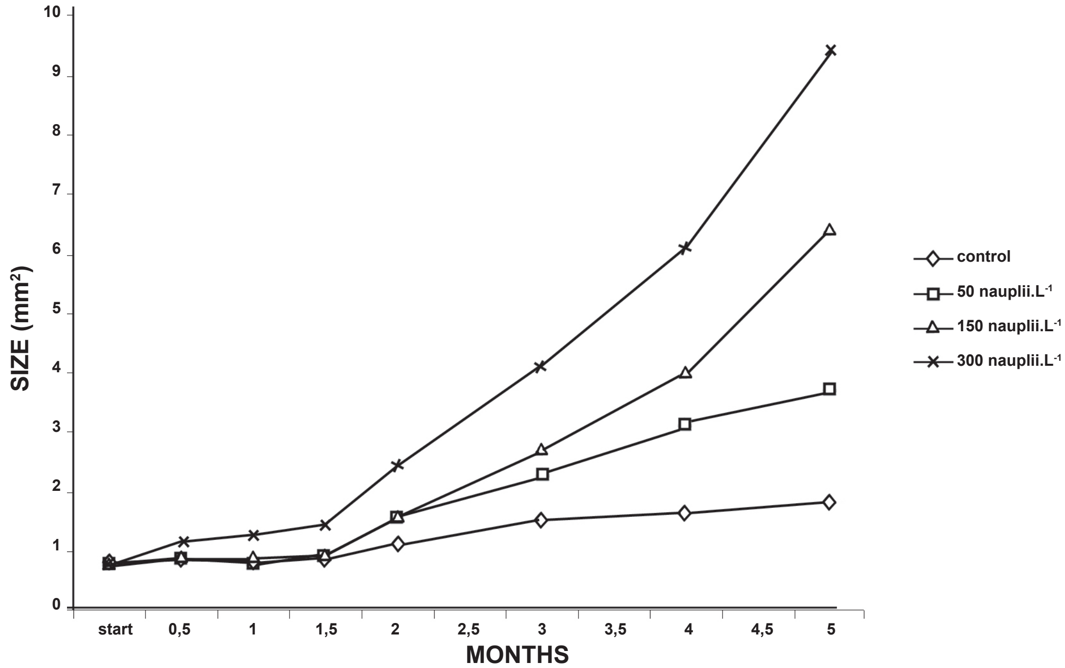

Figure 1: Growth of Favia fragum *under different* Artemia *nauplii concentrations. Please note, scale of y-axis differs from Figure 2. Modified after Petersen* et al. *(2008).*

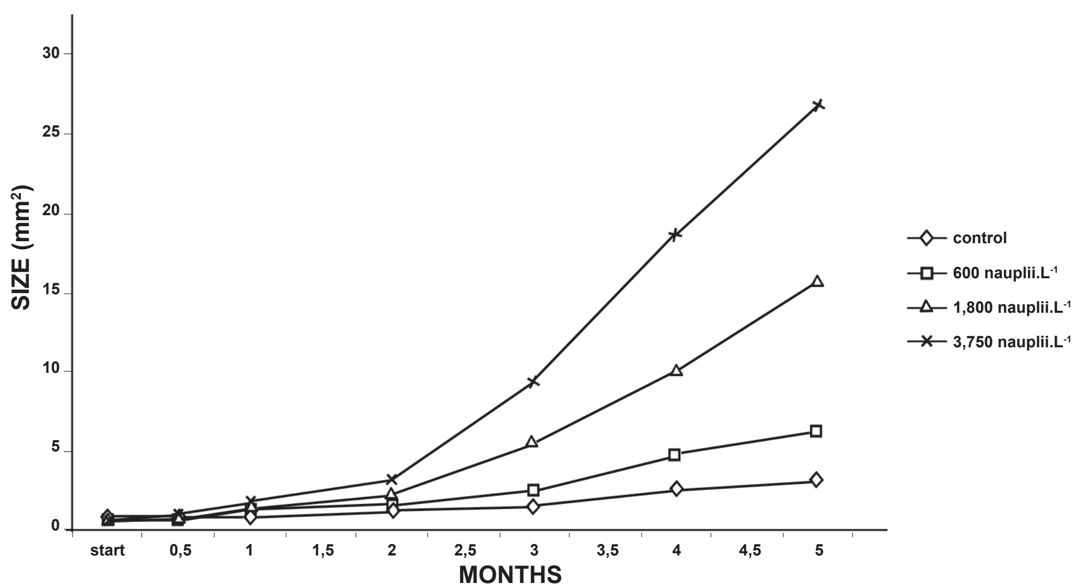

Figure 2: Growth of sexual recruits of Acropora tenuis *under different* Artemia *nauplii concentrations. Please note, scale of y-axis differs from Figure 1. Modified after Petersen* et al. *(2008).*

Compared to the control where juveniles attained a size of 1.8 ± 1.0 mm^2 (mean ± S.D.; duration = 5 months; no food added), juveniles of *F. fragum* attained mean sizes of 9.4 ± 4.9 mm^2 under the highest *Artemia* concentration (300 nauplii $.L^{-1}$). Regarding *A. tenuis*, similar results were observed with the highest nauplii concentrations (3,750 nauplii $.L^{-1}$) leading to mean colony sizes of 26.8 ± 10.3 mm^2 compared to 3.2 ± 2.5 mm^2 in the control. The micro alga *Phaeodactylum tricornutum* and the commercially available dry food (Nori Micro, Zoolife ®) did not show any effect on the colony growth in both species. Although survival differed between the feeding regimes, rates were not significantly different for both species (r-test; p>0.05). Maximum survival rates of 85 % and higher were attained in some of the *Artemia* feeding regimes.

These results suggest that additional food sources such as *Artemia* nauplii may be one of the keys to successfully raise large numbers of sexual recruits in scleractinian corals under aquarium conditions. Meanwhile, we specifically supply to all our culture systems freshly hatched *Artemia* nauplii leading to overall higher coral growth. Water quality parameters have to be carefully monitored to avoid negative influences when food quantities are increased. Reefbuilding corals are zooplankton predators (Sorokin, 1995) even during their very early post-settlement life stages, which needs specific attention in any breeding attempt. More research is necessary to test the influence of different zooplankton groups (e.g. copepods, rotifers, Selco-enriched *Artemia* nauplii). The specific morphology (e.g. polyp size) and physiology (suspension feeder *vs*. active plankton predator) of a particular coral species might further influence the efficiency of different food sources on the growth of sexual recruits.

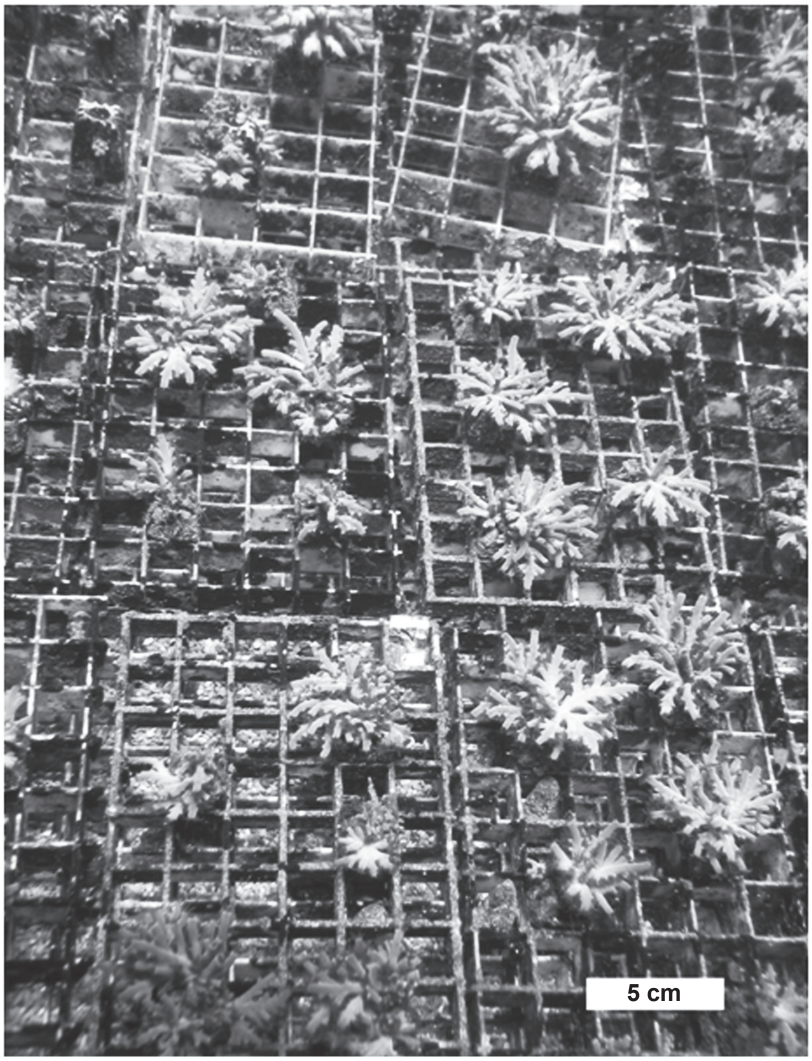

Figure 3: Sexual recruits of Acropora tenuis *(9 months after settlement) supplied with* Artemia *nauplii at Rotterdam Zoo.*

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