Evolution of a 26 years old captive reef kept at the Monaco's Oceanographic Museum

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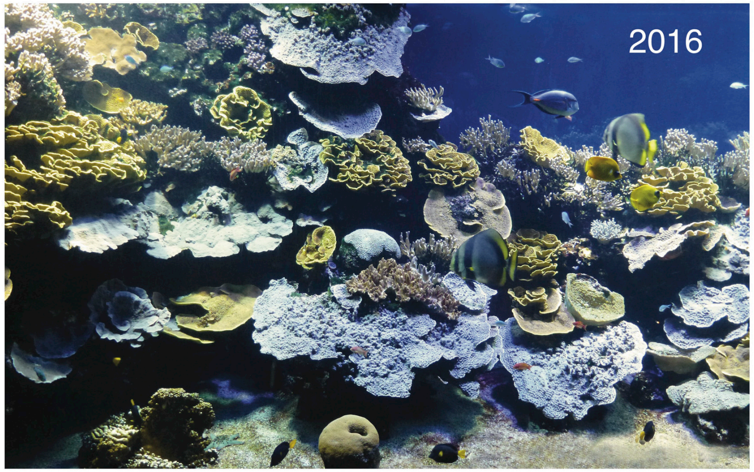


ABSTRACT

The largest of the captive reefs kept at the Monaco's Oceanographic Museum was set up in 1989. It was made of live stones, live sand, corals and fishes collected in the Gulf of Tajoura (Djibouti, Indian Ocean) and used to stock a large ecologically balanced aquarium (Jaubert NNR System). The aquarium was originally operated as a closed-circuit system. Then, following its recovery from a severe osmolation accident that occurred in September 1990 it became a semi-closed system. The branching corals, which were originally abundant have progressively declined in favor of sub massive and foliose species. The latter have built a life-size beautiful patch, which is still thriving today and is one of the (and perhaps the) oldest captive reefs in the world. The Monaco's Oceanographic Museum keeps many other coral tanks. Most of them are more than 20 years old and harbor more than 50 different species of reef-building corals. This stock could constitute the embryo of a coral conservation network that could be developed in cooperation with a selected number of organisms able to propagate corals and/or to restore reefs. The objective would be to save endangered and/or hardy species or strains and to contribute to the preservation reef ecosystems. Today, more than ever, coral reefs are under heavy pressures because of overexploitation, pollution, global warming and ocean acidification. Therefore, these successful experiments open interesting prospects of ex situ conservation, which might contribute to make an increasing number of people undoubtedly sensitive to the ecological importance and beauty of coral reefs and to the need to conserve them.

MATERIAL & METHODS

Tank & LSS. The LSS includes a mechanical filter (Finaflow LACRON HP24.610 F - 20 m3.h-1) but no protein skimmer, no calcium reactor, no U.V. etc. **Water volume**: 37,000 liters. **Light**: 8 x 1,000 watts metal halide HQI bulbs (4 x 6,500°K; 2 x 10,000°K; 2 x 20,0000°K) and 6 x 38 watts fluorescent tubes (Philips TL-D blue). **Photoperiod**: 13:11. **Stirring flow**: 107 m3.h-1. **Temperature:** daily variations 25°C (minimum) 27.5°C (maximum). **Water renewal**: 400 l.h-1 (average value).

Major community components. **Scleractinian corals**: *Echinopora gemmacea* (15), *Goniastrea* sp. (1), *Hydnophora exesa* (2), *Montastrea* sp., *Platygyra lamellina* (1), *Porites* sp. (1), *Stylophora pistillata* (19), *Turbinaria reniformis* (16), *Turbinaria peltata* (2). **Hydrocorallia**: *Millepora* sp. **Octocorallia**: *Sinularia* sp. (3). **Fish**: *Acanthurus blochii* (1); *Acanthurus dussumieri* (1); *Acanthurus sohal* (2); *Chaetodon fasciatus* (2); *Chaetodon paucifasciatus* (1); *Chaetodon semilarvatus* (2); *Chromis viridis* (30); *Genicanthus caudovittatus* (1); *Labroides dimidiatus* (2); *Myripristis murdjan* (1); *Naso vlamingii* (1); *Pomacanthus asfur* (1); *Pomacanthus imperator* (1); *Pseudanthias squamipinnis* (15); *Zebrasoma desjardinii* (3); *Zebrasoma xanthurum* (10); *Platax orbicularis* (2). The *T. reniformis* colonies result from fragments of a colony collected in 1979 in the Red Sea (Gilles et al. 2004). The asexual propagation of this colony, kept for 35 years in aquariums and still living today, has produced a number of daughter colonies, which constitute one of the (perhaps the) oldest coral clone cultivated *ex situ.*

Experimental protocol: The input of fresh seawater was closed during 24 hours. The pH, pO2 and temperature were recorded with data loggers. The nutrients, total alkalinity and calcium were measured from water samples collected every 2 hours during the day and 4 hours at night. PAR irradiance was measured at the air-water interface, just below the light projectors, with LI-192 (downwelling) and LI-193 (scalar) sensors: LI-COR inc., Lincoln NE, U.S.A.).

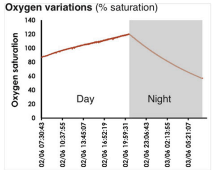
PRELIMINARY RESULTS

The species composition of the present captive reef is very different from that of the original reef. These differences include both the coral and the fish populations. The original Scleractinian corals population included more that 20 species amongst which there were 5 different species belonging to the genus *Acropora*. Today all of the *Acropora* have disappeared and 3 species of reef builders (*E. gemmacea*, *S. pistillata* and *T. reniformis*) form almost all of the reef structure. The present net calcification is positive almost all of the time (average values of 86,6 mol.h-1 during the day and 16.6 mol.h-1 at night). Some net dissolution occurs at the end of the night. The present fish biomass is much higher than that of the original reef. This increased biomass is likely responsible for the increased heterotrophy of the captive ecosystem: the initial photosynthesis-respiration ratio, which was 0.91 (Jaubert et al., 1995) is now 0.76. This value is significantly lower than that (1.09) of a Red Sea coral patch incubated *in situ* near the Marine Science Station of Aqaba, Jordan (Jaubert et al., 1995). Perhaps due to the fact that light might be a limiting factor, photosynthesis don't produce enough oxygen to compensate respiration. Indeed at the end of the night the pO_2 value (60% of saturation) is much lower than that (88% of saturation) recorded at the beginning of the experiment. The average daily downwelling irradiation, at the air-water interface just below the projectors (22,4M.m-2.d-1), is similar to that measured at the depth of 5 m in May 1992 in the gulf of Aqaba (Jordan) during a cloudless day (unpublished result). However, in the aquarium, the downwelling irradiance decreases strongly at the level of most of the coral colonies. The low oxygen production, which results from this weak irradiation, might be responsible for the low pH conditions, which prevail in the aquarium.

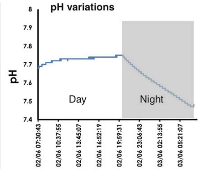
Quantum irradiance (PAR): $\mu M.m^{-2}.s^{-1}$

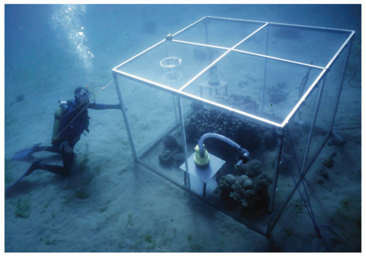
Projector #	1	2	3	4	5	6	7	8
Color °K	6,500	6,500	10,000	6,500	20,000	10,000	20,000	6,500
Downwelling	351	672	432	799	390	483	420	610
Scalar	510	960	600	1,110	620	570	620	700

Oxygen variations (% saturation)



pH variations





Coral patch incubated near the Marine Science Station (Aqaba, Jordan)

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