

Exploring the unprotected deep coral reefs of the Gulf of Aqaba.

Final report by Eran Brokovich

To finalise our findings and actions I will start with a reminder of our goals:

1. We aim to explore this unknown habitat and to implement our findings towards its conservation.
2. The results of this research will be integrated into monitoring, research and decision making and will be implemented immediately in conservation and rehabilitation policies.
3. Comparisons between habitats will enable evaluation of the extent of anthropogenic perturbations and environmental stresses.
4. To help raise public awareness on both sides of the northern Gulf of Aqaba (Israel and Jordan), we will provide and dispatch a deep water fish and coral field guide to the National Nature & Parks Authorities and other interested parties.

Our proposed methods:

Research will be conducted at four different depths (30, 50, 70 and 90 meters) using technical Scuba diving and compared with shallow habitats (5-15 meters).

Outcomes –

As we started the research it became apparent that it will be close to impossible to dive in Aqaba due to bureaucratic problems of transferring scuba tank across the border. Therefore we continued the research in Eilat only. We allocated our efforts to sample more depths and currently finished 5, 10,30,50,65 meters surveys.

Our results have been reported in two National conferences and in the International Indo-Pacific Fish Conference. More over, our results are in a process of review in a number of international scientific journals.

I present here 4 parts of 4 different abstract of manuscripts presented for publications. This will summarize our findings so far. The contribution from RSG enables us to continue our work and I predict many more interesting findings from this work. We currently have 4 additional papers in preparation.

Results:

1. **Fish communities:** Multidimensional scaling (MDS) and analysis of similarity (ANOSIM) revealed significant community-level differences between shallow and deep reefs, attributable to the decline in species richness and a different species composition. The deep reef is characterized by an increased in the importance of the zooplanktivores relatively to the other functional groups. zooplanktivores have become, by far, the most abundant group and they are the reason the fish abundance in the deep coral reef does not fall from that of the richer shallower habitats.

The decline in fish diversity with depth is not related to habitat complexity or to hard or coral cover. Beta diversity increases with depth and the change is attributed both to a decreasing degree of shared species and an increasing degree of species turnover. We urge the study of the deep reef elsewhere and to include this habitat in ecological models and conservation schemes.

2. Fish population: Adult and juvenile reef fish of many species are known to differ in their depth distribution patterns, yet we lack data on deep reefs. Our recent study of the deep coral reef of the Gulf of Aqaba suggests that juvenile angelfish occupy the deep reef habitat (45-65 m) while the adults live in shallower water (30 m). If we can rule out intra-specific competition for food and shelter and consider the high abundance of other zooplanktivorous fishes in the deep reef, we could infer that reduction in predator abundance may be the cause for young fish to live deeper. This study suggests that the deep reefs may serve as nursery grounds for certain fish species. Our findings demonstrate the integrative nature of coral reefs across their entire depth. They further stress the importance of deep coral reef research for understanding the ecological patterns and processes defining the reef community structure.

3. New record of a coral: Two specimens of *Euphyllia paradivisa* (Veron 1990) (Family Euphyllidae) were collected from the deep reef off Eilat. Veron (1990) originally described this coral from Boliano, Philippines. *E. paradivisa* distribution was reported from the Philippines to Indonesia in shallow protected water (Veron 2000). Yet, it is so far unknown in the Indian Ocean or the Red Sea. A single species is currently described from the Red sea region: *Euphyllia glabrescens* (Chamisso and Eysenhardt, 1821) which can be easily distinguished by the unique characteristics of its polyp tentacles. The bathymetric distribution of *E. paradivisa* in Eilat is limited to the deeper reef (50-65 m) and contributes up to 30% of coral cover (S. Einbinder unpublished data). Our finding suggests either a wide distribution of the species in deep water or, that the population may be a relict of a wider past distribution. The accumulation of data from the deep parts of the reef (e.g. fish distribution, Feitoza et al. 2005) may change our understanding of global biogeographical processes.

Euphyllia paradivisa: Material examined – collected by Shai Einbinder at Dekel Beach, 50 m depth, Eilat (29°32'07 N; 34°56'52 E). Date 16.06.05 the Coral national collection of the Tel Aviv University Co-33164

4. Coral physiology: The hermatypic coral *Stylophora pistillata*, has a wide bathymetric distribution (0-70m). Within this range light intensity decreases exponentially. Deep water colonies are planar, with the upper part dark, while its bottom facing part is pale. Shallow water colonies are sub-spherical and whitish. Since coral physiology is light dependent, we expect it to change with depth.

In this study we compared the photoacclimation of *S. pistillata* colonies along the reef profile (5-65m) of Eilat in the Gulf of Aqaba (Red Sea, Israel) in relation to both metabolism and calcification. Calcification and photosynthesis were measured using a submersible respirometer. Photosynthesis versus light curves were generated using oxygen concentration data. Calcification rates were calculated using alkalinity anomaly technique and from pH and oxygen data.

Respiration rate, light-saturated rate of photosynthesis, compensation intensity and minimum light intensity to produce maximum photosynthesis all decreased with depth. In contrast, the efficiency of photosynthesis increased with depth. All colonies displayed “light enhanced calcification” and lower calcification rates at increasing depths.

The change in the photosynthesis parameters along the depth gradient indicates an adjustment of the harvesting and utilization of light by the algal symbionts to the environment. Photosynthesis and calcification rates decreased with depth. The low ratio of photosynthesis to calcification in the deep-water colonies suggests that photosynthesis contributes little towards the daily carbon requirements of the coral.

Outreach:

One of our goals was to produce a field guide for deep and shallow corals. As we were unable to dive in Jordan's deep reef we helped with issuing a shallow reef fish guide that was done through a US-AID regional program. Moreover, it was almost impossible to get high quality photos from the videos we were making. As we don't have the funds for deep water housing for a still camera we did not have good enough photos for a guide.

However, we were interviewed to the national geographic magazine (Hebrew version) and published the interest in the deep reef.

Furthermore, we are giving lectures to BSc and MSc students about our findings and the importance of the deep reef to the area's ecology.

One of our greatest achievements was that the Nature and Parks Authority, after seeing our presentation, recommended to the government to include the deep reef in the area of the marine reserve!!!

Summery:

We reached our primary goal of researching this new environment and found a fertile ground for more research.

Our findings were implemented in the conservation of the deep reef.

Although we were unable to publish the deep reef guide, we managed to reach the public through interviews and lectures and to raise public awareness through them.

We also presented our findings in international conferences.

We submitted four scientific papers with our results, four more are in preparation, and still the research continues.

Although we were unsuccessful so far with the Jordanian dives we are still working on making it happen and we will be diving there!!!

We are now looking to continue this endeavour and to go even deeper using state of the art rebreather systems, which will enable safe diving for deeper reefs down to 120m. this of course depends onn further funding.