

The Israel National Monitoring Program at the Northern Gulf of Aqaba

Funded by the Israel Ministry of the Environment

Scientific report 2006

Prof. Amatzia Genin, Scientific Director

Dr. Yonathan Shaked, Program Manager

(March, 2007)

Introduction

This report describes the work and results of the Israel National Monitoring Program at the Gulf of Aqaba (NMP) in 2006. It is divided into chapters according to the various fields and methods covered by the monitoring program. Each chapter includes a short description of the methods used, a detailed description of the results including data and figures, and a discussion of the findings. A comprehensive description of the methods used is given in the NMP annual scientific report of 2003.

This is the third year in which the NMP operates regularly and data is collected using similar methods by the same team. The ability to review such consistently collected data provides increased analytical power and confidence in our findings. Thus we begin to seek patterns and trends over the past three years. A comparison of the present-day state of the reef with historical data can be found in the NMP report of 2004.

This report is available through the Israel Ministry of the Environment's web-site:

www.sviva.gov.il. The raw data can be obtained through the NMP web-site: www.inm-eilat.org.il.

Key findings

General

During 2006 an analytical error affecting all pH measurements was discovered. This requires that all pH values published by the NMP until November 2006 be considered erroneous. Nevertheless, simultaneous pH values, measured on the same day, may be used for purposes of relative comparison along a profile or between stations during the course of a sampling campaign.

The coral reefs of Eilat

1. In 2006, as in the preceding two years, indications of extreme changes in the state of the reefs were not recognized. The reefs display neither substantial growth nor catastrophic decline. That being said, the numerous proxies of the state of coral reefs in Eilat indicate that the reef is under stress and a trend of decline seems to emerge. Although in most cases the trend is not statistically significant we urge that these be taken seriously: it is likely that the time elapsed since the start of the monitoring program is not yet long enough to statistically distinguish trends from the large natural variability. Ecological processes in coral reefs operate on a time scale of years and decades, much longer than the time the NMP is operating. While statistical standards require prudence in interpreting the data, we feel that caution calls for every effort to be made in reducing risk and damage to the reefs of Eilat.

2. The patchy character of the reefs of Eilat, that manifests in large areas of unconsolidated substrate on which corals cannot settle, calls for coral cover data to be normalized by the area of consolidated (hard) substrate rather than be taken at face value. Thus, the measure of live coverage in a reef is the percent consolidated substrate utilized by corals, rather than the percent coral cover. When this normalized coral cover is considered, all sites display similar values i.e. local inhibition of reef growth at a given site is not recognized. When the data is compared across the years since 2004 a trend of deterioration and drop in the normalized coral cover is indicated, but is not (yet?) statistically significant.

3. The number of coral colonies per line-transect (10m) correlates with the percent coral cover up to cover values of ca. 30%. Transects in which higher cover was recorded do not have a higher colony density but rather larger colonies. On the scale of a site (8-18 transects) a good correlation between coral density and live cover was found – indicating that large colonies are too few to influence the cover of a site, in other words: there are too few large coral colonies in the reefs of Eilat. In addition, a positive correlation was found between the occurrence of large colonies and substrate utilization. On the other hand, a negative correlation was found between the occurrence of small colonies and substrate utilization. These corroborate the assertion that large colonies are the backbone of a healthy reef and that a dominance of small colonies indicates a reef under stress.

At the sites of the IUI, which display the poorest substrate utilization, an increase in the occurrence of “medium” sized colonies with respect to the previous year may indicate a process of recovery.

4. The data collected by the NMP since 2004 indicate a statistically significant decline in

corals health. An examination of the results and the method (the “coral health index”) affirm that these are sound (see appendix G3). The biggest decline is found at the NR-5 site.

5. The Shannon-Wiener species diversity index, calculated for a unit length of one transect (10 meters) is influenced by the patchy character of the reefs. Use of the EstimateS software (Colewell 2005) to estimate the diversity index for each site as a whole brought about a change in the relative diversity between the sites. These higher estimates are largely due to the presence of rare species that are likely missed in a 10-meters-long transect. Over the years there is little change in the diversity index and the twenty most abundant coral genera comprise ca. 95% of the live cover in the reefs of Eilat. Genera richness is much greater than 20, exceeding 40 genera in the richest sites (KATZA-20 and IUI-5), giving additional significance to the presence of rare species in the reefs of Eilat.

6. Coral growth and an expansion of live coral cover since 2004 was generally found in the photo-survey sites. Exceptions are the sites at the northern beach and at Taba where non-branching corals are declining, and at KATZA where a loss of branching coral cover was noted.

7. The distribution of coral genera and temporal changes in the photo-survey sites represent stability of the reef community and do not reflect unusual growth or a catastrophic decline.

Coastal water

8. Most chemical variables measured in the coastal waters of Eilat are controlled by the seasonal cycle of summer stratification – winter mixing of the upper water column. Accordingly, the concentrations of most variables (nitrogen, phosphate, silicate) are higher in the surface waters during the winter. In addition to this natural seasonal cycle it seems that the coastal waters of Eilat are occasionally affected by contamination inputs that alter their chemical properties. These changes are measured on a local scale in close proximity to the source. For coastal monitoring purposes, abnormal concentrations are those that differ significantly from the background given by the majority of stations and especially the Open Sea monitoring station. And contamination refers to input of water or compounds that alter the seawater composition.

9. Abnormal seawater composition (i.e. contamination) was often measured at the vicinity of the Fish Farms, North Beach, and at the Navy/Meridien Hotel stations. Incidents include:

- Significantly high nitrogen concentrations were measured at the FF, NB, and Navy stations in the summer and autumn months.
- High nitrogen concentrations were also measured at the Nature Reserve station in July. The source for this is yet undetermined with likely candidates including the Underwater Observatory, the Orchids Hotel, and the sewage pipeline that runs parallel to the coast.
- High concentration of ammonium, up to five-fold the open sea values were measured through July near the Fish Farms. Since August highest ammonium concentrations were measured at the Navy/Meridien Hotel station. For the second year now high ammonium concentrations were measured at the Taba station at the end of summer. It is worthwhile remembering that ammonium is quickly consumed in seawater and high concentrations will only be measured very close to the source.
- High silicate concentrations were measured early in the year at the northern stations, and in the summer-fall at the Navy/Meridien Hotel station.
- As a general rule phytoplankton and bacteria cell counts were higher at the northern stations than at other stations, especially during the winter and spring.

10. Concentrations of organic carbon and heavy metals in sediments were found to be small. There is a natural distinction between sediments from the northern beach, where metal concentrations are high, and those from the south.

11. Organic carbon concentrations in the sediment core from the northern beach decline towards the top of the core, while at the southern sediment core the concentrations rise towards the top. An explanation to the changes in organic carbon concentrations in the cores is yet to be found.

The open water column

12. The seasonal cycle of summer stratification – winter mixing of the upper water column is the dominant featured observed in the concentrations of nutrients, dissolved oxygen and the dynamics of phytoplankton population in the open waters.

13. Multi-year variations are governed chiefly by the depth and duration of the aforementioned mixing events, and the amount of nutrients stored in the deep water between events. Following the relatively deep 2004-5 winter mixing event we measured a decrease in nutrient concentrations and quantities, and an increase in the dissolved oxygen in deep waters, relative to the alarming values of 2004. However, the winter mixing of 2005-6 was much shallower (~500m) and by the end of the year values were nearly back to the 2004 values. Looking further back in time, nutrient concentrations have been rising and dissolved oxygen concentrations dropping since 2000, in which a particularly strong mixing event occurred.

14. *Chlorophyll-a* concentrations in 2006 were generally higher than the 2005 values, despite the relatively shallow mixing of 2005-6.

15. A gradual rise in deep water temperature since year 2000, amounting to 0.15°C, has been recorded. Changes in deep water temperature may effect the current regime and seasonal dynamics in the Gulf. Rising temperatures may also contribute to the decline in oxygen concentrations, but in this case it seems that it can only explain a small part of it. Declining oxygen concentrations in the deep water must have a different cause, most likely enrichment in organic matter.