

## א.5. תקציר באנגלית, English Abstract

### **The Israel National Monitoring Program at the Northern Gulf of Aqaba** Funded by the Israel Ministry of Environmental Protection **Scientific report 2007**

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#### **Introduction**

This report describes the work and results of the Israel National Monitoring Program at the Gulf of Aqaba (NMP) in 2008. It is divided into chapters according to the various habitats 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. Figures and figure captions are given in English.

This is the fifth year of routine monitoring operations by the NMP in which data is collected using similar methods by a regular dedicated 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 five years. A comparison of the present-day state of the reef with historical data can be found in the 2004 annual scientific report of the NMP.

This report is available through the web site of the Israel Ministry of Environmental Protection: [www.sviva.gov.il](http://www.sviva.gov.il) and on the NMP web-site: [www.iui-eilat.ac.il/NMP/](http://www.iui-eilat.ac.il/NMP/).

A data base that includes the NMP data since 2004 is available for public download through the NMP website.

#### **Key findings**

##### The coral reefs of Eilat

1. Most indicators of the state of the coral reef measured this year were lower than the values determined in the previous year, but higher than those of the years 2004-2006. For most of the indicators 2007 was a year of particularly high values. Thus, the high values of 2007 did not prove to be the beginning of a rising trend. Considering the inter-annual fluctuations, the reefs of Eilat seem stable over the period in which data is collected by the NMP.
2. This year, for the second consecutive time, a deep mixing of the water column occurred (the water column was mixed to a depth of at least 860 meters, the depth of measurement in station B during the joint Israel-Jordan sampling cruise in March 2008). This produced a bloom of benthic algae on the shallow slopes. However, the algae bloom this year was apparently less extensive and of shorter duration than that of the previous year, and no ill effects were detected in Eilat's coral reefs.

3. The highest substrate utilization was found at the shallow Coral Reserve site, NR-5. The shallow reef sites at the Interuniversity Institute for Marine Sciences (IUI-5, IUI-10) have the lowest substrate utilization by corals. At all sites, except NR-20 the substrate utilization measured this year was lower than that of 2007, but still higher than that of 2004-6.
4. In the years 2004-6 a significant declining trend in the Live Tissue Index for coral health at a site was measured, and in 2007 this was stopped and higher values of LTI were measured. This year saw a drop in the LTI compared to 2007, and at many sites values were similar to those measured in 2006.
5. At sites where “small” is the dominant coral colony size substrate utilization is low. This correlation is significant even when data from the IUI (where the majority of colonies are small and utilization of substrate is particularly low) is excluded. This observation leads to the conclusion that these reefs are not limited by reef rejuvenation and settlement of coral planulae but rather by the success (or lack of it) of settled corals and their ability to grow past the initial few centimeters (=years). There seems to be a large pool of young settled corals that are unable to grow beyond the first years. This seems to be the limiting factor in the development of Eilat’s reefs. This conclusion, also stated in our previous annual reports, is supported by data of live coverage and coral colony density.
6. This was the second year in which the reef table (reef flat) at the Nature Reserve Reef was surveyed. This site consists almost exclusively of rocky substrate, and was found to have significantly lower substrate utilization than the other surveyed sites (all on the Fore-reef). Due to its special character the reef flat is not compared to other surveyed sites, and will be monitored separately year to year. State-of-the-reef indicators measured this year on the reef flat are generally somewhat higher than those measured in the previous year. Lacking long-term surveillance this observation should be treated with caution. The small deviations between the years indicate that our coverage of the reef flat is adequate.
7. Permanent photo-sites in the reef document specific locations and do not provide a statistical representation of the live cover/species diversity etc. of the site. In order to enhance the significance of photo-site data an effort was made this year to add new sites at the Nature Reserve and KATZA, where line transects surveys are also conducted.
8. In photos of this year, similar to 2007, growth of corals (stony as well as soft) and increased live cover was documented, in comparison to the data from 2004. Concomitantly, a drop in the colony density was found at all sites and at some sites coral mortality was greater than coral settlement. This combination is further evidence for the importance of coral survival and growth to larger size.
9. At most photo-sites increased live coverage and growth of specific colonies since 2004 was found. The inter-annual changes in live cover and colony density, coral diversity, and other temporal changes represent a stable dynamic population.
10. The coral community at the Nature Reserve lagoon seems stable over the past five years. The coral colony density seems similar year to year, barring small

fluctuations, and is derived mainly from the prevalence of the coral *Stylophora*. Coral diversity (according to the Shanon-Wiener index, calculated using the EstimateS software (Colwell, 2005)) also seems stable. In 2006 coral diversity was particularly high, but in the long term it seems this hasn't changed significantly since 2004.

11. The increase in Sea-urchin density reported in 2007 seems to continue, although to a lesser degree. Sea-feather density increased significantly in the years 2004-2008, and especially during this year.
12. A deep mixing of the water column lead to a bloom of benthic algae, that appears stronger and earlier in the year on this years algae settlement plates, compared to 2007. However, observations of the slopes did not detect benthic algae coverage of similar intensity to that of 2007.
13. The rate of benthic algae growth seems to decrease rapidly with increasing depth, with maximal values found on plates in the lagoon and minimal values at a depth of 20m. At all depths grazing seems to efficiently regulate benthic algae growth, but during the winter months, when growth potential reaches its peak, the chlorophyll-a concentrations also rises somewhat on plates that are exposed to grazing.
14. There was no significant difference in the community structure (according to a division into functional/trophic levels) of reef-fish between 2008 and 2007, the years in which this survey was conducted.

#### Coastal water

15. 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. This year a deep mixing of the water column occurred, of a similar scale to that of 2007, and maximal values of most measured variables – particularly the nutrient and *chlorophyll-a* concentrations – were higher during February to April this year. The high nutrient concentrations at the sea surface lead to a strong phytoplankton bloom and particularly high *chlorophyll-a* concentrations measured in April.
16. This year, fewer abnormal values were measured in Eilat's coastal water compared to the previous year, and the amplitude of abnormal measurements was smaller. This is true for nutrient and Ammonium concentrations. Ammonium being a very rapidly utilized species is an indication for local input sources. Nevertheless, and despite the removal of fish farms from the northern shore, higher concentrations of nutrients and *chlorophyll-a* were occasionally measured at stations along this shore compared to open sea or southern station values.
17. Organic content in sediments did not change significantly since 2003. At most coastal stations a lower organic content was measured this year, compared to previous measurements. At all stations organic material comprises less than 3% by weight of the upper sea floor sediments. The lowest organic content was measured at Taba, the southernmost station, and the highest at KATZA.

18. Lethal bacterium pathogens were not found in this year's survey of wild reef fish. Pending more sampling, this finding may indicate a decline in fish infection sustained by the bacteria *Mycobacterium marinum* and *Streptococcus iniae*, and the myxosporean endoparasite *Kudoa iwatai*. In past years, an increased prevalence of these pathogens among wild fish was suspected as related to the cage-cultured fish.
19. A few cases of fish mortality resulting from strangulation caused by bread were reported from Eilat's Dolphin Reef.

#### The open water column

20. The seasonal cycle of summer stratification – winter mixing of the upper water column is the dominant feature observed in the concentrations of nutrients, dissolved oxygen and the dynamics of phytoplankton population in the open waters. The multi-annual is governed by the depth and duration of annual mixing, and the amount of nutrients accumulated in the deep water. This year vertical mixing of the water column was measured to the sea floor at station B, similar to the mixing of 2007, but it seems that this year's mixing was of shorter duration and was less stable. The effects of deep mixing were felt in the high concentrations of nutrients and *chlorophyll-a* measured in the water column at the beginning of spring.
21. Mixed-season values were higher this year than in 2007, although in later months it became apparent that the big changes in water column concentrations occurred during the previous year. In the months following the deep mixing nutrient concentrations rose to higher values than those of the previous year, though still lower than the concentrations measured in the decade preceding 2007. Many of the trends measured in the past few years ended in 2007 – the nutrient inventory was depleted and the oxygen inventory renewed – and this year's values remain similar to those of 2007.
22. Chlorophyll-a concentrations (planktonic algae) were higher this year than in the previous year, adding to the observed trend of rising springtime chlorophyll-a since at least 2004. While many of the other (chemical) trends that were reported by the NMP now seem like inter-annual cycles coupled to deep mixing events, the rise in springtime plankton algae may still represent a trend.
23. Silicate inventory that was much depleted in the previous year rose considerably during this year, and silicate content in the water column rose to pre-2007 values. It is possible that an intensive bloom of siliceous algae was limited by the availability of other nutrients (e.g. N) but ongoing presence of these algae contributed a continuous flow of silicate that dissolved in the water column.
24. The trend of rising deep-water temperature did not continue through 2008, and deep water temperatures following this year's mixing were not higher than those of 2007. Temperature at depth dropped a little, but is still higher than that of the beginning of the decade.

#### Continuous measurements

25. This year's *chlorophyll-a* values reached their peak near the coral reef earlier than

predicted by multi-seasonal data accumulated since 1988. The seasonal cycle of high winter-time concentrations and low summer-time values commonly reaches a maximum during April, and this year's highest values were measured in March. Last year's *chlorophyll-a* peaks were significantly higher than the inter-annual average while this year's maximum was less abnormal, although high *chlorophyll-a* concentrations were measured throughout the month of March.

26. The sea surface temperature (SST) measured from the Observatory's pier still displays a long-term rising trend, although this year's maximal values were lower than those measured in the years 2005-2007. This could indicate a change in the multi-annual trend, but it is still early to be certain.
27. Highest wind speeds were measured in January-February. These are also the months in which the wind is unstable and southern storm events may occur. Relative humidity and the variance in relative humidity are also highest during these months, and so are the variations in sea level (tides). This year's strongest winds came from the west, in two discreet events at the end of January-beginning of February. Highest air temperatures above the sea were nearly 2°C lower this year than in 2007, while most days in July-August had higher maximal temperatures.
28. The annual variance in SST in the past two years was ~9°C. This year's extreme SST values (both maximum and minimum) were somewhat lower than those of 2007.