

Dr. Martin Falke
GIZ-CIM-Consultant
DONRE/ CCCO (Climate Change Coordination Office)
Da Nang City
Vietnam

Tel.: + 84 122 81 90 902
email: drmfalke@yahoo.de
martin.falke@cimonline.de
Skype: martinfalke

OBSERVATION REPORT
CONCERNING THE STATUS OF THE MARINE ENVIRONMENT IN
SON TRA PAENINSULA AND CHAM ISLANDS MARINE PROTECTED AREAS

by

Dr. Martin Falke

GIZ-CIM Consultant
DONRE/ CCCO
Da Nang City

September 2013



<u>Content</u>	Page
1. INTRODUCTION.....	3
2. OBSERVED SITUATION.....	4
2.1 Fish.....	4
2.2 Corals.....	4
3. REASONS – CONSEQUENCES – WARNINGS.....	5
4. RECOMMENDATIONS.....	8
5. PHOTO DOCUMENTATION.....	10
PHOTOS (Problems & Damages/ Fig. 1 to 18).....	11 to 19
PHOTOS (Healthy Corals/ Fig. 19 to 23).....	20 to 23

1. INTRODUCTION

During August and September 2013 Dr. Martin Falke (GIZ-CIM-Consultant at CCCO/ DONRE Da Nang since 01/09/2012) inspected the coral reefs in the marine protected areas (MPA) at Son Tra and Cham Islands by snorkeling (at Son Tra) and diving (at Cham Islands, down to a max. depth of 30 m).

Dr. Falke is a hydro-geologist but also a certified dive instructor since 1995 (with a special education in marine environment & biology and several years of project experience for the establishment of marine sanctuaries (= MPAs) in the Philippines).

Within this observation report, elaborated on the request of the CCCO Da Nang, the observed facts from his survey, reasons, consequences and recommendations are described.

As well Dr. Falke took approx. **300 underwater-photographs**, of which some of the most relevant are attached to this report for documentation of the observed facts (see 5. Photo Documentation, 23 Figures).

This report is based on only a few snorkeling rounds & dives at only a few locations at Son Tra Paeninsula and Cham Islands during a very limited time period. Consequently it is suggested, to **conduct such marine surveys & monitoring rounds extended and on a regular basis** (best every month) by experienced divers & monitoring patrols (see Recommendation 3 & 10), covering all of the marine protected areas (MPAs) at Son Tra Paeninsula and Cham Islands.

A marine protected area (MPA) is essentially a space in the ocean where human activities are more strictly regulated than the surrounding waters - similar to nature parks on land. These places are given special protection for natural or historic marine resources by local authorities. The most broadly used **MPA-definition** is the IUCN definition:

'A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values'.

MPAs may include marine reserves, as well as other zones in which partial protection is afforded (seasonal closures, catch limits, etc.). MPAs can be multiple-use areas, where a variety of uses are allowed. The types of human activities that are regulated, and the strictness of the regulations, are therefore largely dependent upon the objectives of the MPA.

In the case of the observed MPAs at Son Tra Paeninsula and Cham Islands it became very obvious, that **the MPAs are heavily overexploited in terms of fish catch** and consequently need a recovery time (no fishing at all). As well **many unhealthy and damaged reef areas** were observed, which definitely requires a much more intensive MPA-monitoring and implementation of rules & regulations by marine patrols. Otherwise not only fish & reef species will be lost in the region but entire ecosystems and habitats forever.

All this is discussed in Section 3 (Reasons, Consequences, Warnings) and in Section 4 (Recommendations).

2. OBSERVED SITUATION

2.1 Fish

Almost **no fish** appear in the protected areas of Son Tra and Cham Islands. Only a few small coral fishes (zebra fish, butterfly fish, banner fish) and occasionally lionfish could be observed.

This is most certainly due to **no protection of fish** and the **unregulated overfishing** in the coastal waters of Da Nang & Quang Nam by too many fishermen over an already long period of time. Fishermen use **unsustainable fishing methods** like

- utilizing nets with **too small mesh sizes** (which do not allow the juvenile fishes to escape)
- following **no legally regulated fishing quota** (a legally limited quantity of total fish catch, based on scientific findings for the marine area and the MPAs).

Furthermore the following observed **environmental impacts** can also be named as a reason for the very low fish population:

- **Water pollution** by solid & liquid waste, due to waste input to the sea from boats and the coast as well as untreated waste water releases from the coast
- **Water turbidity**, besides natural plankton currents at least partly caused by waste water releases from the coast
- **Increased water temperature**, causing fish migration (see 3. Reasons).

2.2 Corals

While Dr. Falke has seen some healthy coral areas (see Figures 19 to 23), he often observed **marine environmental problems and coral damages in the "protected areas"**, due to the following reasons and indicators:

1. Eutrophication and suffocation of corals, due to a green-grey algal overgrowth on the corals. This excessive algae growth, which is slowly suffocating the coral polyps and consequently destroying the corals & reefs, was observed at many locations at Son Tra Peninsula and Cham Islands, caused by nutrient rich waste waters released from the coast into the sea (containing nitrates, phosphates and other algae nutrients); **see Figures 1, 2, 3, 4**
2. High water turbidity (murky water), caused by nutrient rich waters, which is – besides natural plankton currents - at least partly caused by waste water releases from the coast. This results also in bad visibility, affecting snorkeling & diving negatively; **see Figures 5 & 6**

3. Coral Bleaching, due to an ongoing temperature increase of, particularly coastal, oceanic waters; this causes the coral polyps to die, finally leaving whitened brittle limestone skeletons of dead corals behind; this is a CC-impacted phenomenon which is beyond any direct local mitigation measures, but its scale should be regularly monitored together with the overall health status of the reefs (see recommendations); **see Figures 7 & 8**
4. Broken Corals, mechanically broken by people (snorkelers, fishermen, nets & other fishing devices), boats (anchors, see 5.) and also storms; **see Figures 8, 9, 10**
5. Fisher nets & anchors in the reefs (damaging & breaking hard & soft corals); **see Figures 11, 12, 13**
6. Unregulated Boat Traffic & snorkelers; up to 15 very noisy & dangerous speed boats at the same time were observed in small coastal bays (particularly at Cham Islands), endangering snorkelers, divers and the marine environment; additionally dozens of untrained snorkelers, swimming too close to the subsurface corals, endangering & breaking them with their fins; **see Figure 14**
7. Solid Waste under water (particularly to be seen in the protected marine areas at Son Tra near the restaurants at the water, where people are throwing waste (e.g. beer cans) into the ocean water; **see Figures 15 & 16**
8. Accumulated Sea Urchins (to be seen in many snorkeling & diving areas at Son Tra Paeninsula and Cham Islands, which is often an indicator of waste water influence & other pollution); **see Figures 17 & 18**

3 REASONS – CONSEQUENCES - WARNINGS

An increasing fraction of the global population lives in coastal areas, as also here along the coast of Da Nang & Quang Nam Provinces. Without appropriate precautions, development (e.g., buildings and paved roads) increases the fraction of rainfall and other water sources that enter the ocean as runoff by decreasing the land's ability to absorb it. This leads to **an increased sediment & pollution input from land to sea** (e.g. the Thu Bon River is conveying immense sediment loads into the Eastern Sea and towards the Cham Islands, particularly during the rainy season).

Furthermore the **untreated waste water release** into the ocean from the coast of Da Nang & Quang Nam Provinces without sufficient treatment adds immensely to the sea water pollution in this region **since decades**.

Reefs in close proximity to human populations as here are faced with local stresses, including this mentioned **poor water quality from land-based sources of pollution**. Sediment smothers corals and interferes with their ability to feed and reproduce. Pesticides from agricultural land use can interfere with coral reproduction and growth. Consequently reefs in such locations are subject to poor water quality from land- and marine-based sources. *UNEP-studies (2006)*

suggest that approximately 80 percent of ocean pollution originates from activities on land. Pollution arrives from land via runoff, the wind and "injection" (deliberate introduction, e.g., drainpipes). Runoff brings with it sediment from erosion and land-clearing, nutrients and pesticides from agriculture, wastewater, industrial effluent and miscellaneous material such as petroleum residue and trash that storms wash away. Some pollutants consume oxygen and lead to **eutrophication**, killing coral and other reef inhabitants.

Excess nutrients, particularly nitrogen and phosphorus can cause eutrophication (as observed at Son Tra Paeninsula and Cham Islands, see Figures 1 to 6), upsetting the balance of the reef by enhancing algal growth, consequently destroying corals. This nutrient-rich water can enable blooms of fleshy algae and phytoplankton to thrive off coasts. These blooms can create hypoxic conditions by using all available oxygen. Biologically available nitrogen (nitrate plus ammonia) needs to be below 1.0 micromole per liter (less than 0.014 parts per million of nitrogen), and biologically available phosphorus (orthophosphate plus dissolved organic phosphorus) needs to be below 0.1 micromole per liter (less than 0.003 parts per million of phosphorus). In addition concentrations of chlorophyll (in the microscopic plants called phytoplankton) needs to be below 0.5 parts per billion (*Global Coral Reef Alliance 2011*). Both plants also obscure sunlight, killing both fish and coral. High nitrate levels are specifically toxic to corals, while phosphates slow down skeletal growth. Excess nutrients can also intensify existing disease, including potentially doubling the spread of *Aspergilliosis*, a fungal infection that kills soft corals such as sea fans, and increasing *yellow band disease*, a bacterial infection that kills reef-building hard corals by fifty percent (*New Scientist 2006*).

Solid waste (or "marine debris", which is any solid object that enters coastal and ocean waters) is another big problem to be observed in the waters and on the beaches of Da Nang & Quang Nam Provinces. An immense amount of such solid waste can be observed at most of the Da Nang beaches everywhere throughout the year, particularly after storms with their respective currents. That waste derives from ships, particularly fishing boats or is indirectly washed out to sea via rivers, streams, and storm drains. The visible human-made items tend to be the most harmful such as plastics (from bags to balloons, hard hats to fishing lines), glass, metal, rubber (boots, tires etc), or lots of styrofoam.

Particularly plastic debris weathers down into tiny particles, enters the food chain and kills lots of reef species and fish. Derelict (abandoned) fishing nets and other gear—often called "ghost nets" because they still catch fish and other marine life despite being abandoned—entangle and kill reef organisms and break or damage reefs (as observed, see Figures 11 & 12).

Rising sea levels due to **climate change** require coral to grow to stay close enough to the surface to continue photosynthesis. Also, water temperature changes can induce **coral bleaching** as it happened particularly during the 1998 and 2004 El Niño years, in which sea surface temperatures rose well above normal, bleaching or killing many reefs. Here in the region beginning coral bleaching can be observed (see Figures 7 & 8). High sea surface temperature (SST) coupled with high irradiance (light intensity), triggers the loss of zooxanthellae, a symbiotic algae, and its dinoflagellate pigmentation in corals, turning coral white. Zooxanthellae provide up to 90% of their hosts' energy supply. Healthy reefs can often recover from bleaching if water temperatures cool. However, recovery may not be possible if CO₂ levels rise to 500 ppm because concentrations of carbonate ions may then be too low (*Leahy 2007*).

A 2010 report by the Institute of Physics (UK) predicts, that unless the national targets set by the Copenhagen Accord are amended to eliminate loopholes, then by 2100 global temperatures could rise by 4.2°C and result in an end to coral reefs (*Institute of Physics 2010*).

Warming seawater may also encourage another emerging problem: **coral disease**. Weakened by warm water, coral is much more prone to diseases including black band disease, white band disease and skeletal eroding band. If global temperatures increase just by 2 °C during the twenty-first century, coral may not be able to adapt quickly enough (*Glynn 1993, 2011*).

Warming seawater is also expected to cause **migrations in fish populations** to compensate for the temperature change. This puts coral reefs and their associated species at risk of invasion and may cause their extinction if they are unable to compete with the invading population (*Airamé 2009*).

The observed overfishing is certainly due to the fact, that there is **no implementation of legal fishing quota regulations**, as well as due to the use of **unsustainable fishing methods** in and around the marine protected areas of Son Tra Peninsula and Cham Islands, most likely since decades. However, the effects of overfishing can be still reversible, if **a sustainable fishing management** is implemented in and around the marine protected areas of Son Tra and Cham Islands, including the following basic ground rules:

- **No fishing at all inside the marine protected areas** (at least for a number of years, until the fish population has recovered)
- **Safe catch limits**
A constantly reassessed, scientifically determined, limit on the total number of fish caught and landed by the fishing boats
- **Controls on bycatch**
The use of techniques or management rules to prevent the unintentional killing and disposal of fish, crustaceans and other oceanic life not part of the target catch or landed
- **Protection of pristine and important habitats**
The key parts in ecosystems need full protection from destructive fisheries; e.g. the spawning and nursing grounds of fish, delicate sea floor, unique unexplored habitats, and corals.
- **Monitoring and Enforcement**
A monitoring system to make sure fishermen do not land more than they are allowed to, **do not fish in closed protected areas** and cheat as less as possible. Strong monetary enforcement is needed (penalties!) to make it uneconomic to cheat.

There are many good examples (e.g. from the Philippines), where the establishment of marine sanctuaries (= protected areas) with the consequent implementation of the above rules has brought back the almost extinct fish population after already a few years. **But it is very important that the damaged and exploited fish stocks get that time, when no fishing is allowed inside the marine protected areas, to recover.**

From the observations of this survey it became very clear, that this fishing recovery time for Son Tra and Cham Islands is urgently required IMMEDIATELY ! Otherwise not only fish & reef species will be lost but entire ecosystems and habitats.

Since a **marine protected area (MPA)** is essentially a space in the ocean, where human activities are more strictly regulated than in the surrounding waters, apart from the above also the observed **unregulated boat traffic and anchoring as well as the exaggerated number of untrained snorkelers** in small bays (see Figure 14) **must be regulated**. Such noisy tourist boats and untrained snorkelers create a very negative impact on the marine environment with lots of damages, as broken corals (Figures 8, 9, 10) and anchors in reefs (Figure 13) show.

Speedboats (and dive boats) should be allowed **only in small numbers** near marked diving & snorkeling areas, where they have to approach & leave with **very low speed**, constantly observing the water carefully for divers & snorkelers. They must anchor at **fixed mooring buoys**, outside the marked diving & snorkeling areas. Untrained snorkelers should be kept away from areas with corals very close to the surface, so that they do not destroy corals with their fins.

4 RECOMMENDATIONS

Due to all of the observed problematic facts (described in Section 2 & 3) the situation of the marine environment in and around the "protected" marine areas at Son Tra Paeninsula and Cham Islands has to be considered "**unhealthy and very severe**".

Consequently the following **mitigating actions** shall be recommended:

1. The observed severe marine environmental situation around Son Tra Paeninsula and Cham Islands should be reported to the "Agency for the management of Islands & Sea/ DONRE" in Da Nang & Quang Nam and all other related departments for **further protective & mitigating action by the local authorities**.
2. The "**protected marine areas**" at Son Tra Paeninsula and Cham Islands **must be protected more efficiently**, for the future benefit of the marine environment as well as for the income producing tourism sector.
The protection must be regulated by clear rules & regulations for the marine protected areas (particularly against unsustainable overfishing, excessive unregulated boat traffic & severe pollution by solid waste and waste water releases from the coast & fishing boats).
3. The **implementation of such rules & regulations as well as the regular monitoring of the biological health condition of the marine protected areas and their fish & reef status should be conducted by marine patrols**, which could be recruited either from the local governments, from the (trained) local communities and/or the existing diving enterprises. Such patrols must receive a respective training concerning the legislation & protection of the marine biology (reefs & fishes) & environment and their protection.

4. **Implementation of a sustainable fishing management with fishing rules & regulation:**
 - a) **No fishing at all inside the marine protected areas** (at least for a number of years, until the fish population has recovered)
 - b) Safe catch limits around the marine protected areas
 - c) Strong monetary enforcement (penalties!) to make it uneconomic to cheat
5. Mooring (throwing anchors) causes damage which can be reduced by **using mooring buoys**. Buoys can be attached to the seafloor using concrete blocks as weights or by penetrating the seafloor, which further reduces damage.
6. **Snorkeling and diving areas** at the marine protected areas **should be marked and fenced with buoy lines** for diver & snorkeler protection against dangerous boat traffic. All boats must stay outside such marked areas at fixed mooring buoys. The boats are also required to approach & leave these areas with **very low speed, obliged to observe the water carefully for divers & snorkelers**. Untrained snorkelers should be kept away from areas with corals very close to the surface, so that they do not destroy corals with their fins.
7. **No more untreated waste water-release should take place into the Northern & Eastern Sea** anymore from the Da Nang & Quang Nam coast as well as from the Cham Islands. This has been done over decades and must be stopped as soon as possible! Otherwise many of the still intact coral reefs around Son Tra Paeninsula and Cham Islands will be suffocated by the excessive green-brownish algae growth and die (as it can be observed already now at several locations (see Figures 1 to 6) . This means, that not only fish & reef species will be lost but an entire ecosystem.
8. **Consequently a complete connection of all households, resorts & hotels to the waste water network & treatment** along the coast of Da Nang & Quang Nam Province is **urgently required**. While this will take place for Da Nang City during the next years to come within major waste water treatment programs (e. g. supported by World Bank), for other coastal areas (as the Cham Islands and at other places along the coast of Quang Nam) the establishment of **smaller, decentralized waste water treatment plants** can be recommended. This was done for coastal communities & smaller cities e.g. in the Philippines (with financial ADB-support) and contributed to an immense relief from pollution for the marine environment and the coastal reefs due to the decentralized cleaning of the waste waters, which accumulate in the overpopulated coastal regions.
9. The severe **Solid Waste-Problem** in the ocean water and at the beaches of Da Nang & Quang Nam Province must be urgently addressed by **Environmental Awareness & Education Campaigns**. These should be conducted concerning terrestrial & marine environmental protection **in Radio, TV, and the Press**. Recommendable are Radio- and TV-programms, conducted DAILY as short 10 to 15 min shows before the main news at major broadcasting times OVER MANY YEARS (as done e.g. during the Environmental Protection Awareness Programmes in Germany or the USA during the 1970ies). As well **Environmental Protection Projects** (including Brochure & Poster Production) should be conducted **in educational institutions** (schools, universities etc).

10. This report is based on only a few snorkeling rounds & dives at only a few locations at Son Tra Paeninsula and Cham Islands during a very limited time period. Consequently it is suggested, to **conduct such marine surveys & monitoring rounds extended and on a regular basis** (best every month) by experienced divers & monitoring patrols (see recommendation 3), **covering all of the marine protected areas at Son Tra Paeninsula and Cham Islands.**
11. Dr. Falke suggests to give a **presentation**, including such above recommendations, to CCCO and the respective departments of Da Nang & Quang Nam, concerned with the environmental protection of the valuable marine water resources & protected marine areas.

5 PHOTO DOCUMENTATION

Photos, as shown on the following pages (23 Figures), were taken by Dr. Falke with a Canon Ixus 400 camera in an underwater housing.

He has archived approx. 300 underwater photographs from Son Tra Paeninsula and Cham Islands, differentiated by location and “kinds of problems and damage”.

PHOTOS (Problems & Damages/ Fig. 1 to 18)



Fig. 1 (Reg.-Nr. 5715): Eutrophication Problem; empty greenish-brownish area, overgrown rock and coral with flimsy algae cover (Location: Bai Nom, Son Tra Paeninsula, water depth 3 m)



Fig. 2 (Reg.-Nr. 5885): Eutrophication and suffocation problem; Partly healthy green coral (*Tubastraea*) with green-greyish algae cover on dying coral branches (Location: Hon Gai, Cham Islands, water depth 20 m)



Fig. 3 (Reg.-Nr. 5887): Eutrophication Problem ; rocks and dying corals with greenish-greyish algae cover, in the center left a lionfish (*Dendrochirus*); (Location: Hon Gai, Cham Islands, water depth 18 m)

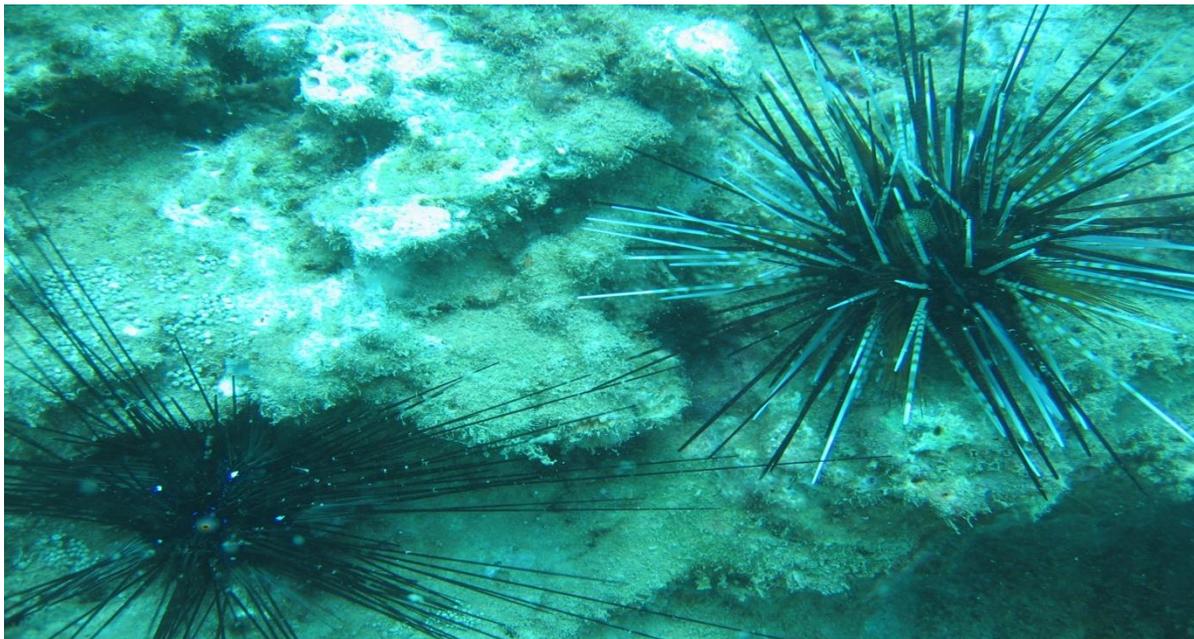


Fig. 4 (Reg.-Nr. 5954): Eutrophication and Waste Water Problem ; Sea Urchins as waste water indicator, surrounded by greenish-greyish algae overgrowth on dead table coral (Location: Hon Gai, Cham Islands, water depth 8 m)

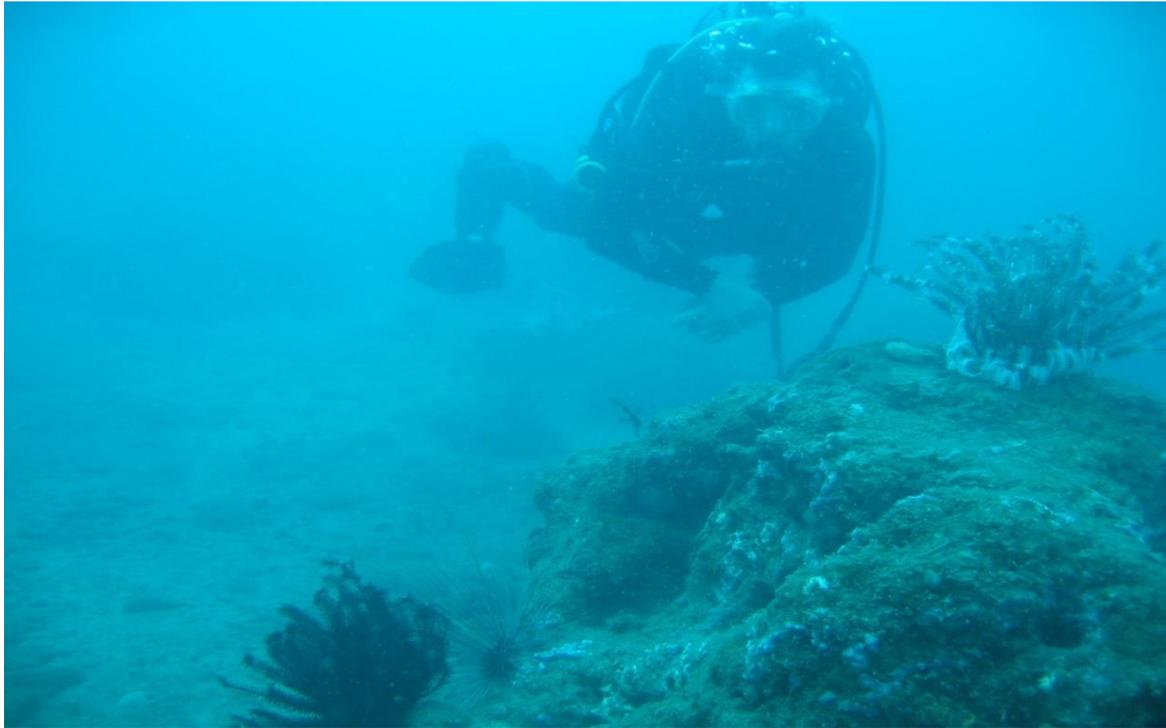


Fig. 5 (Reg.-Nr. 5792): Turbidity (murky water & low visibility) and Eutrophication (greenish algae overgrowth at bottom and on the rock), caused by waste water releases from the coast; (Location: Hon Giai, Cham Islands, water depth 15 m)



Fig. 6 (Reg.-Nr. 5744): Turbidity (murky water & low visibility) and Eutrophication (greenish algae overgrowth at bottom and on rocks & coral), caused by waste water releases from the coast; (Location: Bai Nom, Son Tra Paeninsula, water depth 3 m)

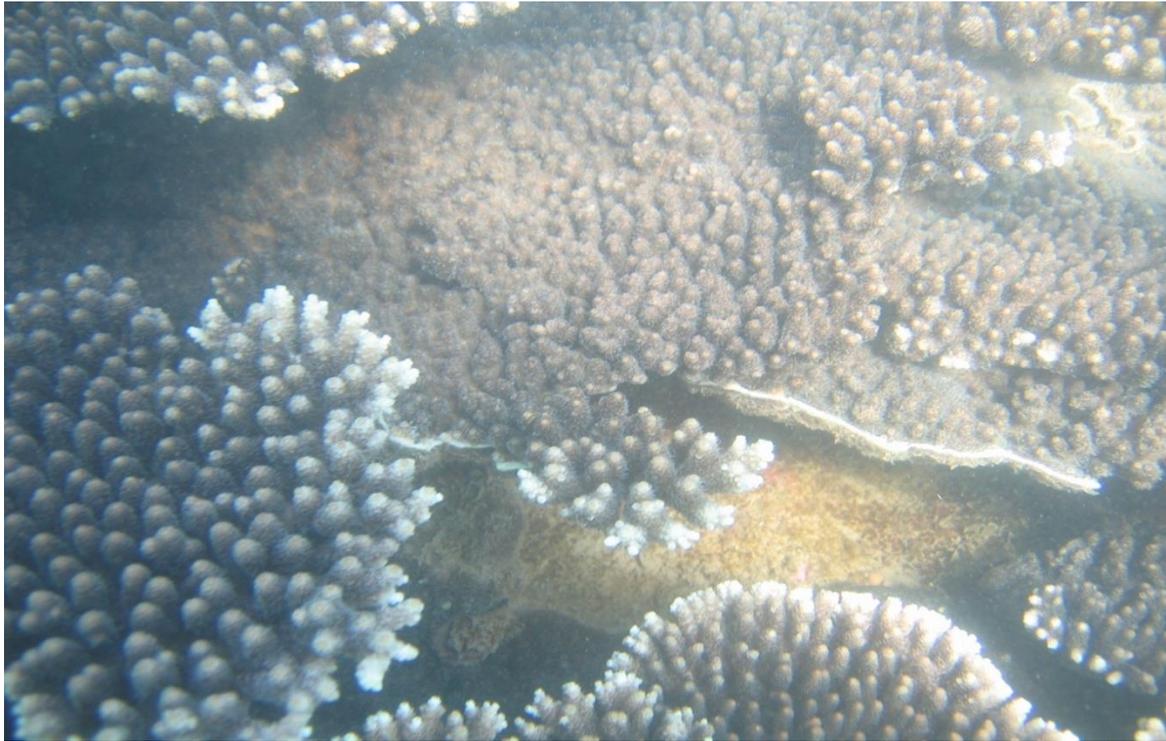


Fig. 7 (Reg.-Nr. 5714): Coral Bleaching Problem ; Bleached Staghorn Coral (*Acropora*); (Location: Bai Nom, Son Tra Paeninsula, water depth 3 m)



Fig. 8 (Reg.-Nr. 5711): Broken & bleached Staghorn Corals (*Acropora*); (Location: Bai Nom, Son Tra Paeninsula, water depth 4 m)

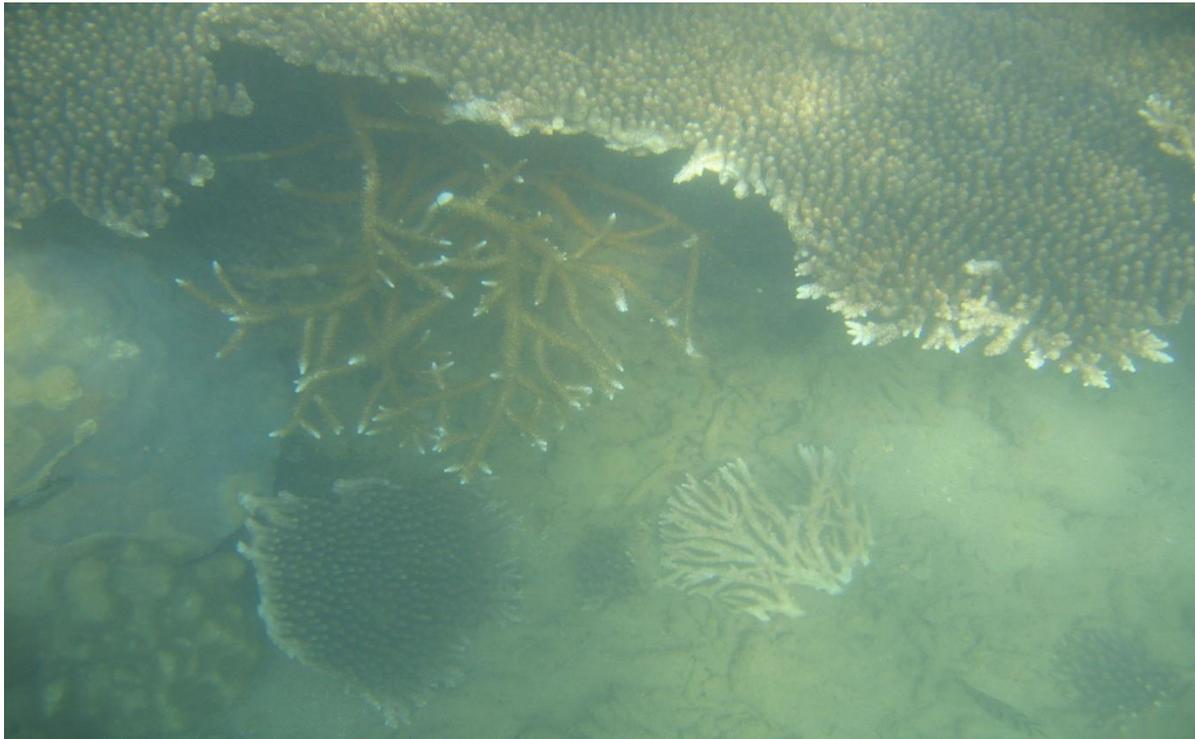


Fig. 9 (Reg.-Nr.5703): Mechanically broken table & staghorn corals (mixed *Acropora* corals); (Location: Bai Nom, Son Tra Paeninsula, water depth 3 m)



Fig. 10 (Reg.-Nr.5718): Mechanically broken stone coral (*Turbinaria*); (Location: Bai Nom, Son Tra Paeninsula, water depth 4 m)

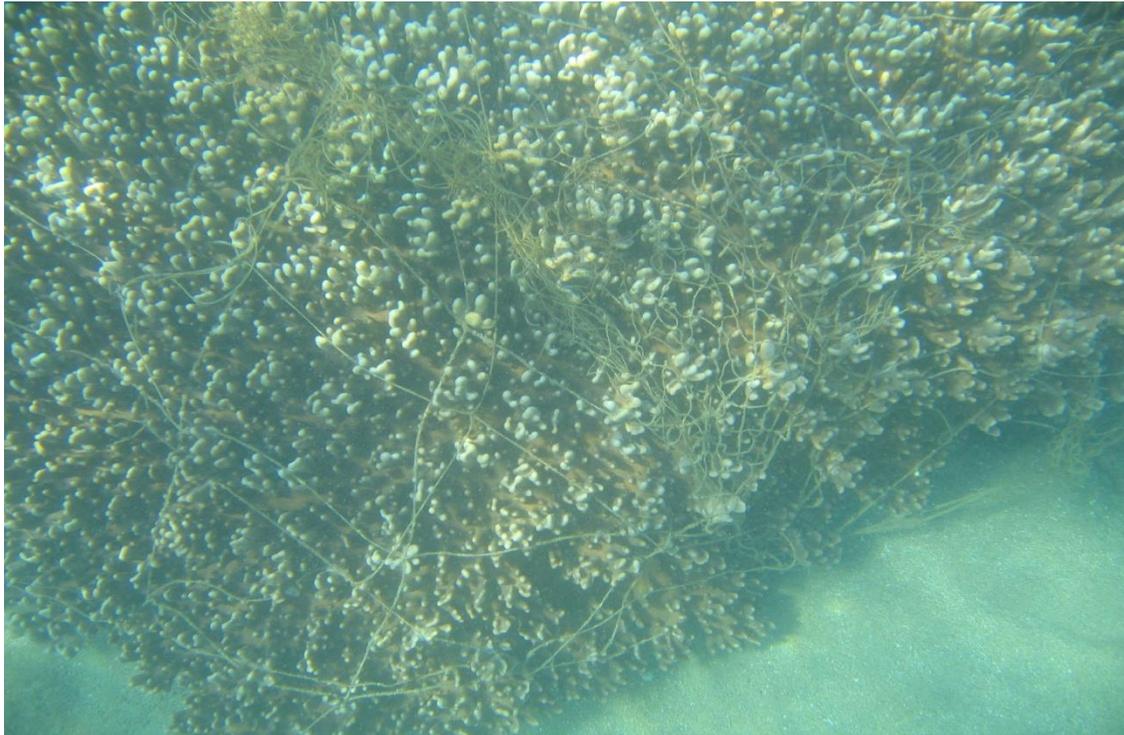


Fig. 11 (Reg.-Nr.5769): Fishing Net in a reef, damaging soft coral (*Sinularia*); (Location: Bai Nom, Son Tra Paeninsula, water depth 3 m)



Fig. 12 (Reg.-Nr.5815): Fishing Net in a reef, damaging corals & feather stars (*Crinoids*); (Location: Hon Giai, Cham Islands, water depth 7 m)

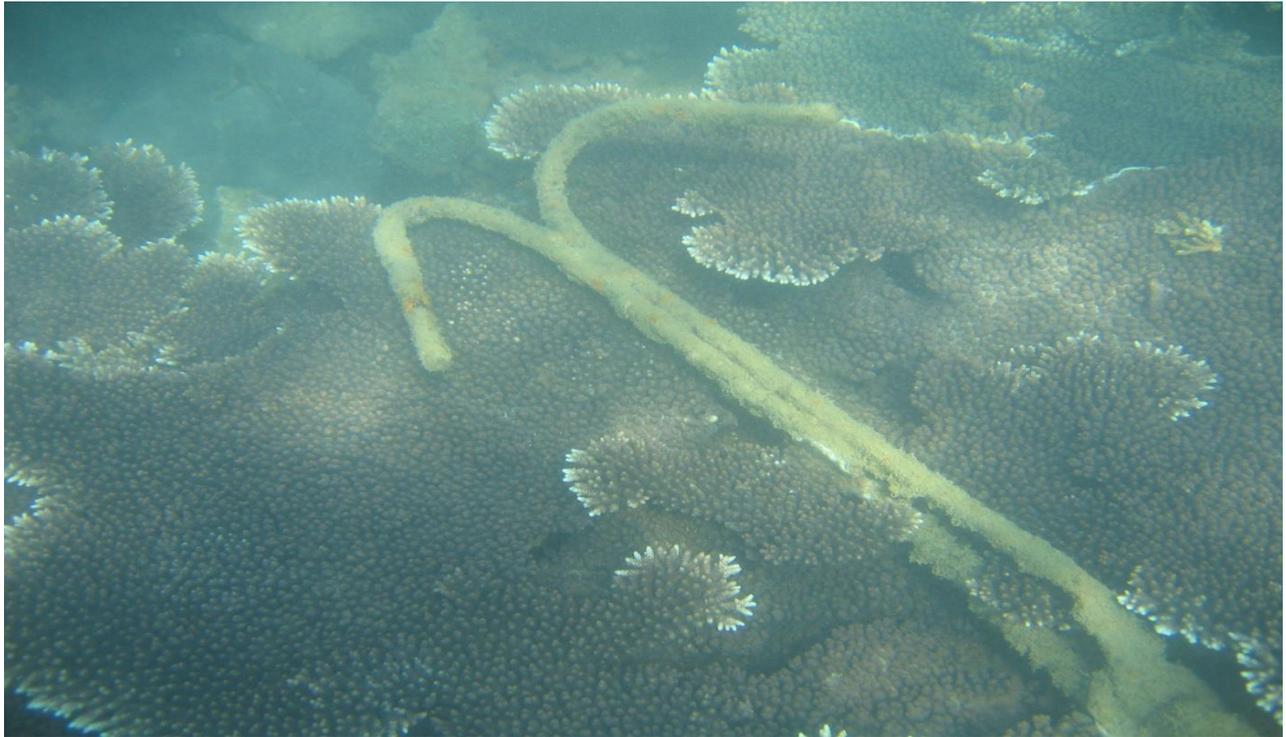


Fig. 13 (Reg.-Nr.5735): Anchor, damaging hard coral (*Acropora*);(Location: Bai Nom, Son Tra Paeninsula, water depth 3 m)



Fig. 14 (Reg.-Nr.5860): Unregulated boat traffic, endangering snorkelers, divers and the marine environment; (Location: Hon Giai, Cham Islands)



Fig. 15 (Reg.-Nr.5745): Solid Waste under water, e.g. such beer cans, particularly to be seen in the protected marine areas at Son Tra near the restaurants at the water (see Fig.16/ Location: Bai Nom, Son Tra Paeninsula, water depth 3 m)

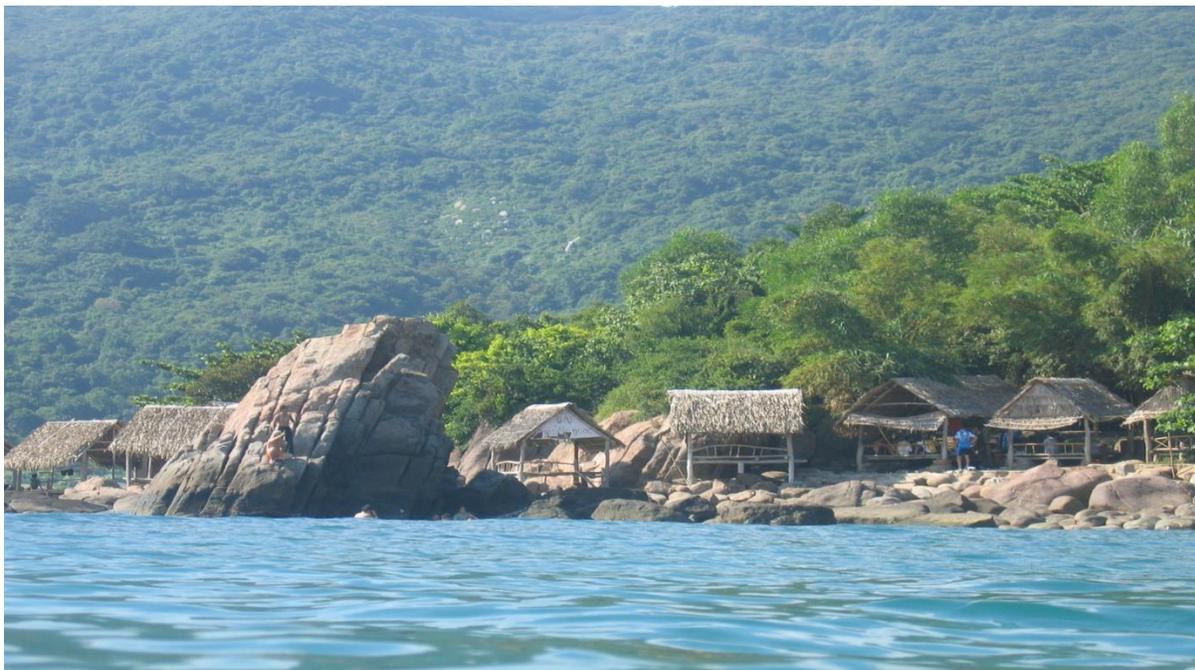


Fig. 16 (Reg.-Nr.5774): From such restaurants solid waste (e.g. beer cans etc) & waste water are released into the protected marine area; (Location: Bai Nom, Son Tra Paeninsula)

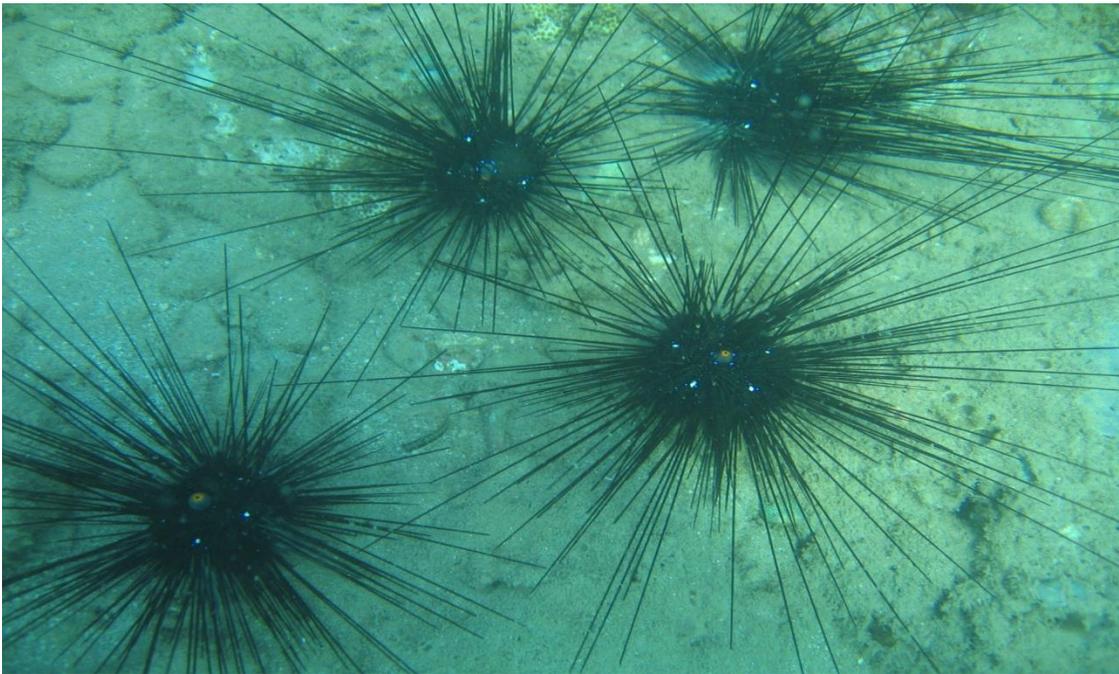


Fig. 17 (Reg.-Nr.: 5778): Accumulation of sea urchins, surrounded by eutrophic algae growth, as indicators of waste water influence, near a restaurant (see Fig. 16, at Bai Nom, Son Tra Paeninsula, water depth 4 m)



Fig. 18 (Reg.-Nr.: 5840): Accumulation of sea urchins as indicator of waste water influence; (Location: Hon Gai, Cham Islands, water depth 6 m)

PHOTOS (Healthy Corals/ Fig. 19 to 23)



Fig. 19 (Reg.-Nr. 5691): Healthy Stone Coral (*Turbinaria*); (Location: Bai Nom, Son Tra Paeninsula, water depth 3 m)



Fig. 20 (Reg.-Nr. 5831): Healthy Feather Stars (*Crinoids*); (Location: Hon Gai, Cham Islands, water depth 9 m)

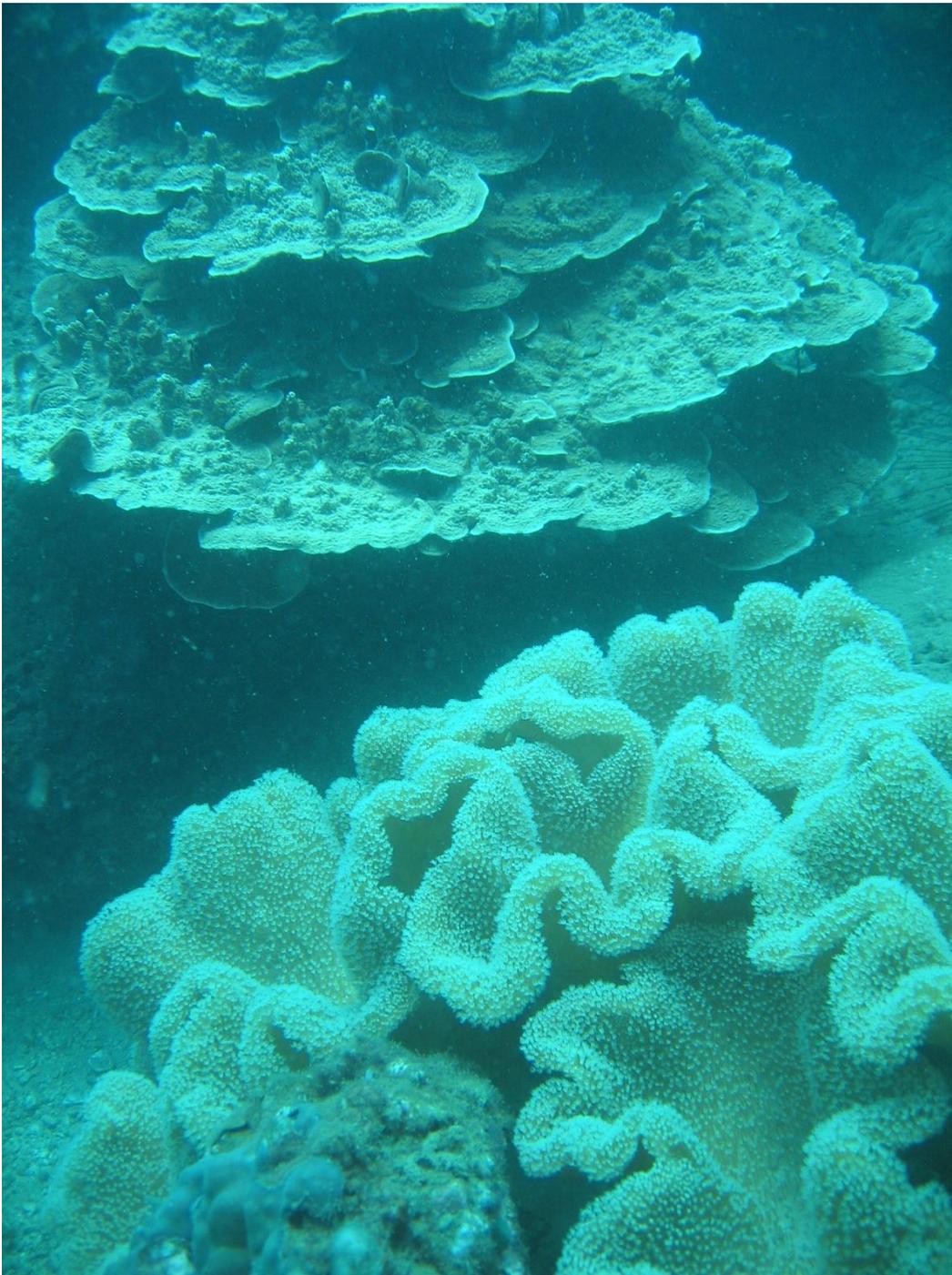


Fig. 21 (Reg.-Nr. 5960): Healthy Hard and Soft Coral (*Montipora* & *Sarcophyton*); (Location: Hon Gai, Cham Islands, water depth 7 m)

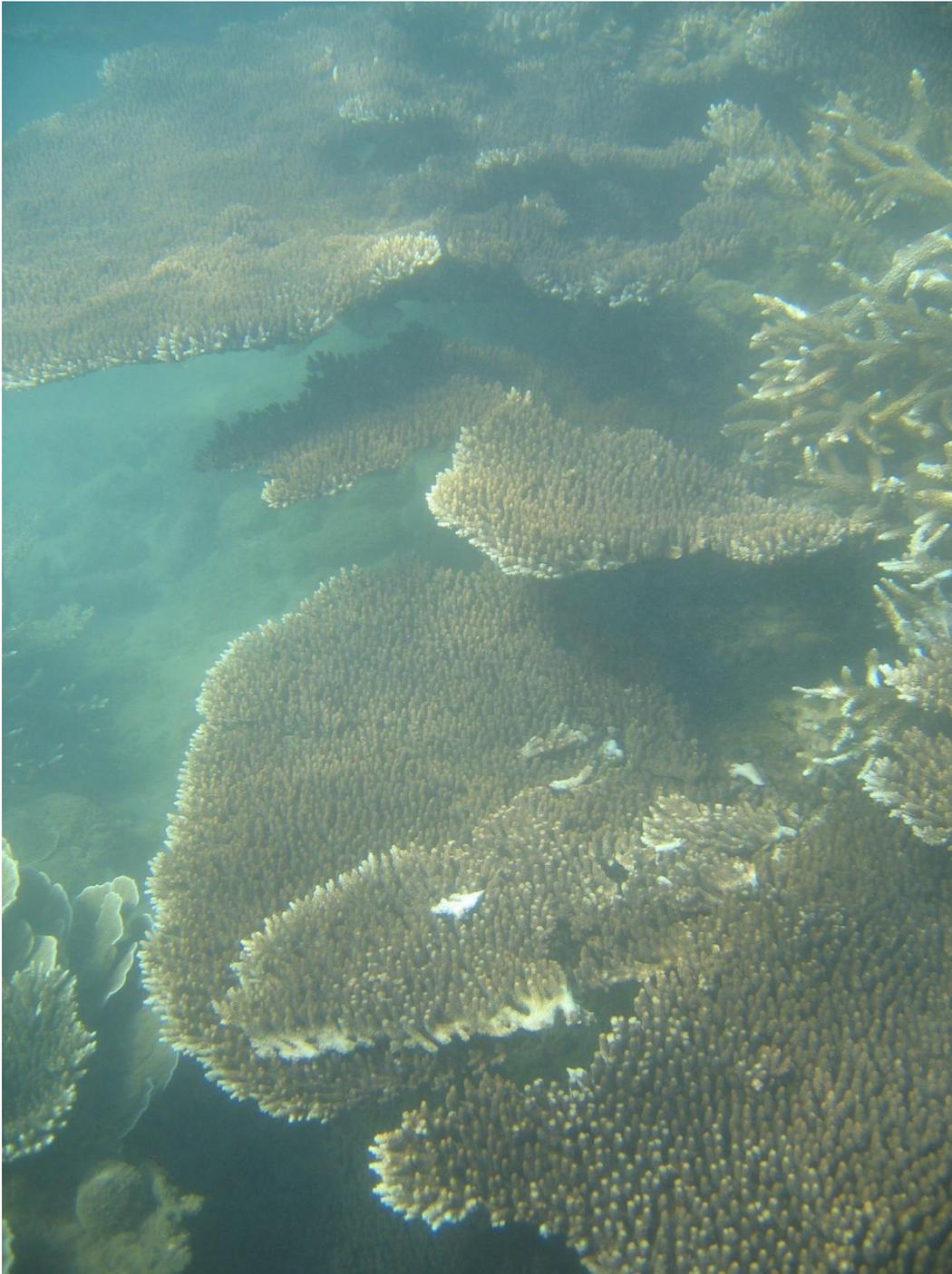


Fig. 22 (Reg.-Nr. 5719): Healthy “Table Coral” (*Acropora*); (Location: Bai Nom, Son Tra Paeninsula, water depth 3 to 5 m)



Fig. 23 (Reg.-Nr. 5969): Healthy Soft Corals (*Sinularia* & *Sarcophyton*); (Location: Hon Gai, Cham Islands, water depth 6 m)

Figures 19 to 23 show the still existing beauty of the coral reef areas around Son Tra Paeninsula and Cham Islands.

This beauty should be efficiently protected and preserved for the benefit of the marine environment (and a reoccurring fish population) as well as the many more generations of tourist and local divers & snorkelers to come.

Consequently the local authorities should protect the marine environment and the “protected areas” more efficiently, while using the following 4 important tools:

- the formulation of **clear rules & regulations** for the marine protected areas
- their consequent **implementation by marine patrols**
- the conduction of **marine surveys and fish & coral monitoring on a regular basis**
- the conduction of **Public Environmental Awareness & Education Campaigns** through all media (TV, Radio, Press).