ADDING PIECES TO A COMPLEX PUZZLE

discovering the benthic life in the channels and fjords of Chilean Patagonia

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FIGURE 1:

With its almost 1600 km of north-south extension, the Chilean fjord region is comparable in size with the fjord land coast of Norway. It is formed by two parallel mountain ranges, the high Andes and the coastal mountains, and thus is the most structured in the world. The Chilean oceanographic institute SHOA calculated that the thousands of islands, channels and fjords enlarge the coast to a length of almost 90.000 km (map scale). Coast morphology in combination with a highly complex interference pattern of physical factors and gradients such as salinity, sedimentation, light exposure, currents, wave exposure etc., create an immense diversity of habitats. The marine life of the Chilean fjord region, however, belongs to the least studied worldwide (Global Marine Environment 1, 2004, p. 12-13). Therefore it does not surprise that new species (Cairns et al., 2005), and even entire new benthic communities such as cold-water coral banks (Försterra & Häussermann, 2003) and mats of chemotrophic bacteria (Gallardo et al., 2005) are regular findings of recent studies. Only some inner fjords of the northern part of this area are accessible from land on a gravel road called *Carretera Austral*; most parts of the area between the Peninsula Taitao and the Straits of Magellan are extremely isolated and can only be reached by boat. To access most of the channels and islands, longer and, due to harsh weather conditions, sometimes adventurous boat trips are required.

Despite these logistic problems the aquiculture industry in the Chilean fjords is still growing at a breathtaking speed and today Chile is the world's largest producer of farmed salmon and the boom is just starting. Other industries and fisheries that have impact on the marine life in this region are expanding, too, and the number of people dedicating to professional sea food harvesting has quadrupled in the last decade and harvesting techniques are as efficient as never before. This dramatically growing pressure on the marine ecosystems requires sustainable management and the urgent designation of Marine Protected Areas. In this context knowledge on the zoogeographic patterns are more relevant than ever.

Since we started working in the Chilean fjords, questions on the zoogeography in this region are driving forces of our activities. In particular, the possible subdivision of the Chilean fjord region into distinct parts has been an unresolved question. Several authors posed

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the hypothesis of a zoogeographic limit around 48° S (e.g. Lancellotti & Vasquez, 1999). Oceanographic conditions (Pickard, 1973) and the Peninsula Taitao that extends far into the Pacific together with the Golfo de Penas represent potential migration barriers at these latitudes. However, poor sampling south of these coastal discontinuities inhibits definite conclusions. Especially the shallow rocky subtidal, where the highest biomass and macrobenthic species numbers can be found, is practically unstudied. Questions on the faunal changes from the inner fjords to the outer islands remained completely untouched.

In March 2005 we launched a two-parted expedition to Chiloé Island and the Guaitecas Archipelago (44°S) and to the fjords and channels around 49°S, adjacent to the southern icefield, respectively. A main focus was set on the distribution of cold water coral banks that we described from fjords of the northern part of Chilean Patagonia (Försterra & Häussermann, 2003).

To be able to operate in an area without scientific infrastructure, we had to take everything with us, from a compressor to fill the tanks over diving and photographic equipment to aquaria and chemicals for sample preservation. It was crucial to calculate enough redundancy for potential equipment failures. With 10 boxes full of equipment we left Huinay Scientific Field Station, our base in the fjord Comau (www.huinay.cl). The Guaitecas Archipelago is connected to Chiloé Island by a weekly ferry but for exploring the area it was necessary to hire a boat. After several dives on Chiloé Island and then waiting two days for the delayed boat together with five colleagues from Belgium and Brazil, we left Quellon harbour shortly before it was closed due to bad weather conditions. During the rough gulf crossing on the crowded boat (dishes were flying around) even the young captain seemed a bit worried. The bad weather kept us another day trapped in the harbor of Melinka, the main village on the Guaitecas before we finally could start our work. Accompanied by only minor problems (motor damage, clogging of the toilet, failure of the generator,…) we were able to realize sampling dives at 5 sites distributed over the islands.

Although we did not see as many sites as we had wished, we got a good impression of the area and collected a considerable amount of material. We were surprised of the high diversity (on first sight it seemed higher than in the inner fjords), patchiness and heterogeneity on several scales in this area. Each site hosted very different communities, sometimes even in close vicinity. And the benthic communities were quite different to those we knew from the inner fjords, e.g. ascidians, very rare in the fjords, were quite abundant in the channels between the islands. We found many species we did not know from the fjords, and the ones we recognized, often were of major or minor importance than in the fjords. Our coral studies brought some very peculiar findings. Corals in general played a minor role at the sites that we examined although the coast morphology often was similar to those fjord sites where large coral banks can be found. Practically all the *Desmophyllum dianthus*, the frame work species for coral banks in the fjords that we found were dead and there were almost no signs of recovery or new recruitment. Inferring from the grade of erosion of the corallites (some of them approx. 60 years and older) it seems that all the corals of the area have died simultaneously some 2-4 years ago, a phenomenon that remains a riddle to us.

The second part of the trip logistically was more challenging. We were heading for the fjords Tempano and Bernardo and adjacent channels for a study of the biodiversity. To get to this remote place we boarded the Navimag ferry that connects Puerto Montt with Puerto Natales and leaves approximately once a week. The ferry that transports an interesting mixture of cattle, fish meal and tourists needs three days for the entire distance. After a day in calm channels and fjords the ship enters open waters to round Cabo Raper on Taitao Peninsula and to cross the Golfo de Penas. Especially this last part (translated Gulf of Sorrows) honours its name and forces many of the passengers to bed or even to the bathroom. After 2 days we reached Puerto Eden, a small village within an Indian reservation and the only stop during this trip. Here German, Manuel, Guillermo y Aliro, the crew of the

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Yepayek (the boat of the CONAF - the national park rangers), were waiting for us. After 7 more hours on this boat we reached the Tempano refuge, a station primarily built for the observation and protection of the huemul, an endangered Patagonian deer species. The next 10 days we stayed on the Yepayek where our 16 hours daily routine consisted of preparing dives, underwater sampling and photographing, registering and preserving samples, filing digital photos, recharging batteries and tanks and drinking hot chocolate to regain warmth.

The landscape adjacent to the large inland icefield is of breathtaking wild beauty. Tempano fjord is characterized by a calving glacier at its head and the influence of glacier-sediment loaded melt water. The sediment that was easily revolved by every move reduced visibility often to zero and made diving very difficult. Our dry suits that worked fine in the northern fjord region hardly isolated enough to prevent us from shivering after 45 minutes in iceberg cooled water. Bernardo fjord is without direct glacier contact, but influenced by sediment-loaded melt-waters. Due to the quite thick freshwater layer caused by the many glaciers and rivers, the most interesting benthic communities started below 20 m. After 8 days of diving 2 to 4 times a day at 13 sites and collecting 249 samples which we all photographed in the habitat and preserved carefully and separately , we were completely exhausted, saturated with nitrogen, but happy about all the great things we had seen.

Quantitative diversity analyses are still in process and specimens are still being identified from taxonomic specialists all over the world, but as a preliminary summary of our findings we can point out that the general diversity in the inner fjords of the southern fjord region seems to be significantly lower compared to fjords north of the Taitao peninsula. This seems to be correlated with the load of sediments coming from the glaciers, that play an important role in the southern fjord region. In the Tempano fjord, rocks were thickly covered by fine glacial sediment. This situation did not even improve towards the mouth of the fjord, since here a large milky river is entering the fjord. We found very few species, most of them restricted to vertical and overhanging walls where sediment stress is lower. Among those species however were some very interesting representatives such as the bivalve *Acesta* aff. *patagonica*

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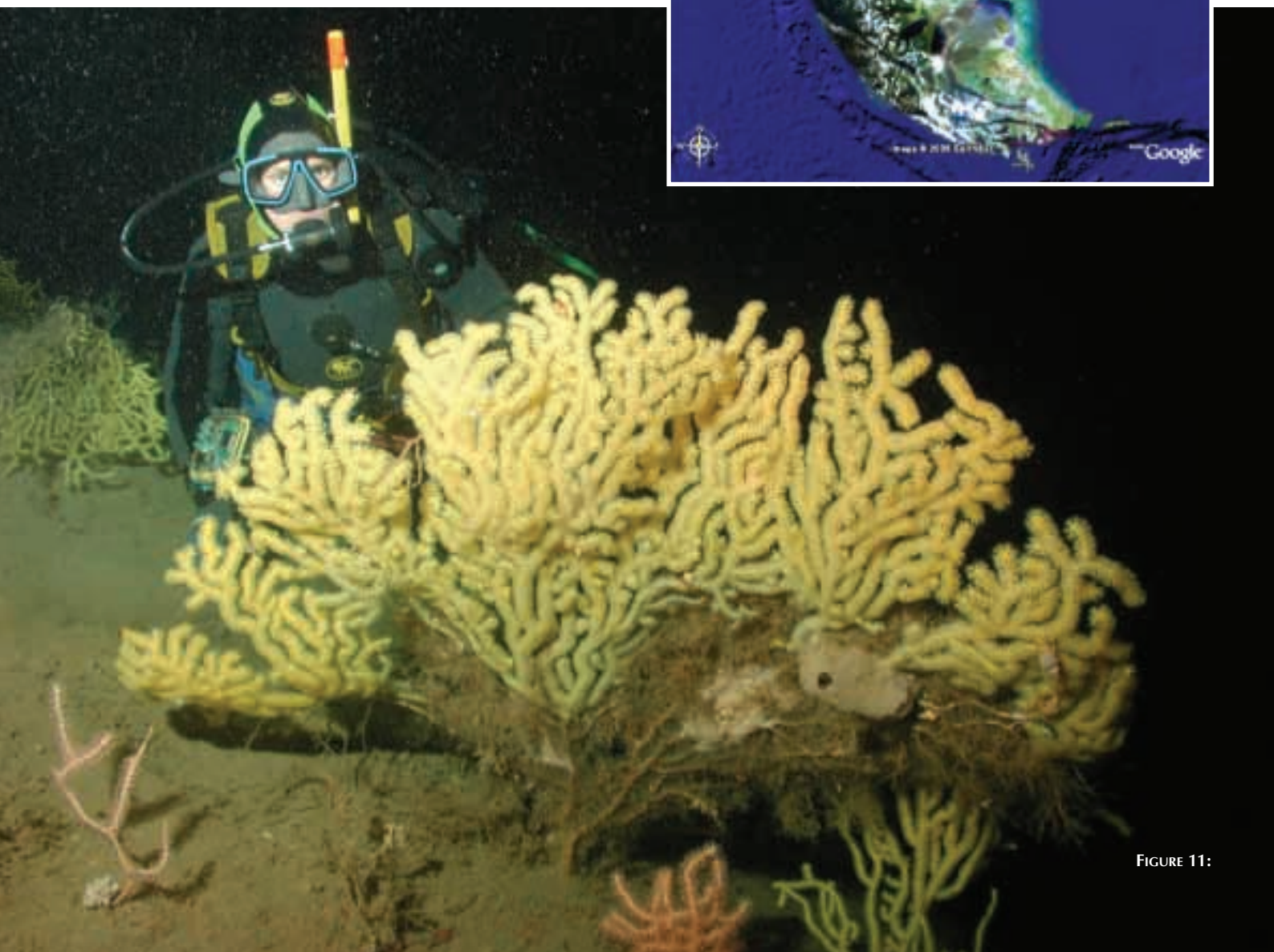

Figure 11:

in less than 20 m depth, which is known from several hundreds of meter depth off the central Chilean coast. The Bernardo fjord is less affected by glacial sediments and consequently was richer in benthic life. Overall diversity was increasing the further we went away from the glaciers towards the channels further west. The “Enlish Narrow” in Messier channel with its strong currents was with distance the most diverse site we examined. Although at first sight we could not find a difference in diversity of the benthic life in the channels south of Golfo de Penas to the channels north of Peninsula Taitao, we were surprised how different the communities were in the two parts of the fjord region. In the south we found communities that were characterized by organism groups and species that we never found in the northern fjord region. Ophiurids were much more common than in the north, at some sites large bryozoans were very abundant. We first time could observe large hydrocorals, giant fan gorgonians and crinoids. The dominating sea anemone species from the northern part (*Anthothoe chilensis* and *Corynactis carnea,* Global Marine Environment 1: 16-17) were replaced in the south by *Metridium senile lobatum* which covered impressive areas. Although all 3 shallow water Scleractinia species from the northern fjords (Cairns et al., 2005) were sporadically present at overhanging portions of the fjords Tempano and Bernardo, corals played a minor role in the benthic communities of the southern fjords and were never present in large accumulations as we described them from the northern fjords (Häussermann & Försterra, 2003).

Concluding from these findings we can confirm the hypothesis about a subdivision of the Chilean fjord region. As in the northern fjord region we found a very complex, patchy pattern with very different conditions and benthic communities even within short distances. And -as in the north- these pattern can only partly be correlated with factors that can be read from a chart such as coast morphology, bathymetry or currents.

Although this is an interesting fact which shows the enormous diversity of this region, it also indicates how much more efforts have to be made before we have data sets that permit reasonable coastal management. The best that can be done in such a situation is to base decisions on what we know so far and on experiences that have been made in comparable regions and of course increase the efforts for benthic inventories and mapping. And in such a situation it is a question of reason to exclude large areas from exploitation and designate marine protected areas until we know more about the distribution and responses of the affected communities.

Our next expedition that shall bring us to the outer channels and the exposed islands of the southern fjord region is already scheduled for next summer. We hope it will help us to add more pieces to this very complex puzzle.

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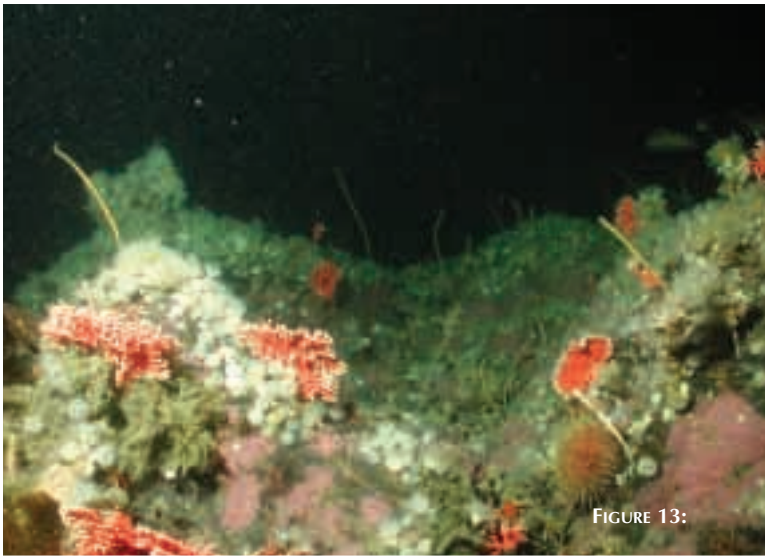
Figure 12:



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