Polarforschung 82 (2), 144–146, 2012 (erschienen 2013)

Antarctica is under pressure – challenges for polar science*

by Angela Grosse*[1]

"Challenges to the Future Conservation of the Antarctic" is the title of a paper Steven Chown from the Monash University and colleagues published nearly a year ago in SCIENCE (CHOWN et al. 2012). They warn that *"… global environmental change and the growing interest in the region's resources increases the stress on Antarctic Treaty System." "Interactions between resource use and climate change are especially significant threats …",* Steven Chown (CHOWN 2012). The challenges to the future conservation of Antarctic are challenges to the polar science itself, because Antarctica is under pressure by global climate change and global lifestyle change.

New studies like the update 2013 of the Antarctic Climate Change and Environmental Report (TURNER et al. 2013) show that the global climate change will affect parts of the Antarctic, especially the Antarctic Peninsula and Central West Antarctica more severely than the rest of the world. This is confirmed by a study by BROMWICH et al. (2012): *"Our reconstructed Byrd temperature record reveals one of the most rapidly warming places on the planet since the 1950s, and its spatial footprint indicates that similar change has probably occurred over a broad area of West Antarctica."* Bromwich and his colleagues show a marked increase of 2.4 °C in average annual temperature since 1958 – that is three times faster than the average temperature rise around the globe and nearly double as high as previous research has suggested. This stresses the nature environment, changes it.

At the same time the human footprint – even by science! – is growing, because more and more people visit Antarctica and as a consequence of life style change humans leave deeper traces on this continent. Two brief examples.

The human use of the Antarctic environment by tourism has increased rapidly – from 6000 visitors in the mid of the 1990s (LAMBERT 2008) up to 35.000 expected tourist in the season 2012/2013 (IAATO 2013). If you ask Google for tourism and Antarctica it gives you 2,540,000 answers – if you ask Google for Serengeti it gives you only 695,000 answers. Nothing better than this result shows the great interest of the public. More than 40 companies from nearly 15 countries offer cruises with shore leaves (RUSSELL et al. 2013).

In combination with climate change this invasion of tourists increases the danger of introduction germs, microbes and of no indigenous species that might become invasive and the risk of pollution. That has often been stressed. TURNER et al. (2013) write that a juvenile spider crab provides the evidence of an assisted transfer, *"possibly by ballast water to the Antarctica"* and warn that warming also increases the likelyhood of invasion by more competitive alien species carried by water and air currents, humans and other animals. *"We really don't know what additional impact that those tourism numbers … are having on what is already a very significantly changing environment",* Neil Gilbert, Antarctic New Zealand's environment manager is quoted in The Salt Lake Tribune early this year (GILBERT 2013).

But not only retirees are watching penguins and whales from the deck of the ship. There has been – and that is even more important – a change of tourism. More and more visitors – like elsewhere in the world – conquers areas that were not entered by humans yet. Adventure tourism and extreme sportsmen (and their sponsors!) have discovered the Antarctica: skydiving, kayaking, snowshoeing, extreme climbing, extreme hiking or scuba diving under ice are some of the activities done on the continent. These activities leave deeper traces on the continent; this development includes more land-based components and the risk of permanent facilities for tourism.

I don't deny: Antarctic tourists as well as extreme sportsman could become ambassadors for the fantastic nature of Antarctica. Surely tourism has the potential to support the efforts to preserve the unique nature of Antarctica, but only – and that is really important – if the tourism industry thinks and acts in long term. Then they can contribute to the preservation of the environment.

But can we be sure? If you look to Himalaya then you can really get great doubt. With strict guidelines and codes of conduct the IAATO has been able to swipe concerns away. But this self-regulation is no absolute guarantee for a sustainable tourism industry on Antarctica. BASTMEIJER (2013) writes in the Polar law Textbook II: *"ATS has often been praised for its proactive approach in addressing possible future policy concerns (e.g., regulating mining activities before they began, prohibiting dogs because of possible disease risks, etc). Nevertheless, it remains uncertain whether the ATCM will be able to adopt this approach in respect of the joint regulation of Antarctic tourist activities."*

Because it is Antarctica every footstep matters. This also applies to the footprints of the scientists. 29 Nations operate 98 research stations and camps in Antarctica. About 4400 people live there during the summer, about 1000 during the winter (COMNAP 2013). Do we really need all of them? Why don't we intensify cooperation?

The human footprint grows by lifestyle change even far away from the Antarctic. The debate in western countries around a healthy diet and around ecological behavior increased the

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* The article is based on an oral presentation at the SCAR History and Social Science Workshop, 1st-5th of July 2013 at BAS, Cambridge.

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demand for fish and seafood. Since the normal fishing cannot satisfy this demand, aquacultures get more and more popular. Right now aquaculture *"is the fastest growing food sector"*, says the report "World in Transition – Sea World's heritage" of the Scientific Advisory Board for Global Change of the German Federal Government. *"Yet it is widely assumed that the increasing demand for fish products in the face of stagnant yields mainly will be met by aquaculture"* (WBGU 2013). Several ecological and social problems are associated with this development; one is Antarctic krill (*Euphausia superba*).

In the 1990th the average catch of krill was 100,000 tons. Recently catches have grown: 211.000 tons of krill were harvested during the season 2009/2010, 180.000 tons were captured in 2010/2011 (CCAMLR 2012 p.56). 43 % of the catches are used for aquaculture (SIEGEL 2006). In the light of new research results, writes Siegel, the demand for Antarctic krill probably will even grow. Krill contains a series of biochemical compounds such as omega-3-oils or carotenoids, which are popular diet supplements in western countries.

But krill is already under pressure – under climate pressure. The West Antarctic Ice Sheet (WAIS) is melting; it currently contributes 0.3 mm to sea level rise each year – second to Greenland, whose contribution to sea level rise has been estimated as high as 0.7 mm per year (BROMWICH 2012). Around the Antarctic Peninsula, the Scotia Sea and the Bellingshausen Sea, sea ice has retreated. These changes in sea ice correspondent with a dramatically decrease of krill; in the Scotia Sea perhaps as much as 38 to 81 % from the mid of the 1970s to the present (Atkinson 2004). But *"Antarctic krill (Euphausia superba) is dominant prey of nearly all vertebrates in this region, including Adélie and Chinstrap penguins"* (TRIVELPIECE et al. 2011), whales, seals, sea birds as well as most fish of Antarctica. Most of the species depend on krill and can't switch easily. Some of them like a special seal species are highly specialized – their food consists of 98 % from Antarctic krill.

"Krill fisheries should be managed with these ecosystem considerations in mind. This includes factoring in the potential impacts of climate change on krill populations", demands the Antarctic Ocean Alliance (AOA 2012, p.8). But the Marine Stewardship Council's – which was created as a result of discussion of more sustainable fishery – certified "Aker Biomarine Antarktic Krill" as "sustainable" on 15th of June 2010. If the discussions about ecological lifestyle in western countries lead to such results we really have to think about it!

What has to be done?

Both brief examples show that the change in Antarctica challenge polar science. Surely we need to collect more data for better understanding and for model development. Surely we need more intelligent technologies, which allow us to discover and to watch the Antarctic year around and without putting a foot onto it. But obviously the threat to Antarctica asks first for more collaboration – between different science disciplines, between the nations, between scientist and public and last but not least between scientist and policy-makers.

Karin Lochte, Director of the well known Alfred-Wegener-Institut für Polar- und Meeresforschung in Bremerhaven emphasized at the Polar Meeting in Hamburg earlier this year (LOCHTE 2013). *"Our research field is no longer just a description of the natural process that shapes the Polar Regions; it has become a social challenge for the global society."*

To cope with the challenges, to provide policy-makers and public more rapidly and more easily with generally intelligible information – the polar science itself has to change! Natural Science, Humanities, Social Science, Psychology, Engineering and Economics are necessary to handle the enormous challenges.

We have to figure out the most important questions science has to answer. The project Science Horizon Scan of SCAR will help to identify the most important and compelling questions in Antarctic and Southern Ocean science over the next two decades, will develop the Antarctic Science into future. I am curious about the result and what will happen to it.

To release the pressure to Antarctica we have to change our lifestyle in our countries. The more sustainable we design our lifestyle, the better we protect the Antarctic. International interdisciplinary cooperation can provide the basis for long-term thinking in society. We have to start a discussion about this, especially with colleagues who work on sustainability research in our countries. Maybe we will find a way to win new ambassadors for Antarctica who don't have to visit this fragile continent.

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