

## **Antarctica and Magellan**

### **A glance for the future scenarios of climate change**

Dr. Jorge M. Navarro Azócar

Professor Instituto de Ciencias Marinas y Limnológicas

Facultad de Ciencias Universidad Austral de Chile.

[jnavarro@uach.cl](mailto:jnavarro@uach.cl)

+56-63-221556



**By NANCY CONTRERAS RESÉNDIZ**

Photography JORGE M. NAVARRO AZÓCAR

Supervision DRA. ALEJANDRA LORENA SAN MARTÍN AZÓCAR

**Insights in Biotechnology**

Departamento de Bioingenierías, Tecnológico de Monterrey, Campus Querétaro

Dra. Alejandra Lorena San Martín Azócar

**Biotechnology Engineering students:**

Adolfo Flores Salamanca

Braulio Roberto Flores Serrano

Oscar González Cruz

Brenda Yaaxnic Vázquez Mata

Svein Esquivel Zavala

José Martí Vallejo Delgado

Alina Márquez Suárez

Alan Alfonso Castro Hurtado

Alondra de Guadalupe Córdova González

Nancy Contreras Reséndiz

Throughout his career, Dr. Jorge Navarro Azócar has been dedicated to investigate the physiological response of marine organisms against environmental fluctuations, including factors produced naturally and by humans. He has also investigated the phenomenon of red tide and the effects of ocean acidification on the behavior and physiology of shellfish. This allows us to detect his interest in issues of great social and economic importance in Chile and of environmental relevance worldwide.

- **How did your interest to study the response that marine life will have against the environmental changes that are coming, arise?**

- This interest arises for three main reasons; one for the great marine diversity of the Chilean coast, for the training I have developed during my scientific career and for the frequent events that occur on our planet because of climate change. So, I made the decision to start studies that allow me to know the response of key species, both from the ecological and economic role, in the face of the environmental changes that are to come.

- **Why in your project in the Antarctic and Sub-Antarctic region, you decided to focus on the fish *Harpagifer antarcticus*?**

- Well, after working with different situations of environmental variations, have been toxins or has been acidification, I now appear working on an Antarctic fish, which is a fish that has no commercial importance. It is a small fish between 15 and 20 cm in length. However, it is a key species within the Antarctic ecological system; it is relatively abundant in the coastal area of the Antarctic Peninsula and it is the main predator of small crustaceans belonging to the group of amphipods, which are similar to Antarctic krill, but smaller. Therefore, this fish is important because of the trophic and ecological role that it has over this abundant community of Antarctic crustaceans.



- **Well, now that we know the reason of the species, can you explain us how did you evaluate the effect of temperature on the fish and which were the main results you get?**

- Yes, well, first I would have to tell you that the environment in which the fish currently lives with respect to temperature is approximately between 0 and 4°C. So, in our experiment, we exposed it to a fairly wide temperature range, ranging from 2 to 14°C. In the same way, its natural environment is characterized by salinity above 30 psu and we exposed it to a range between 34 and 23 psu, assuming a salinity decrease due to the effect of “freshening” or melting of sea ice.

Well, the exposure experiments of almost two weeks at 5 temperatures (we worked with 2, 5, 8, 11, and 14°C) have allowed us to obtain the first conclusions, which indicate that this Antarctic fish is very sensitive to temperature increase.

The first results we obtained were of mortality, certainly a very interesting response. We observed that at 2 and 5°C, which is practically the natural range in which they live, no mortality occurred. But when we raise the temperature to 8°C, we observed the first signs of mortality, approximately 20%. And when we increased to 14°C, the highest temperature, mortality increased by over 93%. These results are preliminary and with other data we are getting, we are already writing the first publications on topics related to physiological energetics, oxidative stress, and osmoregulation capacity, among others.

Now, I have to explain why those experimental temperatures. The temperature of 8°C corresponds to the climate change scenario mentioned in the report of Intergovernmental Panel on Climate Change (IPCC) for the Antarctic Peninsula, where it is reported that there will be a temperature increase of 4-5 °C by the end of the century, so 8°C is a predicted scenario. And why at 11 and 14°C? Because in our project, one

of the main objectives, besides the effect of global change, is the study on the connectivity between what is the Antarctic region and the Sub-Antarctic region of the Magellan zone. In this specific case, we understand connectivity as the possibility that this species of fish increase its distribution, due to the flow of ships between these zones or another cause, and thus can reach the Magellan region. Then, if this fish reaches the Magellan area, it will face temperatures of 11 and 12°C, which are currently reached at some times of the year, and if we consider the scenarios of climate change by the end of the century in this area, temperature could reach 14°C, the same that we used and where a mortality of almost 100% was observed.

- **As you mentioned before, you also evaluated the effect of melting glaciers, that is, the effect of the salinity on the survival of this fish, can you explain us how you did it?**

- Yes, we also use different experimental salinities and that was done thinking about the phenomenon that is happening in the whole area, which is the melting of the glaciers and their contribution of fresh water to the sea, and with that the decrease in salinity. The Antarctic environment inhabited by the *Harpagifer* fish has a salinity of 33-34 practical salinity units (psu). However, when glaciers melt, these ice blocks arrive to the coast and lower the salinity of the water. In January, we were able to see how the blocks of ice that had detached from the glaciers, reached the places where we collected the fish and that caused the salinity to be reduced to 27 psu. Then, we observed that the salinity of 23 psu accentuated the mortality of this organism, that is, it has already a lethal effect with respect to the salinity factor, which is important due to the effects of the global change that cause the melting of the glaciers.



- **The same experiment will be done in Magellan (with the species *Harpagifer bispinis*), you know how that research is going? And will it be possible at a given moment to establish a relationship between these two species in order to know how they will react to future scenarios of climate change?**

- Yes, precisely because this experiment, as I mentioned, includes the objective of assessing the connectivity that can exist between these two regions (Magellan and Antarctica). Based on this, it will be assessed if these species can live in both geographical areas and how they will react to climate change, which effects are expected in both regions.

There are many congeneric species, species of the same genus, which at one time had a common descendent, but when the continents separated, they evolved separately. And what we want to evaluate is if these have evolved differently due to the environmental conditions of each place.

- **What were the main challenges you faced during your stay in Antarctica and the Sub-Antarctic region?**

- The biggest challenges had to do with the difficulty of collecting the animals with which we were going to work, but we had no problems of another type, fortunately there are the facilities at the Escudero Base of the Chilean Antarctic Institute (INACH), for the stay and for the performance of the experiments. So, I can say that we had no big problems. The challenge was to get the data because at the time we run the experiments, they leave practically no time to do anything else, since all day we have to be controlling the conditions to get reliable results.

- **How do you feel both as a researcher and Chilean, to be part of the Austral University of Chile and the FONDAP IDEAL Center, institutions that drive this great project that gives a huge contribution to science?**

- I am very happy, very proud, to be an academic at my university (Austral University of Chile), I studied at this university and later on I was hired. I received my PhD in Canada and my postdoc in England. In this sense, it has allowed me a full academic and scientific development. And I really appreciate this opportunity.

And, on the other hand, with respect to the FONDAP IDEAL Center, I am also proud to belong to it because it is a prestigious research program in Chile, this program provides funds to study the areas that are a priority for the country. In this case, the study of the Antarctic and Sub-Antarctic region. This fund is very competitive at the national level; it is the first time that a center of this type is created in southern Chile, let's say here in

Valdivia, so we compete with many other universities and fortunately we succeeded. Therefore, I am very happy to participate and to be in charge of one of the research lines, which has to do with physiology, genetics and molecular biology to study the effect of environmental conditions on physiological response and adaptation of marine species. We are several researchers who belong to this line and we are committed to generate the best possible results, because these centers have a very tough international evaluation.

- **What do you think about what has been said by Mayor Jorge Flies, about Magellan and Antarctic, regions that by 2020 could count with one scientist for every 160 inhabitants?**

- That's right, we have had several meetings with the mayor, and really, his team is doing a very good job in that sense because he is worrying a lot about developing science in the area of Magellan. At the moment, there are about 300 researchers and week by week new national and international scientist are arriving to settle in the zone. Therefore, I believe that if this regional policy is maintained, it could be possible that a region with 160-170 thousand inhabitants can have about 1000 scientist within a couple of years.

- **What do you think about the fact that Magellan, Antarctica and the Sub-Antarctic region have become a natural world-wide laboratory, where due to their vulnerability to current climate change scientific studies can be carried out?**

- Well, I think that's very important for the science. And I think it is necessary to identify many regions of our planet with unique characteristics such as those in the southern region of Chile. States must create facilities so that scientists from all over the world can research these places and study them to try to still maintain our planet or at least some places, under relatively little intervened conditions. The area of Magellan is a zone that has been supported by the Chilean State in a very significant way. There is a special support fund for the development of this region and it includes science, in fact, it belongs to what is called the "development of extreme zones of Chile". The Biomedical Research Center and the sub-Antarctic research center are being built, and the Antarctic international research center will be started in 1-2 years more. All this is obviously something we had not seen in any region of Chile so it this seems to me very good.

- **This way of working, so productive, brings with it countless benefits, but it could seem that it doesn't leave you so much free time, when you were in the Antarctica you had time to relax and enjoy?**
  - Really this kind of experiments require a lot of dedication. We were four colleagues who were working on the project, but what I have mentioned is only 10% of all the results that we are obtaining from the experiment with this fish, there are many other time-consuming results, like those of oxidative stress, osmoregulation and gene expression, which will be published later on, and at the moment, we are in the analysis of that. Then it requires a lot of time, but as my passion is nature photography, obviously, I gave myself the time and photographed some interesting places in the Antarctica. That obviously compensates all the work that one has and gives me great satisfaction to be able to accompany scientific research with a subject that is as exciting for me as nature photography. Always the two things can be combined.



- **Do you believe that the results of your research allow authorities and society make the necessary decisions to protect these ecosystems?**
  - Not specifically the results with the experiments with *Harpagifer*, but during the first year we carried out several studies of longer exposure of animals for two or three months related with climate change, species of commercial

importance, like scallops and some marine snails. We truly have a responsibility to society, as we are working with species of commercial importance and we are delivering this information through seminars and publications, so it reaches to fishermen, schools and authorities which are the ones that have to make the decisions.

- **What is your message to the community of young and emerging scientists?**

- I believe that a young scientist must be decided to invest much time in studying and specializing at a high level in the subject of his interest. In addition, young and emerging scientists must be able to generate collaborations at both the national and international levels that help their formation. In this way, they will be able to be inserted more easily in the scientific community of their country and internationally.

Finally, Dr. Jorge Navarro mentions that the project of which he is part of, involves collaboration with people from all over the world, since it comprises five lines of research: marine productivity in a changing ocean, adaptation of marine species, structure and function of both plankton and benthos, and the human dimension of marine ecosystems, in order to understand the interaction between the Antarctic and Sub-Antarctic regions and to contribute to the protection and sustainability of marine life towards the global change that our planet is facing.

**Thanks Dr. Navarro!**