OECD FELLOW SUMMARY REPORT

OECD Fellow: Dr Silvana N.R. Birchenough

Subject: Optimizing science, technology and innovation for the study of ocean acidification on commercial species (OSTIONES).

OECD Co-operative Research Programme Theme II Managing Risks in a Connected World

Host Institution: Centro de Estudios Avanzados en Zonas Aridas (CEAZA) and EULA centre.

Hosts: Dr Bernardo Broitman / Dr Cristian Vargas

Fellowship period: June 19th to September 12th, 2017

Consent: this fellowship report can be posted as material to support the Co-operative Research Programme.

1. Relevance

The work conducted under this fellowship has direct relevance to Theme II MANAGING RISKS IN A CONNECTED WORLD of the OECD Co-operative research programme. This project aimed to obtain new scientific knowledge on the OA effects on commercial shellfish species (mainly scallops, and mussels) in Chile and to complement this knowledge with ongoing work on cockles, mussels and scallops in the UK. Most of the information available on ocean acidification effects on commercial species is generated by experimental work. Therefore, the intention of this work was to extract the available information in country working with colleagues at CEAZA and U de C-EULA (Chile). The data collection enabled the compilation of the current knowledge existing commercial species, with a detailed overview on biological and physico-chemical responses. The opportunity to synthesise this information, has helped to expand on the current understanding on the OA effects on these commercial species. One of the most important aspects of working in Chile, was to entre this work in coastal areas. These areas are often subject changes in water chemistry (resulting from the constant up-welling conditions) in the North of Chile. The local conditions found in these areas are often showing extremely low pH values. The information gathered, has help to illustrate that some populations of species are already well- adapted and thriving under these local changes.

This work has the potential to influence the current knowledge available to support the development of climate change adaptations strategies and scenarios in both countries. During my visit I was able to disseminate nationally and internationally my research across many levels. The local dissemination activities were organised to cascade discussion activities with scientists, the local mariculture and aquaculture sector (working mainly with scallops). These workshops helped me gain understanding on current changes observed in connection to OA effects on commercial species. This work has the potential to assist marine planning and readiness to support the aquaculture sector supporting food security in both countries.

The work developed under this project could enhance the evidence-base knowledge on the potential effects of ocean acidification on commercially important species (e.g. scallops, mussels and cockles) in UK and Chile. This work has provided the opportunity to facilitate the exchange of science, knowledge transfer and production of outreach activities to inform a wide range of end-users. The results from this project will provide outputs to Chilean development of climate change policy with regards to fisheries helping to create awareness and understanding of ocean acidification effects on commercial species. The project was designed to promote knowledge transfer of technology and scientific expertise. The work discussed with the local communities has helped to develop capacity building. Some of the topics discussed were targeted to ocean acidification, but equally other stressors are operating over these system (e.g. oxygen, temperature, nutrients), which their effects were also identified and ranked in terms of their importance. These discussions were useful to create awareness, and to provide appropriate strategies to safeguard commercial species and food security.

2. Objectives of the fellowship

The overall objectives of this study were:

a) To examine the current methodology to undertake studies that measure the effects of OA on commercial invertebrate species through laboratory studies and different development phases.
b) To assess monitoring and surveillance of pCO_2 and carbonate chemistry (pH, DIC, TA) strategies in Chile and UK territorial waters, where some changes have been already observed. The main idea was to support discussions on the best sampling methods employed as well as setting up the understanding of variability and change on these systems;
c) Dissemination and knowledge transfer on the main messages resulting from the scientific understanding of the effects of ocean acidification on commercial species in UK and Chile to end users (e.g. mariculture and mariculture sector, scientists and government representatives).

The results from this work have helped to develop a technical note and a peer review publication to help documenting the national and global studies on effects of ocean acidification on commercial species, with recommendations relating to ocean acidification effects, strategies for end-users to safeguard these commercial species and some recommendations to support policy applications.

3. Major achievements (up to three)

The opportunity to collaborate with collegues in Chile provided a unique experience. The main highlights from this work are summarised below:

3.1 *Interaction with colleagues and end-users*- a workshop was organised to discuss with local stakeholder (e.g. fisherments, local hatchery, navy officers, teachers, students, and other scientists) on the current issues associated to the local area and in the view of climate change effects, commercial species, other emerging threaths (e.g. microplastics). The two day workshop enabled the opportunity to showcase my research as well as to place into context current concerns, cuerrent scientific developments and strategies that could help to educate and potentially provide the tools for end-users to adapt to climate change effects in the region. The worshop was organised by CEAZA collegues on the 22-23 June, 2017. The first day dealt with "Development of adaption techniques to cope with Climate Change effects in the Bay of Tongoy, Coquimbo Regio". The scond day was targeted to "Developing sources for sustainable aquaculture". Some key recommendations and messages were synthesised from this activity. The overall messages were discussed, with some key proposed actions at a regional goverment level. Some of these messages were developed in one article tageted to industry in support of susteinable aquaculture. A second manuscript (in prepr.) is in conneciton to translating applied ocean acidification research into direct end-users applications, full references are provided in Section 4: Follow-up.

3.2 *Further network and collaborative opportunites (MOU and the development of a research proposal to expand this work in Chile and Peru)*- The ability to interact and network with colleagues in Chile helped to cement future networking opportunitites, this was possible via the agreement to sign an MOU with my Institution (Cefas, UK) with CEAZA and EULA, Universidad de Concepcion, Chile. Further ideas were discussed whilst I was working in Chile and recently a proposal was developed in conjunction with colleagues in UK, Peru and Chile. The aim of this work will be to understand the effects of the Humbolt current on commercial species (mainly scallops) in Chile and Peru. The work consists in three stages from: i) collection of new data sets, ii) economic valuations and modelling scenarions to set up future specie's responses and iii) management strategies to safeguard the fisheries of scallops at local, regional and between countries. The proposal was submitted to RCUK (via NERC, UK) and Conicyt (in Chile) on the 13th October. The outcomes of this proposal will be announced in February 2018.

3.3 *Invitation to present ongoing UK work at LAOCA I Buenos Aires, Argentina*- I was the invited as a key note speaker, opening the I Simposio Latinoamericano en Acidificación del Océano Red Laoca 2017 on the 24th October in Buenos Aires, Argentina. During this event I was able to present the current ocean acidification perspective, some of my work conducted on commercial species and monitoring, as well as the new challenges for this research area ("***La acidificación de los océanos: una perspectiva de especies comerciales, monitoreo y nuevos desafíos para la ciencia*"**). More details in the link below: http://laoca.cl/congreso2017/wp-content/uploads/2017/10/Programa_Libro_Resumenes_LAOCA2017-1.pdf

4. Follow -up

From the events and time spent in Chile, the experience to expand my network and to get a good understanding of the research and effects of ocean acidification on commercial species. The work conducted under this fellowship, was summarised in an article published, helping end users with suggestions on how the potential furture climate change effects can be considered to support and enhance aquaculture practices. Some targeted recommendations were developed under this technical note (see full referecne below Broitman et al., 2017). The full article was done in Spanish to cascade the wider knowledge and advice on aquaculture procatices to end-users in country. The full citation is as follows:

- Broitman, Bernardo & Halpern, Ben & Gelcich, Stefan & Lardies, Marco & Vargas, Cristian & Vazquez-Lavin, Felipe & Widdicombe, Steven & Birchenough, Silvana. (2017). Expansion sustentable de acuicultura. Salmon Expert. 57. 2-7.

The second publication was more science based, taking account on the current data sets available on commercial species' resposnes to ocean acidficaiton. The work takes account on how curretn research can be translated into applied strategies to support end-users (e.g. aquaculture and mariculture sites) . The title and paper is drafted and final formating and editorial changes are currently being done. See the full citation below:

- Birchenough, Silvana N.R., Vargas, Cristian A., Gelcich, Stefan and Broitman Bernardo, R. (*in prep*.) A helping hand: translating ocean acidification research into practical applications in support of aquaculture and ensure food sustainability. Target Journal Global Change Biology.

5. How might the results of your research project be important for helping develop regional, national or international agro-food, fisheries or forestry policies and, or practices, or be beneficial for society?

Ocean acidification is closely linked with climate change, as they share the same driver, the increasing atmospheric carbon dioxide (CO2) causing threats to the ecological health and biodiversity of the marine environment. Seawater uptakes CO2 from the atmosphere altering the chemistry of the oceans, decreasing pH levels. Ocean pH has decreased by about 0.1 units since the start of the Industrial Revolution and CO2 concentrations are projected to increase by the end of the century as fossil fuel reserves are exploited. Evidence indicates that future OA will affect marine organisms, with implications for ecosystems and services. However, the understanding on the potential effects of OA on commercial species are still limited. There are many uncertainties relating to the scale of socio-economic impacts on marine species and food security. This work has contributed with increasing understanding on the current observed effects that pH and other stressors could have on commercial species. This information has been used to inform end used and local communities depending on these resources. The scientific outcomes of this project have helped to educate and created awareness on the likely risks on commercial species and overall repercussions for food security. This work could be used as newly acquired evidence, helping to inform future OECD assessments on food security and potential risks for the aquaculture sector resulting from climate change effects. Similarly this information could also feed onto key climate change documents (e.g. IPCC assessment) to illustrate the current levels of variability and future risks on commercial species resulting from OA effects to safeguard food resources.

6.Satisfaction

The OECD fellowship exceded my expectations, as the opportunity to work overseas in a country which has a strong up-welling systems, and a variety of extrement risks (e.g. 3 Tsunamis over the last 8 years) and continues to generate a good quality and a large proportion of scallops has helped to understand and observe the changes experienced by some of the scallops populations. There are several strategies that can be put in place to ensure the quality of the water continues to be of high quality to support harvesting practices. The idea to monitor these systems regularly, can help to improve the current practices, helping to preserve the fisheries and ensuring the exploitation in a sustainable manner.

During my fellowship, I did not encounter any issues or practical problems, completetely the opposite, I felt very welcomed and colleagues were extremely receptive to my ideas and to foster future collaboration between the differt Institutions. A clear outcome has been the recently signed MOU between Cefas (my organisation) and CEAZA/EUHLA (Host organisations). This MOU will ensure the future collaboration and continous development of projects and applied science. The submission of a recent research proposal (if successful) will continue to support an active collaboration to work in this area of science.

A suggestion to improve the Fellowship Programme could be to consider organising an Annual event. The event could invite the Fellows to present and disseminate the main outcomes of their work. This could be a useful way to cascade further the OECD aims and current scientific devleopments under differt Themes.

7. Advertising the Co-operative Research Programme

This fellowship provided me with new scientific and personal opportunities to develop science, enhance my networks and create new opportunities for research in my field of expertise. I received the information via e-mail, with details of the OECD website. I looked at some of the previously funded projects. The available summaries were very useful as examples to provide guide and inspiration of the type of potential projects. The Theme co-ordinator was also very active providing direction and examples of previous funded research. One suggestion will be to make these type of projects more visible, this could be further disseminated if the OECD will organise an Annual Event, and an overview of project could be presented across the community and releveant countries. These types of activities could help to: i) widely promote the Co-operative Research programme, ii) ensure legacy of the achievments from projects and iii) create a scientific network of OECD fellows, helping to promote, evaluate and raise profile of the programme.

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