

The Monaco Environment and Economics Dialogue

International Workshop, 16-18 November 2010



Economics of Ocean Acidification
Bridging the Gap between Ocean Acidification Impacts and
Economic Valuation



The climatic fact: Ocean acidification, the other CO₂ problem

Several recent policy briefs and information packs have drawn attention to the impacts of carbon dioxide on our oceans – a problem that is still largely unknown to policy-makers and the general public. Indeed, few people are aware of the potential consequences of the anthropogenic CO₂ currently entering the world ocean at a rate of 25 million tons of CO₂ per day.

The acidity of the oceans has increased by 30% since the beginning of the industrial revolution and a three-fold increase is expected by the end of this century if emissions continue at current rates. The absorption of carbon dioxide by the oceans contributes to mitigation of global warming, but at a cost: when CO₂ dissolves in seawater, a series of chemical perturbations occur. Concentrations of inorganic carbon and bicarbonate ion increase, while pH and the concentration of carbonate ions decrease. Ocean pH has already decreased by about 0.1 pH units (i.e. an increase of acidity by 30%) since the preindustrial time (8.1 vs 8.2). A pH of about 7.8 is reasonably expected for 2100.

These chemical changes may have biological consequences – in particular, but not exclusively, on organisms producing a calcium carbonate shell or skeleton (Source EPOCA).

This international workshop, organized jointly by the Monaco Scientific Centre and the International Atomic Energy Agency, on the socioeconomic impacts of ocean acidification brought together, a dozen economists, a dozen of natural scientists and representatives of international organizations for 2.5 days in Monaco. This followed the previous recommendation by 155 scientists from 26 nations in the 2008 *Monaco Declaration* to build better linkages between socio-economists and life scientists to enable future understanding of the impacts of ocean acidification on society. Emblematic figures in this area of the multidisciplinary research were present to facilitate discussions among the different communities and to start to build the methodology for integrating knowledge from these different disciplines so that in the future we can better study the economics of ocean acidification. This interdisciplinary approach was very successful, stimulating the relevant debates and identifying research prospects to new levels not yet explored. The enthusiasm and motivation of all participants overcame the initial difficulties of communication between the various disciplines. The discussions, rather than being only alarmist, identified a positive and constructive approach in also seeking policy-oriented solutions to the threats raised

by ocean acidification. Although integrated studies are yet to be developed between the Natural Sciences and Economics, the discussions have already led to policy recommendations, for both the global mitigation and local adaptation to ocean acidification.

This workshop has motivated a group to continue these discussions and pursue joint interdisciplinary research projects, particularly where there is a degree of uncertainty, paucity or even absence of life science results that are directly applicable to economic models. In short, the advent of another type of research has taken place at this workshop: real multidisciplinary research on ocean acidification, which aims to deliver clear messages to policy makers so that the problem can be addressed in a timely fashion in order to minimize the future detriments to biodiversity and human society. This workshop is the first in a series. The birth of such a novel research focus is symbolic of Monaco's high concern about the threat of ocean acidification and how this may effects a vital and essential part of our environment and our well-being, the Oceans. While focusing on ocean acidification, the group is well aware that this environmental challenge needs to be placed into a wider context of other stressors like ocean warming, expanding hypoxic zones, overfishing and pollution.

THE FIRST CONCLUSIONS

Working groups were formed around four themes:

- 1) Ocean acidification risk assessment. The economic impact of ocean acidification: the bounding Magnitude of the problem,
- 2) Modeling and developing tools that integrate the natural sciences and economics,
- 3) Policy decisions,
- 4) Funding of political struggle against the ocean acidification.

1) Ocean acidification risk assessment. The economic impact of ocean acidification: bounding the magnitude of the problem

The economic impacts of ocean acidification have to be mapped on both market and non-market economic activities. Firstly, economic sectors such as fisheries, aquaculture and tourism are more likely to be directly affected, together with other economic sectors affected indirectly, depending on the structure of the national economies. Secondly, the non-market activities will refer mainly to the impact of ocean acidification on the ecosystem goods and services, ranging from carbon sequestration to shoreline protection. The effects on human welfare, and respective economic measurement in monetary terms, will require a vibrant dialogue across disciplines involved. This integrated approach will identify the current gaps in knowledge, including the identification of the most critical data required. Hence we need a dialogue across disciplines to identify key areas of scientific research that will help fill these gaps and enable future economic evaluations of impacts from ocean acidification. Economists need to advise biologists and biogeochemists on the exact data that are required for their assessments. This will help to refine the risk assessment for ocean acidification. The common objective is to reduce the uncertainties i) biologically about both individuals and ecosystem responses to ocean acidification and ii) economically, on measurements of losses in term of the value of ecosystems. It is also clear that some geographical regions are more vulnerable than

others. It would be important to identify and prioritize these regions and countries to alert them about the risks and motivate political action to prevent or mitigate risks.

2) Modeling

The evaluation and measurement of impacts of ocean acidification on society may serve as a guide for policy decisions on mitigation strategies and adaptation to climate change.

A range of tools needs to be developed to guide policy makers by showing them the extent of damage caused by ocean acidification and to evaluate different strategies for mitigation and adaptation. A multidisciplinary model will need to be developed that integrates the different disciplines (physics, biology, biogeochemistry and economics). In fact, each discipline will develop a model of ocean acidification and then the outputs of each model will be used as inputs in the other, creating a structurally integrated model. Although very comprehensive and sophisticated, it will give pragmatic interpretations of data that can be directly used for political decisions. This will be an interdisciplinary model for decision support, where each discipline is at the service of another.

3) Policy decisions

Ocean acidification is now believed to be a credible threat to the resilience of marine ecosystems and the only way to directly reduce ocean acidification is to reduce the atmospheric concentration of CO₂. It was also recognized that ocean acidification is another major motivation to reduce local stresses in order to build the resilience of marine ecosystems, by the following actions:

- Establishing and sustaining networks of effectively managed marine areas that maintain and restore functional ecosystems such as kelp forests, mangroves, seagrass beds and coral reefs;
- Developing consensus and mechanisms for stakeholder engagement across public and private sectors to build resilient marine ecosystems, using advanced techniques to manage these marine protected areas and communicate the results so as to encourage future achievements and potential investors;
- Protecting and rehabilitating diverse and productive marine habitats that increase the average pH of the water to combat ocean acidification.

Shellfish aquaculture, in particular, is one place where adaptation will play a large economic role. Helping the industry to conduct real time monitoring of seawater chemistry and identify more resilient species are two examples which support such adaptation.

Furthermore, assessment should incorporate the monetary values of the services rendered by ecosystems in the national accounts so as to show their importance in terms of economic growth. This is particularly important for developing countries where these values are positive achievements for the welfare of the population. This concept of natural capital should be highlighted as a treasure to preserve or restore if it has been destroyed.

Certainly, every policy/management action has a cost, but the costs of policy inaction

may well be associated with even higher costs. In this context, one can conclude that policy inaction is not acceptable from a welfare perspective. Furthermore, if we wait too long before acting, the costs of political decisions will be even greater. Therefore the cost-benefit analysis will assess the advantages and disadvantages of each decision and recommend the best policies to be undertaken at a given time frame.

In fact, acidification of the oceans, like CO₂, is a global problem and the solution can only be achieved over the long term. So, local decisions should be framed by international regulations. International organizations can only have this long-term vision, because national policy makers are often constrained by short-term electoral concerns. Therefore, the role of international institutions is essential and Monaco can influence the decisions that will be taken in promoting a realistic point of view with regard to the environment. Research by the Monaco Environment and Economics Group (MEEG) and its network will help to sustain such policy recommendations that based on sound science.

4) Funding

Like the Green Fund that was designed during the CPO 16 Cancun meeting in December 2010, it is recommended that a Global Fund (some kind of Blue Fund) should be established that is dedicated primarily to ocean acidification with considerations of all stressors. This Commons Trust Fund would be used to assess environmental damages, return part of the fund to countries as dividends for good environmental management and use the remainder to restore the environmental commons. It should integrate land and sea impacts and should take into account carbon sinks in the sea as well as on land (i.e. UN-REDD Program Fund and Blue Carbon type sinks and stores of carbon). It could be created with the UN and the World Bank. Future research should include the following; how to distribute dividends, attribute responsibilities for damages, govern the trust fund and build global support for the idea. These activities could be addressed at future MEEG workshops.

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