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CLIOTOP planning meeting, Sète, France, 4-7 November, 2003

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Amongst the top predator species in the vast pelagic ecosystem, tunas and tuna-like fishes, billfishes and sharks have the greatest commercial importance, either in terms of catch (e.g. skipjack tuna is the 4th most productive and fished marine species in the World, after Peruvian anchoveta, Alaska pollock and Atlantic herring) or economic value, e.g. the price of bluefin tuna frequently reaches more than US$100 per kg on the sashimi market. Most pelagic top predators are migratory species that are fished worldwide, from the Equator to temperate regions by multiple national fleets using many different fishing gears (Fig. 1). During recent decades, tuna fisheries have expanded their range worldwide, with a continuous increase of fishing effort and fishing capacity leading to a dramatic increase in catches.

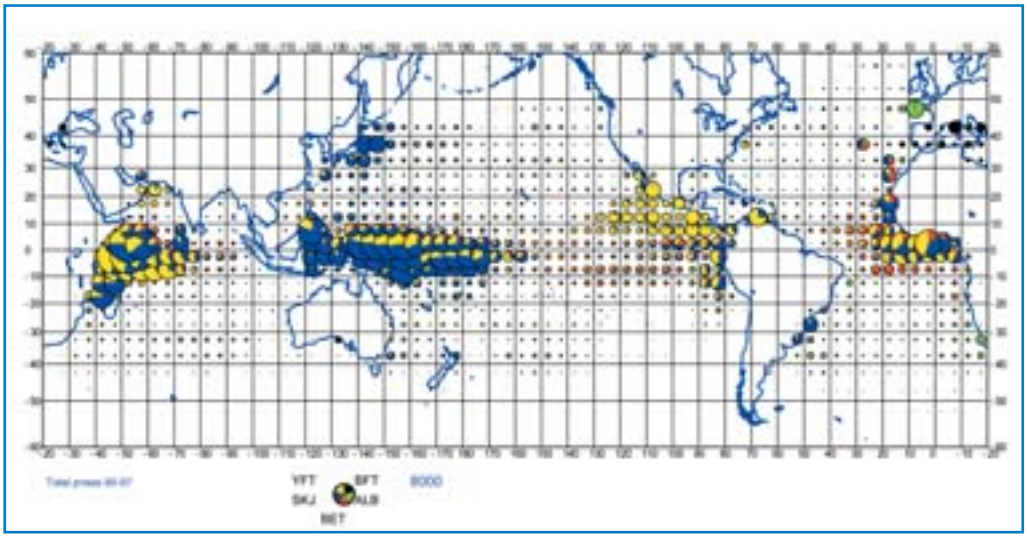

Figure 1. Worldwide distribution of tuna catch cumulated over 1990-1997 (tonnes). Yellow: yellowfin tuna: blue: skipjack tuna: red: bigeye tuna; green: albacore tuna; black: bluefin tuna. Data source: FAO. Figure: courtesy of A. Fonteneau. Picture by P. Lehodey.

Currently, open ocean ecosystems support catches of approximately 6 to 7 million tonnes per year of large pelagics (mostly tunas, billfishes and sharks). Because they mostly comprise the highest trophic levels, there is an increasing concern about the potential top-down cascading effects that fishing may have on the overall ecosystem. At the same time, environmental variability determines phytoplankton abundance and distribution and then leads to important bottom-up effects on forage species and then on top predator abundance and distribution. There is also increasing evidence for the impact of climate variability on tuna stocks and pelagic ecosystems at seasonal, interannual, or decadal time scales, and long-term global changes will modulate this variability and may have unexpected effects on ecosystems dynamics. Simultaneously studying those bottom-up and top-down effects in the context of climate variability requires extensive collaboration and the development of new approaches and appropriate models of the processes occurring within open ocean pelagic ecosystems. In this context, the GLOBEC CLIOTOP initiative has been developed as an international framework of collaboration and exchange with a multi-disciplinary comparative approach for considering these issues.

The first CLIOTOP meeting was held in Sète, France, 4-7 November, 2003, with the support of IFREMER and the French

CLIOTOP

CLimate Impacts on Oceanic TOp Predators

Institut de Recherche pour le Développement. An enthusiastic group of 40 scientists attended this planning meeting in this historical city of the Mediterannean French coast. The scientists from France, Spain, USA, England, Japan and Australia who attended were well representative of the worldwide interest in this project, and of the multi-disciplinary approach that is encouraged. The objective of the meeting was to write the science plan of this new planned GLOBEC regional activity, based on a preliminary draft that was circulated through the community of fisheries and marine scientists and made available through the GLOBEC web site.

The meeting first discussed the preliminary definition of the working groups and came up with a new simplified structure of five groups (Fig. 2). Through a series of presentations and group discussions, the participants identified several key scientific questions (Box 1) for each working group and started to develop the implementation strategies that will be necessary to tackle these questions.

The comparative approach constitutes the basis of CLIOTOP. Comparing various species, regions and ecosystems by searching for regularities and differences is indeed of fundamental importance because universal patterns would reveal common principles underlying the organization of ecosystems and their response to climate forcing. Therefore, impacts of both fishing and climate variations on marine ecosystems inhabited by open ocean top predators will be evaluated by analyzing and comparing long-term data series, ocean/atmosphere and biogeochemical reanalyses, field observations, *in situ* and laboratory experiments and measurements. Significant emphasis will be also given to modeling and simulation as a comparative framework used to identify key processes, and to deduce and understand the dynamics of the ecosystem and its constituent populations, leading towards the development of 'next-generation' models, which will embody both a high degree of realism and predictive skill.

Figure 2. CLIOTOP working groups

These objectives require an approach involving research teams currently working in process-oriented projects which address the mechanisms linking physical forcing, zooplankton production, prey abundance and distribution and top predator behaviour and ecology, and modellers involved in climate, physical and biogeochemical oceanography, and individual, population and ecosystem dynamics. Given the complex nature of its foci, the CLIOTOP project strongly encourages the co-operation and exchanges with other IGBP programs such as IMBER or GAIM as well as WCRP programs such as CLIVAR, and the SCOR affiliated Census of Marine Life (CoML) projects. Being able to make use of the tools and expertise provided by those international programs will be crucial for an effective "open sea" project.

The revised science plan will be submitted to the next GLOBEC Steering Committee and will be available on the GLOBEC website. For more information contact Olivier Maury, IRD, Sète (maury@ird.fr) or Patrick Lehodey, SPC, Noumea, New Caledonia (PatrickL@spc.int)

Figure 3. The Sète group

CONTENTS

Key scientific questions identified for the five CLIOTOP working groups

WG1 - Early life history of top predators

Q1: What environmental characteristics define the spawning areas and timing of top predators?

Q2: What environmental and biological characteristics most influence larval survival of top predators?

WG2 - Physiology, behaviour and distribution of top predators

Q1: To what extent does spatial dynamics result from proximate cues and to what extent is spatial dynamics independent of environmental cues?

Q2: How does school size and fidelity vary in relation to environmental variability and change?

Q3: What determines the time and place of reproductive and feeding-related behaviour?

Q4: How do anthropogenic forces such as fishing interact with environmental impacts on distribution and population structure?

WG3 - Trophic pathways in open ocean pelagic ecosystems

Q1: What are the main trophic pathways of pelagic top predators and how do they differ between and within oceans?

Q2: Is there evidence of change in trophic pathways over time and space consistent with climate variability? Can seasonal and spatial variability be used to explore climate variability?

Q3: Is it possible to identify indicators, such as prey species/size spectra, that would highlight significant changes in trophic pathways?

WG4 - Synthesis and modelling

Q1: What is the relative importance of exploitation and the environment in structuring pelagic ecosystems?

Q2: Does one mechanism (e.g. match/mismatch) explain observed variation across species, trophic pathways, regions, etc.? Do alternative mechanisms have equally good explanatory power? Which mechanism(s) provide the greatest predictive power?

Q3: What alternative states might occur in pelagic ecosystems, how might they be characterized (e.g., can they be described by indicators), how might they be caused, what are their consequences, and are they reversible?

Q4: Does knowledge about environmental forcing and the nature of fisheries (e.g. the species composition of the catch) suggest an optimum allocation?

WG5 - Socio-economic aspects of managing and responding to climate impacts on oceanic top predator species

Q1: What are the socio-economic pressures on, and context of, tuna fisheries ?

Q2: How have fisheries organizations (whether local, national, regional, or international) addressed climate change issues?

Q3: What are the Flows in capital and knowledge among the world's large fisheries and how do they respond to variability?

Q4: How useful are the fisheries management decision support tools developed by WG 5?

Editorial

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I am writing this Editorial shortly after attending the annual meeting of the Scientific Committee of the International Geosphere-Biosphere Programme (IGBP), co-sponsor of GLOBEC. The Chair of GLOBEC, Prof C Werner, was asked to present highlights of recent GLOBEC research worldwide, to provide the IGBP with a broad view of the programme's achievements and development. The presentation, prepared in coordination with many of the leaders of GLOBEC research at national and regional level, was extremely well received. Just like the other GLOBEC sponsors (SCOR and the IOC) the IGBP recognised that GLOBEC is reaching its peak in terms of outputs and relevance, a message that needs to filter through to the community at ground level. The feeling that the pieces are finally "completing the puzzle" is very real, as can be perceived from a recent science update article in Nature (Nature, 4 March 2004), heavily relying on multi-institutional, multi-disciplinary GLOBEC work in the North Atlantic. International science is all about adding value to local research, an effort that does not happen overnight. We need to build upon this platform, and this Newsletter provides some tools to do so. In this issue I would like to highlight a special section on GLOBEC Germany, after their recent phase one review. The work is relevant to many other GLOBEC projects and thus may generate fruitful contacts and add more pieces to our puzzle. In addition, the Newsletter introduces further developments of two new GLOBEC activities at regional level: ESSAS (see GLOBEC Newsletter 9.2: p.30) and CLIOTOP (see GLOBEC Newsletter 9.2: p.3). Science Plans for these activities are in the process of completion, cementing GLOBEC's geographical implementation and scientific relevance.

Meeting Announcement
Joint PICES/CLIVAR workshop
Scale interactions of climate and marine ecosystems, Honolulu, 23-24 October, 2004

Both the physical climate system and the marine ecosystem vary on a wide range of time and space scales. The focus of the workshop will be how the various scales of climate variability impact upon the population of a given species and the ecosystem as a whole, in the North Pacific. The workshop will bring together experts in physical oceanography, climate variability, marine ecosystems, and fisheries. The workshop follows the PICES XIII meeting in Honolulu and is open to all. For more information visit www.pices.int or contact Alexander Bychkov (bychkov@pices.int) or Kelvin Richards (rkelvin@hawaii.edu).

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CLIOTOP planning meeting.

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