MARBENA

Creating a long term infrastructure for marine biodiversity research in the European Economic Area and the Newly Associated States.

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Deliverable

Presentation MARBENA at the EPBRS meeting 'Europe's Mountain Biodiversity: Research, Monitoring, Management.

Vienna, Austria
10-11 March 2006

Morato, T & Santos, R.S. UAÇ-DOP, The Azores

PROJECT CO-ORDINATOR: **Prof. Dr. Carlo Heip**
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PROJECT START DATE : 1 December 2002 **DURATION :40 months**

Seamounts

Abstract

Karin Zaunberger (MARBENA EC-officer) has asked the MARBENA consortium to study possibilities to organise a 10 day electronic consultation on Seamounts for the European Platform for Biodiversity Research Strategy (EPBRS) meeting in Austria (March 2006). Ricardo Serrão Santos is finishing a book on seamounts, and offered to make a synthesis on this topic in cooperation with the other editors of the book.
Telmo Morato, researcher from IMAR-DOP/UAz, together with Ricardo Serrão Santos have prepared a talk named “Underwater mountains: an unknown world” for the meeting concerning “Europe's Mountain Biodiversity: Research, Monitoring, Management” under EPBRS. They have synthesized the main points on seamounts knowledge. The outcome was presented in the 10 and 12 of March during the EPBRS meeting in Vienna by Telmo Morato. As a result, the considerations on seamounts were included in 12 of the paragraphs of the recommendations. The final version of this document is not available yet.

Recommendations of the meeting

Working document of the Recommendations of the meeting of the
European Platform for Biodiversity Research Strategy

held under the Austrian Presidency of the EU
Vienna, 10-11th–March 2006

Concerning

Europe's Mountain Biodiversity: Research, Monitoring, Management

To achieve the objectives of the European Community biodiversity strategy and the target of halting biodiversity loss by 2010, the participants of this meeting place high priority on research to:

1. assess the status of European mountain biodiversity and to define favourable states for habitats and populations and preference states for ecosystems;
2. increase understanding of the patterns and drivers of seamount biodiversity and its dynamics at various scales of space and time, the key processes maintaining the high biodiversity on seamounts, and the impacts of human activities on long-term sustainability of seamount biodiversity;
3. clarify the role of diversity of organisms for ecosystem dynamics, functions, and services in mountain systems;
4. explore the significance of relict populations, refugia and genetic basis for adaptations;
5. upscale results from site-specific long-term ecosystem studies in the context of mountain regions
6. build or improve regional models of global change scenarios for mountain ecosystems, taking advantage of the palaeological records;
7. understand better the governance of mountain regions to improve its effectiveness for sustainability with respect to the different stakeholder goals;
8. understand processes and dynamics in mountain and seamount ecosystems by coupling long-term monitoring and research;
9. develop cost-efficient monitoring schemes, particularly in mountain or seamount areas with difficult access, extreme environmental conditions, or high anthropogenic impact;
10. clarify the allocation of responsibility for monitoring and managing seamounts in extraterritorial waters;
11. assess the impacts on biodiversity and ecosystem services in mountains of: climate change, infrastructure developments like roads, pylons, hydro-electric schemes and tourist facilities, land tenure regimes such as communal rights, tenant rights and access rights, changes in agricultural practices, including land abandonment and activities leading to

eutrophication, changes in socio-economic conditions, perceptions and behaviour of local populations and mountain users, and the effect these impacts have on traditional habitats and culturally important species;
12. define criteria, indicators and processes for effective conservation and sustainable management of biodiversity of mountains and seamounts;
13. explore the potential of participative and adaptive management with the aim to improve sustainability of mountain and seamount ecosystems;
14. evaluate ecosystem services incorporating local knowledge as appropriate;
15. integrate socio-economic and ecological models into decision-making systems for policymakers to examine the impacts of policies on mountain land-use, conservation and biodiversity.

These research priorities were derived from the following considerations and from an analysis of the GLOCHAMORE research strategy on global change in mountain regions:

- Mountains are found in all major terrestrial biomes from the tropics to the polar regions. Europe has mountains in most of these biomes, including the tropics.
- Europe's alpine environments above the tree line cover only 3 % of the continent's area, but are the centre of distribution for 20 % of all native European vascular plants.
- Mountains are characterised by low temperatures, small-scale heterogeneity in habitats, and steep ecological gradients, giving rise to centres of endemism and relict species, speciation hot-spots, and high numbers of species within small areas.
- Half of humanity depends on ecosystem goods and services provided by mountains. Changes in ecosystems on mountain slopes may have significant impacts in supply of services not just in the mountains but also in the lowlands.
- Mountains are important as refugia when climate changes, for those species that can migrate upwards as climate warms. There is however no upward escape from the top of a mountain. Therefore, climate change poses particularly serious management challenges in mountain areas, and they should be used as test-beds for conservation-related research.
- [suggest deletion: does any of the recommended research stem from this observation?] Airborne pollutants concentrate on mountain slopes and endanger certain species and ecosystems, especially mountain freshwater ecosystems.
- [suggest deletion: rather obvious] Many mountain environments suffer pressures from, for example, urban sprawl, infrastructure development, transit traffic, changes in agricultural practices, unsustainable tourism, and the introduction of species, which can create conflicts between those interested in the conservation of biodiversity and other stakeholders in mountain areas.
- Property regimes and associated management practices have strong impacts on biodiversity in mountain areas, which are often characterised by shared property rights.
- Seamounts are prominent features of the world's underwater topography. In the European seas, there are over 350 seamounts that rise more than 1000 m above the ocean floor.
- Seamounts are characterized by high species density over restricted areas, and by the concentration of nutrients caused by hydrological phenomena.
- Relatively few seamounts have been studied, with only about 10% having been sampled. On a global scale, their biodiversity is poorly known.
- Seamount biodiversity is threatened both by climate change, which could alter nutrient supply through modification of underwater currents, and by direct human activities, such as mining and trawling, which destroys populations of benthic species over a significant portion of the limited seamount surface.
- Long-term monitoring is a necessary part of research needed to understand slow ecological processes and dynamics especially in mountain and seamount ecosystems with long-lived species. Attention should be paid to the integration of knowledge gained from long-term ecological research sites.

Slideshow Presentation

Underwater mountains - an unknown world

Telmo Morato [1], Ricardo S. Santos [1]

1- Departamento de Oceanografia e Pescas, Universidade dos Acores, Portugal

European Platform for Biodiversity Research Strategy
10th – 11th March 2006, Diplomatic Academy, Vienna, Austria

Seamounts – **Workshop and Book**

Workshop – Horta, May 16th – 22nd 2005

Seamounts – **What is it?**

Photo of Pico Island

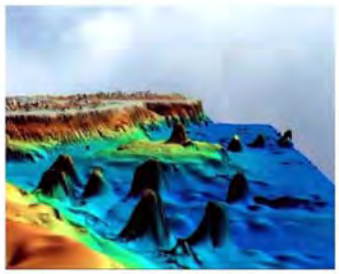
Underwater mountains: an unknown world – T. Morato & R.S. Santos

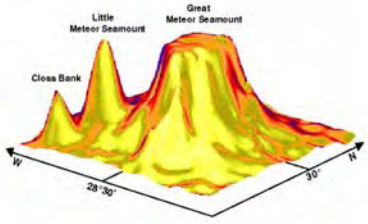
Seamounts – **What is it?**

Geology

Seamounts are undersea mountains that rise (usually more than 1000m) from the sea floor to below sea level (1);

Underwater mountains of heights between 500-1000 m as knolls, and those below 500 m as hills (2).





1- Epp and Smoot, 1989; 2- Rogers, 1994

Seamounts – **What is it?**

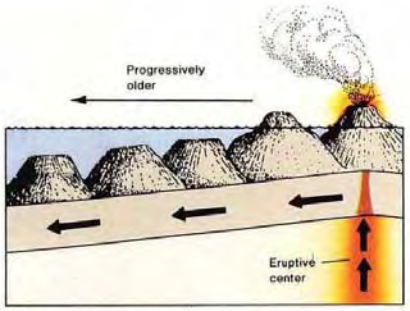
Geology

Typically, seamounts are formed by volcanic activity over hotspots in the earth's crust;

and are often arranged in long chains or clusters.

When a seamount becomes tall enough to break the sea-surface it becomes an oceanic island.

The Azores were subsurface seamounts at some point in the past.

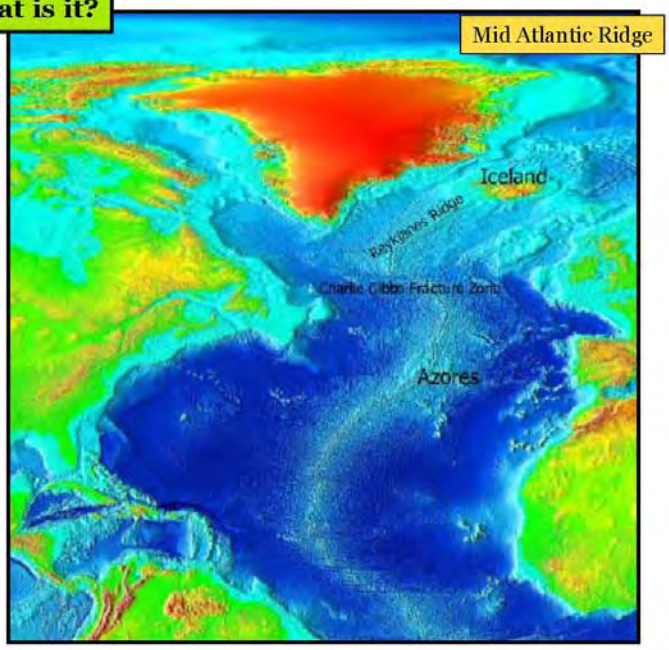


Sea Floor Moving Over a Mantle Plume
Credits: SIOExplorer Digital Library Project

Underwater mountains: an unknown world – T. Morato & R.S. Santos

Seamounts – **What is it?**

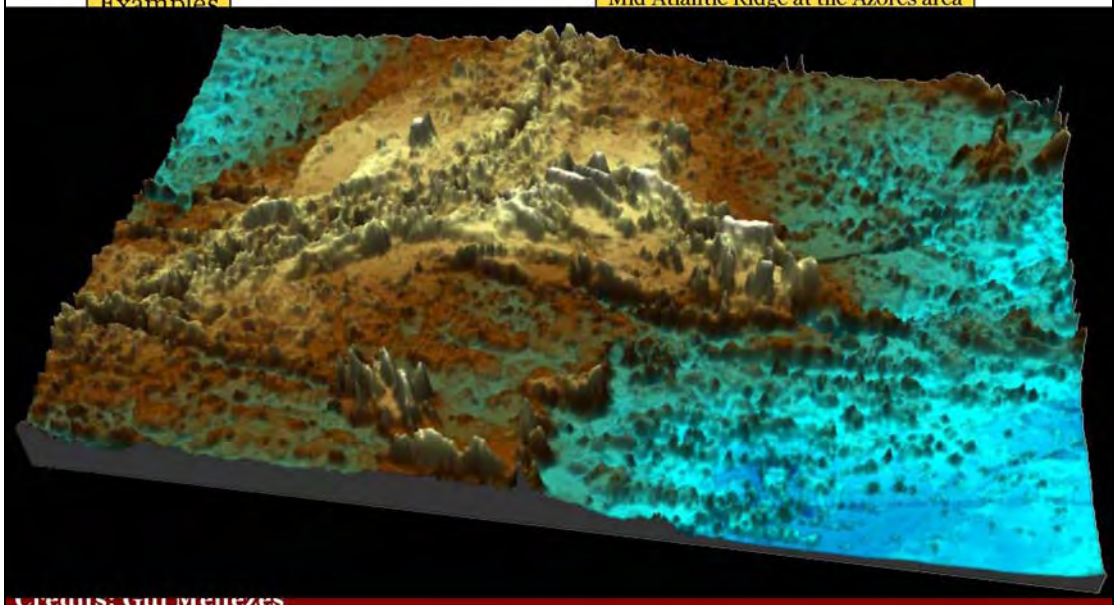
Examples



Seamounts – **What is it?**

Examples

Mid Atlantic Ridge at the Azores area



Credits: Gui Menezes

Underwater mountains: an unknown world – T. Morato & R.S. Santos

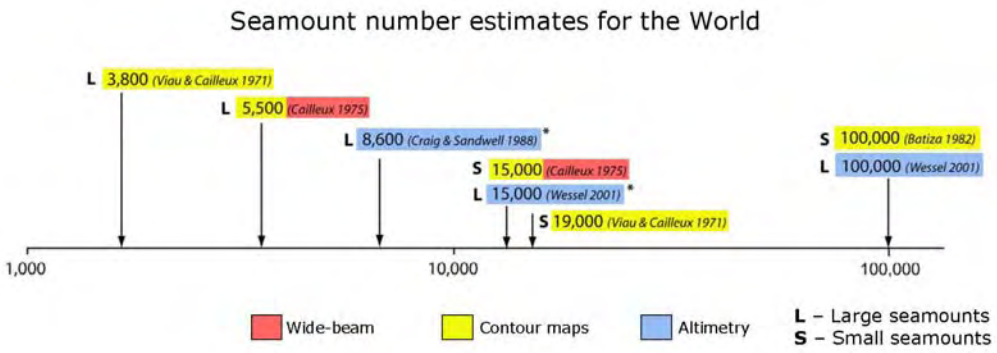
Seamounts – **How many are in the World?**

"the surfaces of Mars, Venus, and the Moon are much better mapped than Earth's ocean floors"

Sandwell et al., 2002

Seamounts – **How many are in the World?**

Historical estimates



Kitchingman et al. (*in press*)

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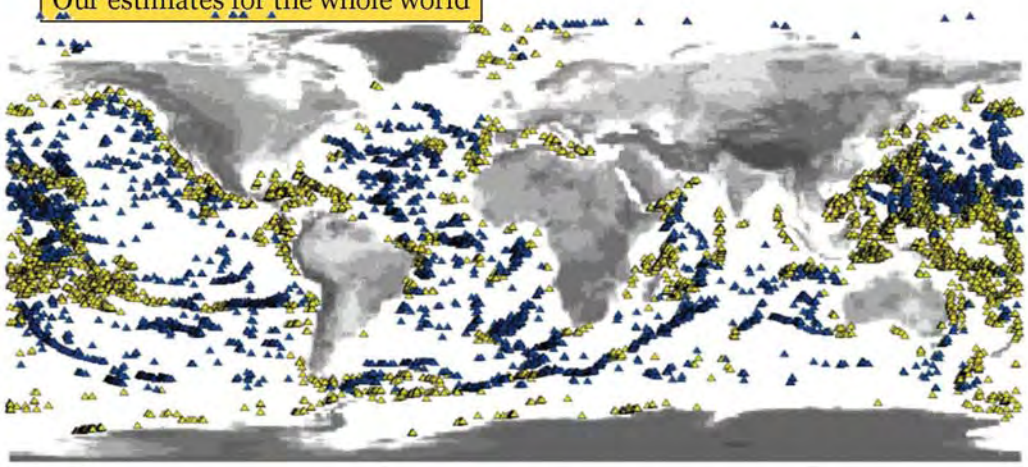
Seamounts – **How many are in the World?**

Our estimates for the whole world

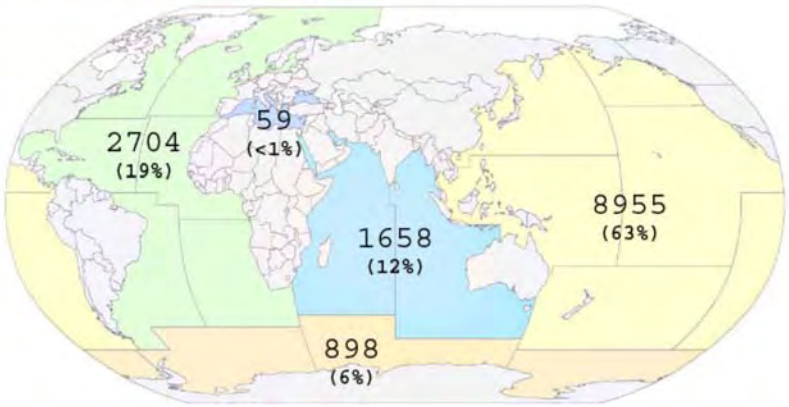


Locations for 14,287 seamounts. Yellow indicates seamounts within EEZs (59% of total), blue indicates seamounts in international waters (41%).

Data by Kitchingman et al. (*in press*). Map by Karen Stocks

Seamounts – **How many are in the World?**

Our estimates for Ocean basis



Data by Kitchingman et al. (*in press*)

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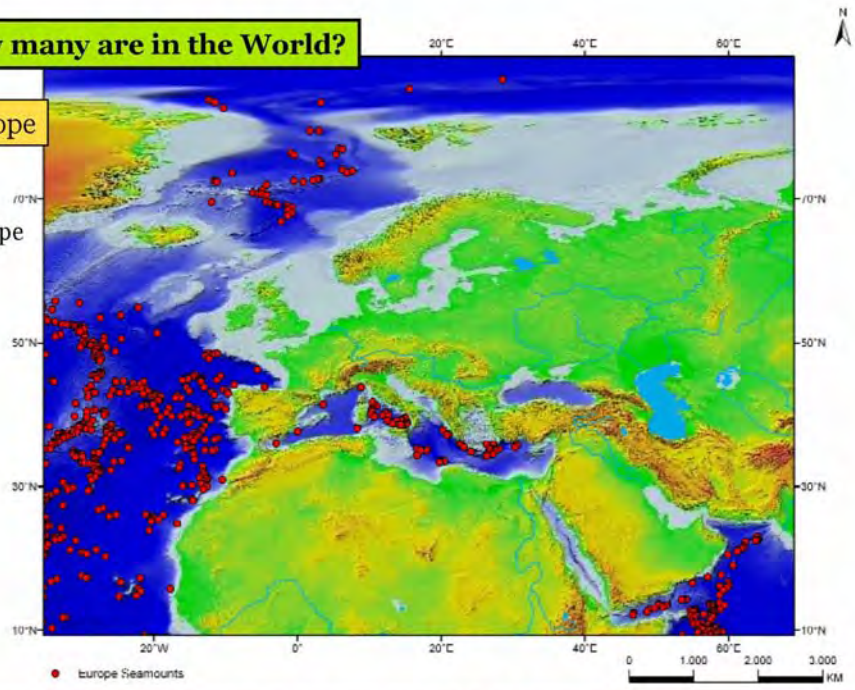
Seamounts – **How many are in the World?**

and for Europe

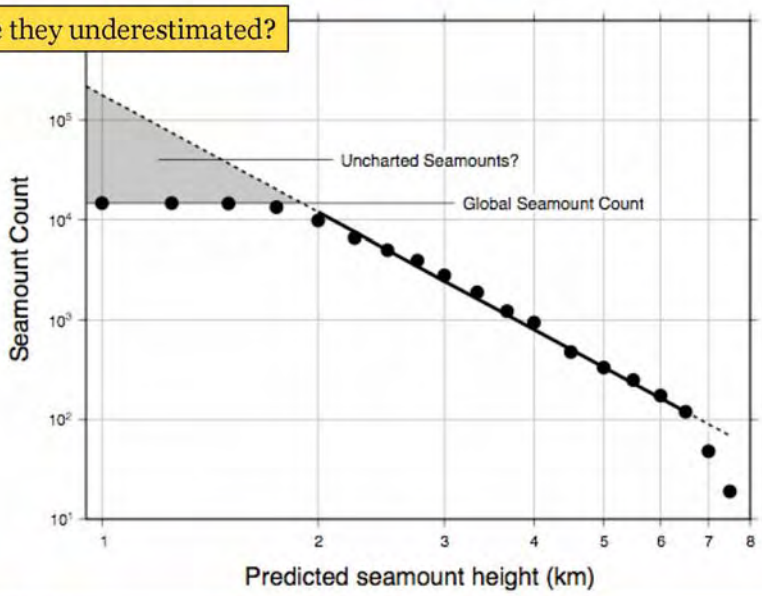
About 380 in Europe



Data by Kitchingman et al. (*in press*). Map by Ricardo Medeiros (DOP)

Seamounts – **How many are in the World?**

Are they underestimated?



Paul Wessel, 1997

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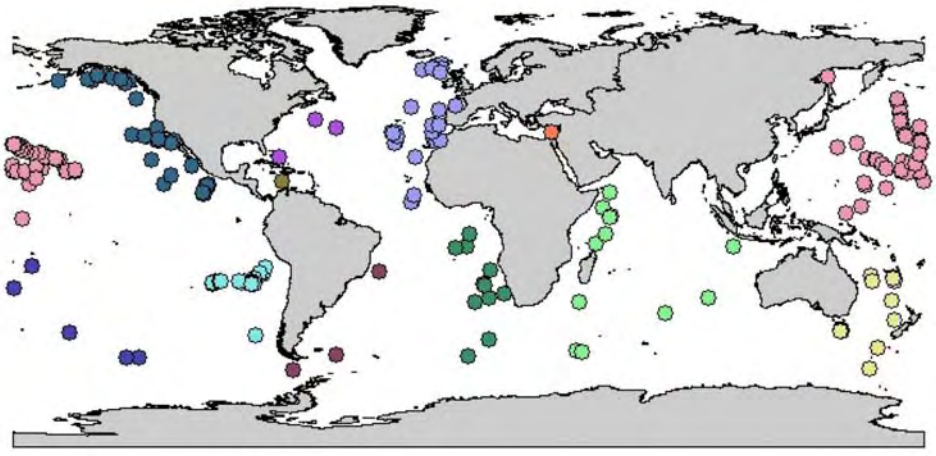
Seamounts – **Our knowledge on this ecosystems**

Studied seamounts



K. Stocks, 2005. SeamountsOnline; WWF

Seamounts – **Why Seamounts are of great interest ?**

"Oceanic Oasis"

Open oceans are, in general, known for having a very low biological productivity

The presence of seamounts in flat areas of the abyssal seafloor, produces a series of topographically-induced changes

That lead to enhanced productivity

Seamounts have often been described as "Oceanic Oasis"

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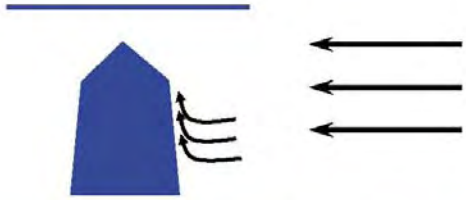
Seamounts – **Why Seamounts are of great interest ?**

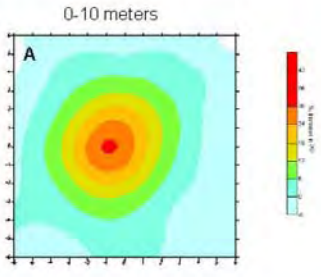
Oceanography - upwells

Seamounts can generate and upwells (1);
(Hypotheses reasonably tested)



A result of upwells can be a localized bloom of Primary Production) (2-6) **(Hypotheses not fully tested).**

However, many studies failed to demonstrate persistent high chlorophyll *a* patches over seamounts (7).



1- Lueck & Mudge, 1997; 2- Genin and Boehlert, 1985; 3- Dower et al., 1992; 4- Odate and Furuya, 1998; 5- Mouriño et al., 2001; 6- Comeau et al., 1995; 7- Pelaez and McGowan, 1986

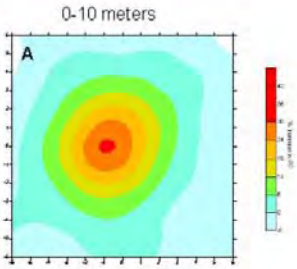
Seamounts – **Why Seamounts are of great interest ?**

Oceanography - upwells

an increase in PP may result in

an increase in zooplankton (1, 2)

and, therefore, an increase in local supply of food for animals (3,4) **(Hypotheses not fully tested)**.



1- Fedosova, 1974; 2- Huskin et al., 2001; 3- Genin et al., 1994; 4- Haury et al., 2000

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Seamounts – **Why Seamounts are of great interest ?**

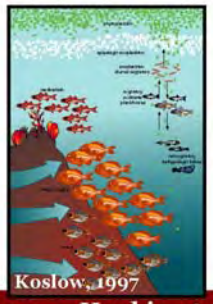
Oceanography - Taylor columns, eddies

Seamounts tend to enhance water currents (1,2).

can have their own eddies, and closed circulations over the top known as (Taylor columns) (3). **(Hypotheses reasonably tested)**

"Taylor caps" may trap advected organism and/or vertically migrating zooplankton (4,5). **(Hypotheses not fully tested)**

External food supply for seamount communities



1- Genin et al., 1986; 2- Boehlert, 1988; 3- Lueck and Mudge, 1997; 4- Huskin et al., 2001; 5- Genin et al., 1994

Seamounts – **What lives there?**

"It is likely that the total species diversity is not known for any seamount" (1)

"and it is likely that many species will never be known" (2)

1- Stocks et al., *in press*; 2- Probert et al., *in press*

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Seamounts – **What lives there?**

Fish species

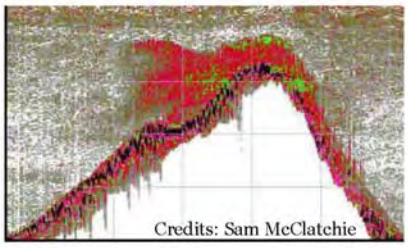
1. 794 fish species have been reported on seamounts
2. approx. 50 are commercially important
3. approx. 10 are mostly caught on seamounts

Morato et al., 2004

Seamounts – **What lives there?**

Fish aggregations

Seamounts may host substantial aggregations of bottom fishes in the water column (1-4).



These aggregations are supported by the enhanced flux of prey organisms past the seamounts (5-7)

1- Boehlert and Sasaki, 1988; 2- Koslow, 1996; 3- Koslow, 1997; 4- Koslow et al., 2000; 5- Tseytlin, 1985; 6- Genin et al., 1988; 7- Koslow, 1997.

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Seamounts – **What lives there?**

Fish aggregations

Orange roughy
Hoplostethus atlanticus

Alfonsinos
Beryx spp.

Roundnose grenadier
Coryphaenoides rupestris

Oreos
Pseudocyttus maculatus

Pelagic armourhead
Pseudopentaceros richardsoni

"It's ugly. And endangered, too?"- Toronto Star

Koslow et al. 2000; Vinnichenko 2002

Seamounts – **What lives there?**

Benthic communities

On the seamount floor there are often rich communities dominated by suspensions feeders, e.g., gorgonians and corals (1-3)

Enhanced currents and steep slopes expose the volcanic rocks and favour the growth of suspension feeders (4-7).

1- Richer de Forges et al., 2000; 2- Koslow et al., 2001; 3- Ohkushi and Natori, 2001; 4- Genin et al., 1986; 5- Grigg et al., 1987; 6- Wilson and Kaufmann, 1987; 7- Rogers, 1994

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Seamounts – **What lives there?**

Endemism

Seamounts may host a large number of endemic species

11.6% of fishes and 15.4% of invertebrates reported from seamounts were endemic species (1)

51% for bottom/near bottom invertebrates and 44% for fishes (2)

29-34% of fish and invertebrates species) (3)

It is important to remember that these data represent a small and biased sampling of seamounts. Whether this reflects endemisms, or merely lack of samplig, is not clear

1- Wilson and Kaufmann, 1987; 2- Parin et al., 1997; 3- Richer de Forges et al., 2000

Seamounts – **What lives there?**

Visitors

Sharks ([10, 11]) and tunas ([12-15]) sometimes congregate around seamounts. **(Hypothesis not fully tested)**
Seabirds have also been shown to be more abundant in the vicinity of shallow seamounts ([19-21]). **(Hypothesis not fully tested)**

10- Klimley et al. 1988; 11- Hazin et al. 1998; 12- Fonteneau, 1991; 13- Holland et al. 1999; 14- Itano and Holland 2000; 15- Sibert et al. 2000; 19- Haney et al., 1995; 20- Monteiro et al., 1996; 21- Yen et al. 2004

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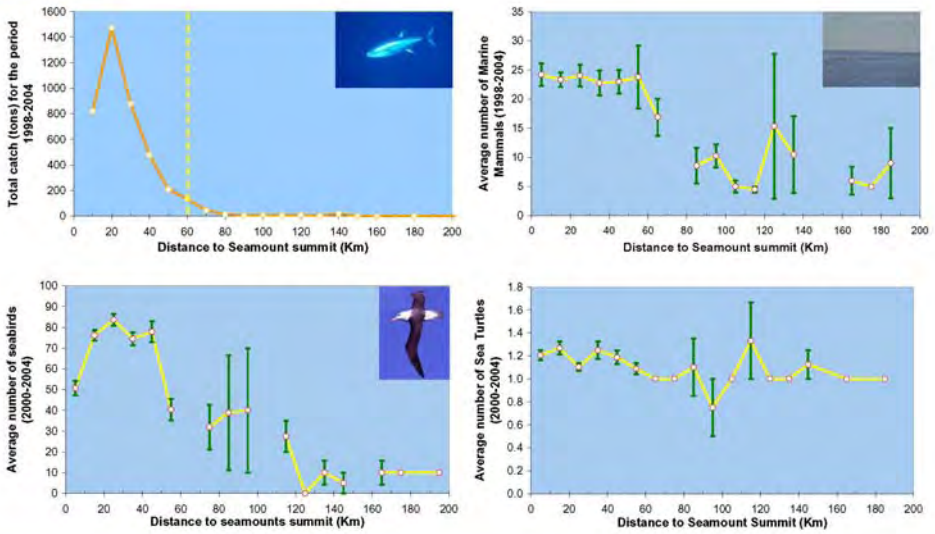
Seamounts – **What lives there?**

Visitors

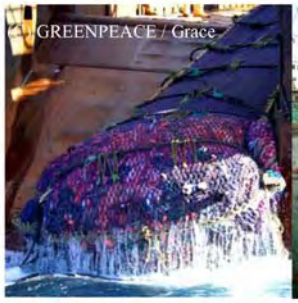


Morato et al., *in press*

Seamounts – **Threats**

Top 4

- Fisheries targeting large aggregations
- High impact of trawling on benthic communities
- Exploration of geological and mineral resources
- Impact of research activities in sensitive seamounts, mainly those with hydrothermal activity



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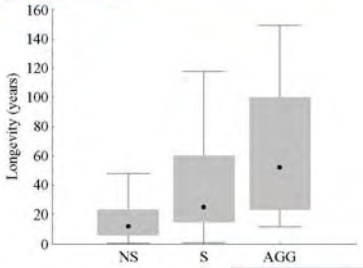
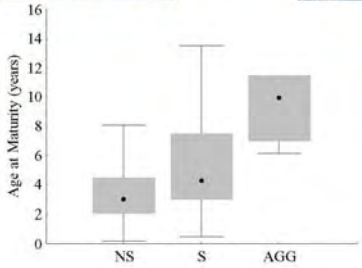
Seamounts – **Threats** Fisheries

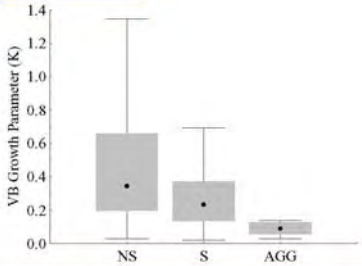
Longevity



Age at Maturity

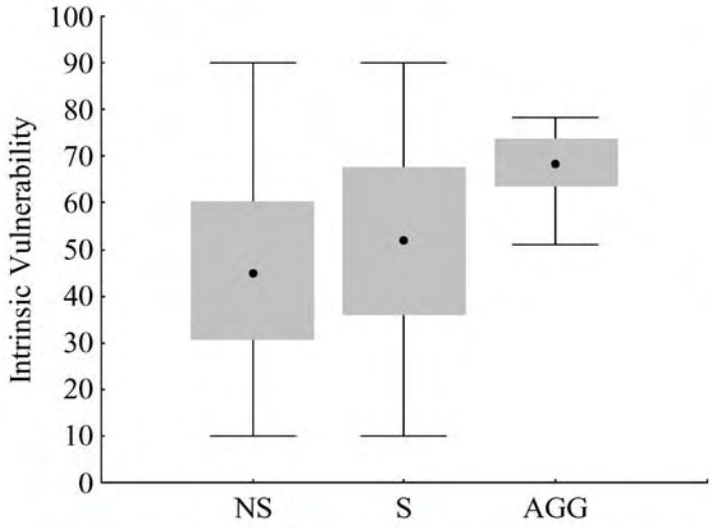


VB growth K



Morato et al., 2006

Seamounts – **Threats** | Fisheries



NS – "non-seamount"; **S** – "Seamount"; **AGG** – "Seamount-aggregating"

Morato et al., 2006

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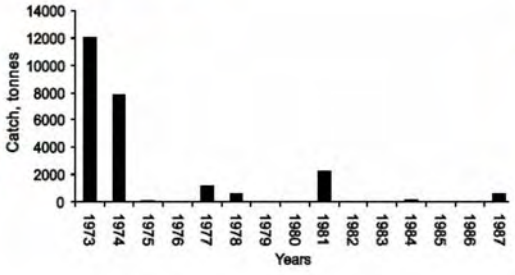
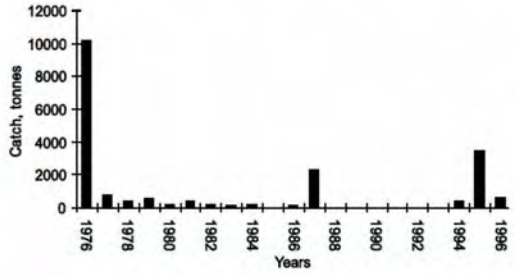
Seamounts – **Threats** | Fisheries

South Azores Area



9 seamounts
Alfonsino, *B. splendens*
Scabbardfish, *L. caudatus*

Corner Rising



3 seamounts
Alfonsino, *B. splendens*

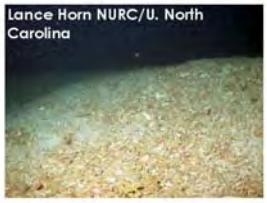
Vinnichenko, 2002

Seamounts – **Threats**

Impact of trawling in benthic communities

Un-trawled

Trawled



While for **terrestrial mountains** threats are easily seems

For **underwater mountains** we have no clue on what is happening down there

Underwater mountains: an unknown world – T. Morato & R.S. Santos

Seamounts – **Threats**

Impact of trawling in benthic communities

Between 30 and 50% of the *Lophelia* reefs off the coast of Norway, have been partially or totally damaged by trawling (1)

also off the west of Scotland (2), off western Ireland (3), and in the northern Rockall Trough (4).

In the northwest Atlantic, trawl damage to gorgonian corals was observed on 29% of transects (5).

(6)	Lightly fished (n=11)	Heavily fished (n=11)
Biomass (kg)	7.0 (+/- 5.8)	1.1 (+/- 3.4)
No. of species	20.1 (+/- 3.6)	8.7 (+/- 6.3)

1- Fossa et al. 2002; 2- Roberts et al. 2000; 3- Hall-Spencer et al. 2002; 4- ICES 2002, 2003; 5- Mortensen et al. 2005; 6- Clark and Koslow, in press

Seamounts – **Managment**

Management Issues

- Deep-sea **bottom fishing** has been identified as the **major threat** to seamount communities and habitats

- In the short term, there is **little likelihood** of cataloguing **every seamount** in the world's oceans, together with a **detailed inventory** of their key characteristics and ecology.

- Management proposals need to reflect a highly **precautionary approach** given the current state of knowledge about seamounts and the extent and impacts of human activities on seamount ecosystems.

- Management objectives must target **recovery and restoration** as well as **preventing degradation** of seamount communities.

Probert et al., *in press*

Underwater mountains: an unknown world – T. Morato & R.S. Santos

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Management Issues

Given that it may not be possible to have sustainable and economically viable commercial fisheries for at least some species on seamounts, **fisheries management measures will have to adjust**.

In some fisheries, this may require **changes in fishing practice**, such as switching from trawling to long-lining to minimise disturbance to seabed habitats and associated fauna.

Other fisheries **may simply be unsustainable** and therefore unacceptable practice on seamounts.

Probert et al., *in press*

Seamounts

Thanks