# KERGUELEN PLATEAU SYMPOSIUM

31 March – 2 April 2025

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# BOOK OF ABSTRACTS

## KERGUELEN PLATEAU SYMPOSIUM ON MARINE ECOSYSTEMS AND FISHERIES

## 31 MARCH – 2 APRIL 2025

## STATION MARINE DE CONCARNEAU

**LIST OF ABSTRACTS**

**Development of an underwater camera to study deep-sea benthic ecosystems in the Southern Ocean: the Bendicam project**

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**Abstract**

The "Bendicam" project, the fruit of an interdisciplinary collaboration between several research teams, aims to develop an autonomous underwater camera model dedicated to the observation of deep benthic ecosystems. It is part of the scientific monitoring of French fisheries and nature reserves in the Southern Ocean by the Muséum national d'Histoire naturelle. This monitoring is based on the implementation of observation protocols carried out by scientific observers on board ships during commercial fishing operations or fish stock assessment campaigns. The aim of the project is to develop a cost- effective technological solution that will enable the deployment of sufficient instruments to equip the entire French fleet operating in the Southern Ocean. Technological development is being carried out by two teams of engineers working together on high-pressure mechanics and advanced electronics.

**Keywords**: instrumentation; high-pressure mechanics; electronics

**New insights on ecological niche segregation and demography of sympatrically breeding blue petrels and thin-billed prions at Kerguelen**

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**Abstract**

Understanding the processes structuring communities is a fundamental goal in ecology and conservation biology. Although our understanding of the structure and ecology of the Kerguelen seabird community has considerably improved during the past decades, ecological information is lacking for the smaller species despite their high abundance. We used at-sea movement and stable isotopes to investigate the spatial and trophic ecology of two petrel species during the breeding period (blue petrel *Halobaena caerulea* and thin-billed prion *Pachyptila belcheri*). During incubation, there was a strong latitudinal and longitudinal segregation between species. Mean maximum distance from the colony during foraging trips was  2330 km and  1300 km for blue petrel and thin-billed prion, respectively. Foraging habitat segregation occurred during incubation, as did spatial and habitat segregation during chick-rearing. Blue petrels fed on prey from a higher trophic level than prions, indicating trophic segregation. Spatial distribution and diet are the primary segregation mechanisms for these species, and segregation patterns may result from competitive exclusion rather than from niche specialization. Spatial and trophic segregation may have evolved to minimize competition allowing co-existence of these two abundant sympatric breeding species. Temporal trends in demographic parameters were compared between both species in the light of these ecological differences and environmental changes.

**Keywords**: at-sea distribution, demography, habitat partitioning, stable isotopes, trophic position

**The mechanisms of natural iron fertilization of the Kerguelen Plateau remain an enigma.**

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**Abstract**

The marine environment above the Kerguelen Plateau and Heard Island Plateau —both components of a vast, submerged, volcanic, large-igneous- province in the southern Indian Ocean—supports thriving populations of micro and macro-organisms. Thirty years ago, the spatial extent of this high biomass region was revealed by the first generation of ocean color satellites and pioneering oceanographic campaigns since have demonstrated that the primary factor maintaining the high biological production is natural iron fertilization. Where are we three decades later? To answer this question, we review here observations on iron biogeochemistry from the Kerguelen plateau. Multiple research projects (ANTARES, KEOPS, SOCLIM, HEOBI, MOBYDICK, SWINGS, MARGO) have addressed this issue from various perspectives. The investigations of sources and sinks of iron have provided a detailed but still incomplete view of the origin of natural iron fertilization. The internal cycle of iron associated with biotic and abiotic processes is complex and not entirely elucidated and the bioavailability of iron for microorganisms remains a central and unresolved question. The Kerguelen Plateau bloom is associated with ecosystem services (carbon sink, fisheries, and iconic ecosystems) which are experiencing the consequences of the rapidly changing Southern Ocean. In this context, filling the gaps in our knowledges of iron biogeochemistry remains a challenge and a priority.

**Keywords**: iron biogeochemistry carbon cycle ecosystem

**The challenges facing the TAAF fishery in the waters of the Kerguelen Plateau**

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**Abstract :**

While the beginning of the century was marked by the fight against illegal, unregulated and unauthorised (IUU) fishing, for several years now, despite frequent satellite passes, no suspicious vessels have been detected. The presence of authorised vessels in the area, the permanent monitoring kept by the national fisheries surveillance centre, which receives any satellite detections, and the military patrol in the southern waters, provide what can only be described as an effective deterrent to potential IUU vessels. However, vigilance is still required and the TAAF are working with the French government to improve satellite detection technologies.

The current issues surrounding the Kerguelen plateau for France are :
- Revising the management plan for the toothfish fishery, in a context of uncertainty about the future dynamics of the stock, due to a period of low recruitment in the early 2000s and potential external factors, up to 2025;
    - The project should make it possible to test a recruitment assessment method that is simpler to implement than the POKER trawl surveys, and to consolidate data sets in order to better anticipate future dynamics;
    - A major issue will be the depredation by cetaceans (killer whales and sperm whales), which is a real challenge not only for the preservation of the currently endangered killer whale population and the limitation of disturbances to marine ecosystems, but also for the economic profitability of the fishery;
    - The three years of management should enable the introduction of e-monitoring systems on board vessels to relieve the counting work currently carried out by on-board fisheries inspectors, who must also constantly monitor compliance with regulations and implement various scientific protocols;
- Revising the management plan for the national nature reserve, based on the results of the previous management plan, with a deadline of 2028;
- Continuous improvement of IUU fishing detection technologies, in particular through the implementation of the European MARIO programme, in Crozet waters mainly in cooperation with South Africa, but whose results could be useful for other southern EEZs. Training the algorithms of the Unseenlabs radio-frequency detection system should improve the effectiveness of ghost ship detection systems;
- The ambition to manage the Kerguelen EEZ as part of the network of marine protected areas in the sub-Antarctic Ocean, in particular by pooling initiatives and positive advances.

**Keywords:** fishery management, marine reserve

**Key science and management developments on the Kerguelen Plateau – update from Australia**

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**Abstract**

This presentation will highlight key developments in science and management on the Kerguelen Plateau since the second Kerguelen Plateau Symposium in 2017. These include planned activities by the Australian Antarctic Program (AAP) and ongoing collaborative efforts between Australia and France, critical to achieving mutual objectives for the marine ecosystems and fisheries of the Kerguelen Plateau. Australia and France share a rich history of close collaboration on the Kerguelen Plateau across a range of important domains, including scientific research, operations and logistics, and engagement within Antarctic Treaty system forums. Australian and French scientists continue to work together to develop a joint understanding of the region's climate and ecosystems, and population dynamics of toothfish across the Kerguelen Plateau. These efforts advance shared commitments in the 2023 *Australia-France Roadmap: A New Agenda for Bilateral Cooperation*, to improve global understanding of climate change and of the ecosystem and fish populations on the Kerguelen Plateau. In January 2025, the Heard Island and McDonald Islands Marine Reserve was expanded by approximately 310,000 $km^2$ to a total of nearly 380,000 $km^2$. Unique geological features and biological assemblages are included within the additional area, strengthening protection for species and communities in the face of emerging pressures, including climate change. This expansion will also provide stronger protection for foraging and breeding areas for listed species of birds and mammals. The boundaries and zoning of the expanded reserve ensure protection of important conservation values, while enabling the continuation of sustainable fishing in the region. This presentation will provide an overview of the expansion and next steps for management of the reserve, including development of the new management plan and an overview of plans for the next management and research visit to the region.

**Keywords**: Key science and management developments

**A synthesis of historic records of zooplankton diversity and distribution around the kerguelen plateau**

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**Abstract**

The Kerguelen Plateau and its Subantarctic islands support a diverse marine ecosystem influenced by unique geological features and dynamic ocean currents. They provide crucial habitats for seabirds and marine mammals, which are experiencing population declines due to diminished prey availability and climate impacts. Zooplankton play a crucial role in the ecosystem, serving as a primary food source for fish, seabirds, squids, penguins, and seals. This study synthesizes historical zooplankton abundance from the 1970s to now, creating distribution maps and analyzing temporal and spatial variations. The resulting maps reveal significant temporal and spatial variations in zooplankton populations. The study highlights critical hotspots of zooplankton concentration that correspond with regions of high primary productivity. Understanding these historical dynamics provides a baseline for predicting future changes in the marine ecosystem of the Kerguelen Plateau under the influence of climate change and human activities. This research aligns with the working group PHOCIS (Pelagic High Seas Ocean Ecoregionalisation of the Indian Subantarctic), under the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), aiming to delineate priority conservation areas within the high seas and bolsterprotection measures for species and ecosystems significantly impacted by climate change.

**Seabirds from the Kerguelen Islands as bioindicators of large-scale marine pollution**

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**Abstract**

Metallic and organic contaminants threaten marine ecosystems globally, yet their occurrence and trends are challenging to quantify in vast oceanic regions. Seabirds from remote areas are primarily exposed to contaminants through their food webs and serve as bioindicators of large-scale marine pollution. We measured trace elements, persistent organic pollutants (POPs), and trophic proxies (C and N stable isotopes) in the blood, feathers, and organs of 27 species from the large, emblematic Kerguelen avian community, which includes seabirds with diverse diets (crustacean-eaters to carrion consumers), feeding habitats (Antarctic to subtropical waters), and migratory strategies (resident to long-distance migrants). Overall, we showed that feeding ecology and age-class were key drivers of variation in tissue contaminant concentrations, while taxonomy played a minor role. Our results revealed spatial variation in the transfer of mercury and POPs in oceanic- feeding species, with birds exploiting warmer waters showing higher mercury and lower POP burdens than those feeding in colder waters. Additionally, species reliant on low trophic-level prey from the productive Kerguelen plateau exhibited high contaminant diversity. Ongoing analyses will examine how migratory destinations influence contaminant burdens in the brown skua, a long-distance migrant. Perspectives on advancing pollution monitoring through selected seabird species as bioindicators in these remote areas will be discussed.

**Keywords**: feeding ecology, Kerguelen Islands, metals, pollution, seabirds.

**Pecheker: a fisheries and ecosystem-based database for scientific monitoring and data curation in the Southern Ocean**

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**Abstract**

The scientific monitoring of the Southern Ocean French fishing industry is based on the use of the Pecheker database. Pecheker is dedicated to the digital curation of the data collected on field by scientific observers and which analysis allows the scientists of the Muséum national d'Histoire naturelle institution to provide guidelines and advice for the regulation of the fishing activity, the protection of the fish stocks and the protection of the marine ecosystems. The template of Pecheker has been developed to make the database adapted to the ecosystem-based management concept. Considering the global context of biodiversity erosion, this modern approach of management aims to take account of the environmental background of the fisheries to ensure their sustainable development. Completeness and high quality of the raw data is a key element for an ecosystem-based management database such as Pecheker. Here, we present the development of this database as a case study of fisheries data curation to be shared with the readers. Full code to deploy a database based on the Pecheker template is provided. Considering the success factors we could identify, we propose a discussion about how the community could build a global fisheries information system based on a network of small databases including interoperability standards.

**Keywords**: fisheries, monitoring, data curation, ecosystem, Southern Ocean

**Studying spatial structuring and patterns to elucidate the pelagic seascape of the southern Indian ocean**

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**Abstract**

Mid-trophic level organisms, including micronekton and macrozooplankton, play a crucial role in ecosystems of the (meso)pelagic zone (0-1000 m depth) and the cycling of biochemical compounds where they connect phytoplankton to higher trophic levels, birds, mammals, and exploited species. While the influence of climate change and anthropogenic pressures (fishing, contaminants) currently increase, it is becoming crucial to understand how food webs — in terms of communities, biomasses and distribution — as well as marine habitats will be affected. The pelagic ecosystem in the Subantarctic area around Kerguelen is a natural laboratory to study a rich and unique biological chain in the Southern Ocean, from plankton to top marine predators. In recent years, several successive programs (MyctO-3D-MAP, REPCCOAI, MOBYDICK, THEMISTO) have proposed to explore the pelagic ecosystems supported by the high biological production of the Kerguelen region and feeding the large populations of birds and mammals. Thanks to various approaches, the objective is therefore to better understand the pelagic ecosystems of the southern Indian Ocean, their biodiversity and their variability in relation o physical forcing. Recent studies using multifrequency acoustic and functional approach help to better understand pelagic seascape and particularly transition between sub btropical and subantarctic area, and the apparent drop in biomass observed in the Southern Ocean.

**Keywords**: Marine trophic ecology, Biological structuring, Mid-trophic levels, Mesoscale, Multiscale variability

**Skates Captured As By-Catch In The Toothfish Longline Fishery In Kerguelen EEZ**

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**Abstract**

Skates are among the main bycatch species (unintentional catch of non- targeted species) of longline fishery targeting Patagonian toothfish (*Dissostichus eleginoides*) in Kerguelen EEZ. The aim of the present research was to obtain knowledge about biology and ecology attributes of skate species in order to constitute a basic understanding allowing to propose operational solution to mitigate fishing impacts. We composed a large dataset of reporting fishery data, data routinely collected by fishery observers and data from particular protocols implemented as part of this research. Using these data, we were able to estimate a large variety of attributes. First results highlighted that the Kerguelen Sandpaper skate (*Bathyraja irrasa*) was less productive than the Eaton skate (*Bathyraja eatonii*) with higher maximum age and age-at- maturity. Then species ecology revealed that *B. irrasa* was more susceptible to capture. Its feeding ecology has indeed suggested a strong affiliation to the benthic habitat where fishing lines are set and mean size of capture is lower than size-at-maturity implying a large part of juveniles are captured. In contrast, *B. eatonii* showed a limited accessibility to fishery with a refuge area from 0 to 500 m deep (where fishing is prohibited). Acquirement of these knowledge provided inputs for mitigation measures proposals, such as spatial avoidance and modification of fishing gears, and has only been possible thanks to efficient collaboration between scientists, fishery managers and industry.

**Keywords**: feeding ecology, ageing, spatial distribution, population density, by-catch mitigation

**A glimpse into the contribution of marine predators to nutrient recycling around the Kerguelen Plateau: from their potential prey, their faeces and the terrestrial recipient ecosystem**

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**Abstract**

The rich nutrient content of marine predator faeces suggests that their defecation may facilitate nutrient recycling at lower trophic levels of food webs. Yet, their contribution to nutrient fluxes has never been assessed in the singular biogeochemical area of the Kerguelen Plateau. We are exploring the role of marine predators in nutrient cycling through three different angles. First, we examined the nutrient composition of potential fish prey, which are rarely known despite being largely determinant of the composition of predator faeces. We found that forage fish showed important variability in their nutrient concentrations, so that the preferential consumption of one or another prey may have different consequences in terms of biological nutrient cycling dynamics. Then, we examined the multi-nutrient composition of scats of a local predator, the Antarctic fur seal (*Arctocephalus gazella*), and estimated how much nutrients breeding females from two colonies release at sea and on their colonies during the breeding season, using scat compositions and a bioenergetic model. In total, breeding females deposit up to 628 kg (95% CI [548 - 710]) of phosphorus, or 46.4 [39.8 - 53.2] kg of iron. We found intra and inter-colony differences in scats, so that colony nutrient release levels did not simply reflect colony abundances. Finally, in an ongoing interdisciplinary study, we aim to assess the nutrient and trophic footprints around marine predator colonies on terrestrial ecosystems.

**Keywords**: animal-mediated nutrient cycling; major nutrients; trace nutrients ; contaminants ; sea-land continuum

**In-situ underwater acoustic recordings from biologged elephant seals as an alternative source of wind speed data**

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**Abstract**

Obtaining reliable and precise wind data in remote regions, such as the Southern Ocean, remains a significant technical challenge. In-situ measurements from ships and buoys are sparse, and scatterometers, along with atmospheric models, rely on such data for calibration. To address this gap, underwater passive acoustic recordings have emerged as an alternative source of wind speed data over the past few decades. Notably, biologged elephant seals have provided valuable datasets with fine temporal resolution, offering in-situ wind speed measurements in otherwise hard-to-access areas. To evaluate the potential of this method, various machine learning models were trained using reanalysis data from ERA5 as ground truth reference. Results indicate that neural networks, particularly Long Short-Term Memory (LSTM) and Multi-Layer Perceptron (MLP) models, outperform traditional empirical approaches. Furthermore, integrating acoustically derived wind data with co-localized underwater measurements of temperature and salinity profiles from CTD tags reveals a correlation between surface wind speed and mixed layer depth. This combined approach offers promising insights for improving environmental monitoring in remote oceanic regions.

**Keywords**: wind speed, underwater passive acoustics, mixed layer depth

**Inter-annual variations of the environmental and oceanographic conditions in the Indian sector of the Southern Ocean and their effects on Kerguelen elephant seals pups weaning conditions.**

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**Abstract**

This study investigates the interannual variations in weaning conditions mass and length of Southern Elephant Seals (SES) pups between 2006 and 2023 from Kerguelen Island (KI) in response to changes in environmental and oceanographic conditions. Major changes in environnemental conditions were detected within the Kerguelen region. Spatially structured changes in wind speed were observed. Using 17-years of float and SES temperature and salinity observations within the Kerguelen region a marked difference is observed in the mixed layer (ML) properties. Two regions were identified, a deeper ML one was found on and west of the southern plateau and a shallower one north and East of KI. ML Depth is shoaling in winter and deepening in summer and those changes are likely to have direct consequences on the biomass and composition of phytoplankton communities as well as heat exchange between the atmosphere and the ocean interior. Over 1997-2022 period chlorophyll-a biomass tended to increase with contrasted regional differences and large interannnual variaitions. In additions to maternal effects, pups weanning condition was strongly affected by the foraging habitat of their mother as well as the wind strength during the previous spring and winter in relation to the SAM index influencing Chlorophyll-a. This study emphasizes the cascading effects of the ongoing climatic change on the physiscal and biological conditions over the Indian sector of the SO.

**Keywords**: Environmental changes, Mixed Layer, phytoplankton, Elephant seals, Weaning condition

**Contribution of fishery observation program to scientific knowledge on the Kerguelen plateau**

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**Abstract**

The data collected by fishery observers are of crucial importance for the management of fisheries, and contribute to a better understanding of the marine ecosystems. On the Kerguelen plateau, fishing activities are conducted year-round by longliners targeting Patagonian toothfish on the seabed between 500 and 2200 metres. Other fish and invertebrate species are also collected as bycatch. Observers are deployed on all the vessels to collect data on the benthic species caught, as well as seabirds and mammals interacting with the fishery. The data are used to gain information on life history traits of both targeted and bycatch species, such as reproduction, through biometry and gonadic stages analysis, growth and individual movements through mark and recapture protocols and otolith collection, diet composition, through the analysis of stomach contents. Investigating the diet of deep-sea predators is also a way to sample benthic and demersal compartments for prey species that would not be accessible otherwise. The fine scale capture data allow to update species bathymetric and geographic distribution, which in turn is used to inform fishing boats on the zones to be avoided to prevent accidental bycatch of vulnerable species. The observation data of marine mammals and birds are used to complete knowledge on the species distribution, monitor the interactions with the fishing fleet, and investigate population dynamics thanks to photo-identification catalogues for cetacean populations.

**Keywords**: Kerguelen, French EEZ, life history traits, fishery observation, *Dissostichus eleginoides*

**Climate Change on the Kerguelen Plateau and Implications for the Design of Demersal Fish Research Surveys**

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**Abstract**

Sitting at the edge of the Antarctic Circumpolar Current, the Kerguelen Plateau is known for its complex oceanography that drives a unique sub- Antarctic marine ecosystem supporting significant diversity. The region's water column has already been shown to be affected by climate change with further changes predicted into the future. Fisheries and ecosystem managers are increasingly faced with the challenge of monitoring the effects of climate induced change on fish stocks. Ensuring monitoring and survey design produces data that contains adequate information is vital to support quantitative analyses. To aid monitoring design, we computed various climate change metrics for the northern part of the plateau, such the change in extreme events like Marine Heatwaves and the overall rate of change of various oceanographic metrics. Using clustering analyses, we show that not all areas changed in the same way and will change differentially into the future. In fact, there are distinct depth-dependent, as well as North-South and East-West patterns in the spatial distribution of clusters. We simulate sampling of these clusters using existing as well as hypothetical demersal fish sampling designs. Our findings underscore that both France and Australia must work together in order to ensure all areas of change are sampled adequately, as clusters are not evenly distributed in space. Findings also highlight there may be benefits to considering using longline sampling in addition to the current trawl sampling techniques used in the scientific surveys in order to capture data on all clusters.

**Keywords**: climate change metrics,

**PHOCIS: Pelagic high seas ocean ecoregionalisation of the Indian subantarctic**

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**Abstract**

A pelagic ecoregionalisation initiative for the Subantarctic Indian region was launched at a workshop in South Africa in 2019. The initiative evolved into the PHOCIS project, with annual workshops focusing on the distribution of plankton, mesopelagic fish, seabirds and marine mammals to inform conservation planning. Preliminary results underscore the significant influence of oceanographic regions and major frontal zones on pelagic ecosystems. The project employs a biogeographic approach to delineate potential habitats, species assemblages and key production areas. Targeted species groups include Euphausiids, Amphipods, Salps, Copepods, Myctophids, fur seals, penguins and some flying birds. Baseline data are gathered through net sampling, the Continuous Plankton Recorder, tracking studies, and international databases. Current efforts focus on developing spatial distribution models for synthetic species assemblages using advanced predictive techniques. Key achievements of PHOCIS include updating its work plan to advance integrated ocean management, establishing monitoring systems, and developing higher education materials. Within three years, PHOCIS aims to propose a framework for a representative system of Marine Protected Areas (MPAs), aligning with CCAMLR and BBNJ guidelines. This initiative complements existing national MPAs, enhancing regional conservation efforts, with particular attention to the Kerguelen Plateau and the area between the Crozet and Prince Edward Islands.

**Keywords**: Pelagic, Ecoregionalisation, Marine Protected Areas, Conservation, Climate Change

**Net Gains: Harnessing Commercial Fishing vessels as Ships of Opportunity for Marine Science.**

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**Abstract**

The marine environment and ecosystems of the Kerguelen Plateau remain poorly understood and are difficult to study. While scientists are eager to explore this vast, under-researched region, research efforts face significant logistical and financial challenges. Chartering a dedicated research vessel can be prohibitively expensive, and the harsh conditions complicate access. However, collaborating with the fishing industry offers a valuable opportunity to regularly access this remote area. Fisheries Observers deployed by the Australian Fisheries Management Authority (AFMA) on fishing vessels have collected extensive scientific data to assess the impact of fishing on target species, bycatch, and the broader ecosystem. By placing scientists and observers on board, it's possible to gather valuable data, deploy scientific instruments, and conduct sampling that would otherwise be unfeasible. These activities can be conducted at a relatively low cost for all involved and offer mutual benefits. Recent collaborations between the Australian fishing industry, Fisheries Observers, and researchers have ranged from the incidental collection of scientific specimens to routine data gathering and the deployment of deep- sea instruments. This talk will highlight some of these efforts and discuss the factors that contribute to the success of such partnerships.

**Keywords**: Fisheries, data collection, observers, instrumentation.

## Improving Age Estimation Accuracy in the Patagonian Toothfish: An Updated Ageing Error Matrix

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**Abstract**

Age estimation of Southern Ocean fish species, particularly the Patagonian toothfish (*Dissostichus eleginoides*), is vital for fisheries management and conservation. Otoliths, calcified structures in fish inner ears, contain growth increments analogous to tree rings, enabling precise age estimation. However, challenges arise due to the dense and complex structure of otoliths, particularly in slow-growing, long-lived species. Accurate age determination requires minimising variability, often achieved by involving multiple specialised readers. This study updates and evaluates an ageing error matrix (AEM), a probabilistic framework designed to quantify the likelihood of assigning a true age class to an observed age class during sampling. Building on established methodologies the AEM leverages readability scores and discrete distributions to model integer-based ageing errors, addressing limitations of Gaussian-based models that can predict biologically implausible ages. Additionally, the model accounts for the assumption of inter-year comparability in age interpretation, acknowledging potential biases introduced by changes in otolith preparation methods, viewing protocols, and readers.

**Keywords**: ageing, error matrix, stock assessment, Patagonian Toothfish, otolith

**A Marine Protected Area (MPA) network linking South Africa, France and Australia's existing MPAs across the high seas in the Indian Subantarctic region**

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**Abstract**

The Pelagic High seas Ocean eCoregionalisation of the Indian Subantarctic (PHOCIS) project aims to enhance our understanding of pelagic ecosystems in the Indian Subantarctic region (20°W–160°E, 30°–60°S) by analysing the distribution of key pelagic species, including seabirds and marine mammals, the drivers influencing them, and the potential impacts of climate change. The project seeks to provide science-based recommendations for sustainable management and adequate protection of this ecologically critical area. The key output will be a network of marine protected areas (MPAs) linking existing MPAs across the high seas, using systematic conservation planning approaches to design a representative and ecologically coherent network. This MPA network will encompass ecosystems surrounding South Africa's Prince Edward Islands, France's Crozet and Kerguelen Islands, and Australia's Heard and McDonald Islands, leveraging comprehensive biophysical and biodiversity data. Human activities, particularly fisheries, will be considered in the design to minimise adverse industry impacts. The implementation of such a network necessitates robust international collaboration among countries and adherence to legal frameworks, including CCAMLR regulations, Exclusive Economic Zone MPAs, and the High Seas Treaty. PHOCIS represents a critical step toward safeguarding the biodiversity and ecosystem processes of the Indian Subantarctic region amidst escalating global environmental challenges. [1490]

**Keywords**: pelagic, ecoregionalisation, marine protected area, high seas treaty, systematic conservation planning

**Environmental constraints on the composition and spatial distribution of deep-sea epibenthic macroinvertebrate communities of the Kerguelen EEZ**

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**Abstract**

Benthic macroinvertebrate communities in the Southern Ocean display considerable variability in terms of their specific composition and spatial distribution. However, extreme environmental conditions and the remoteness of the Southern Ocean drastically limit the accessibility of deep benthic ecosystems for scientific observations. The result is a patchy knowledge of the structure of benthic communities, often limited to shallow coastal and littoral zones. This is particularly true of the Kerguelen EEZ, where deep-sea communities of epibenthic macroinvertebrates remain largely unknown. Our research has enabled us to establish the first descriptions of the deep-sea communities of epibenthic macroinvertebrates in these two zones, to characterize their distribution patterns and to deepen our understanding of the impact of environmental constraints on the faunal composition and spatial structuring of these communities. Our results have highlighted the role of the Polar Front as a major factor influencing community structure in the Kerguelen EEZ.

**Keywords**: ecoregionalisation ; modelling ; benthic ecology

**A review of life-history parameter estimates for mackerel icefish (Champsocephalus gunnari) in the vicinity of Heard Island and McDonald Islands in Division 58.5.2**

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**Abstract**

Knowing the life history parameters of a species is essential to projecting productivity and effective management of a fished species. Here, we investigate changes in estimates of several life history parameters for mackerel icefish (*Champsocephalus gunnari*) between 1997-2024 around Heard Island and McDonald Islands in Division 58.5.2. All explored life history parameters showed some level of variability throughout the investigated time series. Estimated length at 50% maturity showed an increase in size for both males and females, and estimated length at age increased over the years. Further work is required to explore which, if any, environmental variables are linked to these changes, or if they are a result of the highly dynamic nature and large changes in interannual population size of this species.

**Keywords**: Fisheries, Icefish, Climate Change, CCAMLR

**Initial investigations of longline fishery interactions with scavenging crustacea in the vicinity of Heard Island and McDonald Islands.**

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**Abstract**

Anecdotal evidence suggested an increasing interaction of scavenging crustacea depredating fish caught on longlines within the Heard Island and McDonald Islands toothfish fishery. Since 2022, Australian vessels have been trialing bespoke traps designed to sample the scavenging crustacea. Here we present the development process of the traps, and with over with over 1400 deployments during the trial period, and initial investigations into distribution and abundance of scavenging crustacea. Typically, the distribution of crustacea have been highly heterogeneous even within small sampling distances, whilst size of individuals within Amphipoda and Isopoda have shown increasing size with decreasing latitude.

**Keywords**: Fisheries, amphipods, isopods, CCAMLR, toothfish

## Exploration of Patagonian toothfish (*Dissostichus eleginoides*) movement patterns across the Kerguelen Plateau

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**Abstract**

Mark-recapture research programs based on sighting histories of uniquely identifiable individuals is a common approach to assist in improving understanding of a variety of biological and demographic parameters in animal populations including population size, movement patterns, growth rates, and estimates of mortality (Otis et al. 1978, Pine et al. 2011). Tagging programs have been undertaken by commercial fisheries vessels within the EEZs of both Kerguelen Island (KI) and Heard Island and McDonald Islands (HIMI) since 2007 and 1998, respectively. Since this time, more than 200,000 Patagonian toothfish (*Dissostichus eleginoides*) have been tagged from trawl, trap, pot and longline vessels. This paper provides a broad summary of the temporal and spatial patterns in toothfish tagging releases and recaptures across the Kerguelen Plateau with the intent of informing and updating our understanding of toothfish ecology, movement patterns and stock structure across the Kerguelen Plateau.

**Keywords**: Tagging program, mark-recapture, abundance, biomass, spatial heterogeneity

**Progress in our understanding of toothfish stock and its environment in the northern part of the Kerguelen plateau and Skiff bank**

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**Abstract**

The northern region of the Kerguelen Plateau and the Skiff Bank host a population of Patagonian toothfish (*Dissostichus eleginoides*), with a spawning stock estimated at approximately 180,000 tonnes pre-exploitation time. This stock, commercially exploited since the 1990s, suffered significant depletion (40%) due to illegal fishing until 2008. However, the containment of illegal fishing and the implementation of strict management measures by the TAAF (Terres Australes et Antarctiques Françaises) has enabled the stock to rebound paving the way for the establishment of a sustainable fishery. Since 2006, a tightly controlled annual catch limit of about 5,000 tonnes has been enforced, in line with the scientific recommendations. This management strategy led to partial stock recovery until 2017, when the upward trend began to reverse. This demographic trajectory has been unraveled by recent advances in stock assessment models enhancing our understanding of the stock dynamic. In this presentation, we will highlight significant results on estimating toothfish recruitment trends and habitat characterization through its long life cycle.

We will discuss potential environmental and fishery-related drivers contributing to the observed declining trend of the stock, identify critical knowledge gaps in our understanding of these drivers, and highlight how recent surveys fill these gaps.

**Keywords**: fishery, sustainability, recruitment, stock trajectory

**Anthropogenic $CO_2$, air-sea $CO_2$ fluxes and acidification in the Southern Ocean: results from a time-series analysis at station OISO-KERFIX (51°S- 68°E).**

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**Abstract**

We evaluated the temporal variation of air-sea $CO_2$ fluxes and pH in the Southern Indian Ocean based on both in-situ data collected since 1985 at a fixed station and reconstructions from a neural network model. During austral winter, the fugacity of $CO_2$ ($fCO_2$) in surface waters increased at a rate close or slightly lower than in the atmosphere over 1985-2020, whereas we observed contrasting trends in summer depending on the decade and related to changes in phytoplankton biomass. As a result, the regional air-sea $CO_2$ flux evolved from an annual source to the atmosphere in 1985 (0.8 molC.m$^{-2}$.yr$^{-1}$) to a sink in 2020 (-0.5 molC.m$^{-2}$.yr$^{-1}$). The annual pH trend in surface waters over 1985-2020 was - 0.0165 ±0.0040.decade$^{-1}$ and was mainly controlled by the accumulation of anthropogenic $CO_2$ estimated from subsurface data at +0.53 ±0.01 μmol.kg$^{-1}$.yr$^{-1}$ with a detectable increase in the trend in recent years. However, the summer pH trends were also impacted by natural processes that reduced the acidification rate over the last decade. A projection of future total carbon concentrations for a high emission scenario (SSP5-8.5) indicates that the surface pH in 2100 could decrease to 7.32 during winter, 0.86 lower than the pre-industrial pH and 0.71 lower than the pH observed in 2020. For this scenario, the aragonite under-saturation in surface waters would be reached as soon as 2050 and 20 years later for the stabilization scenario SSP2-4.5, with potential impacts on phytoplankton species and higher trophic levels in the rich ecosystems of the Kerguelen Island area.

Keywords: Ocean Carbonate System, Ocean acidification, anthropogenic $CO_2$, air-sea $CO_2$ fluxes, Southern Ocean

**Identifying the environmental and operational drivers of killer whale and sperm whale depredation on Patagonian toothfish longline catches around the Crozet and Kerguelen islands**

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**Abstract**

Large marine predators feeding on fish caught by fishers on fishing gear, a behaviour termed "depredation", often leads to conflicts with ecological and socio-economic impacts. While the occurrence of depredation is likely mainly determined by the spatio-temporal overlap between fishing activities and marine predators, the environmental and operational (fishers behaviour) drivers of this overlap are often unclear. Yet, such information is essential to implement effective mitigation strategies of the issue based on the spatio- temporal avoidance of depredation. Our study used 20 years of data and generalized additive models to identify environmental and operational factors, both static and dynamic, that influence the occurrence of killer whale and sperm whale depredation on Patagonian toothfish catch in the demersal longline fishery operating around the Kerguelen and Crozet Islands. In addition to producing new insights on the natural distribution of the two predator species, and how this distribution may change in time and in response to fishing activities, we provide maps of predicted probabilities of depredation occurrence and number of depredating whales. Together, the findings can help the fishers to implement avoidance strategies of killer and/or sperm whale depredation and, therefore, may be used for the mitigation of the conflicts associated to this behaviour in the region.

**Keywords**: Depredation, killer whales, sperm whales, drivers, Southern Ocean

**Contribution of a glaciogenic iron delivery to the spatial extent of the Kerguelen open ocean bloom**

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**Abstract**

In contrast to the average low Primary Production (PP) of the Southern Ocean, the Kerguelen region is home to massive blooms that extend hundreds of kilometers offshore. The blooms have been shown to be sustained by continental iron inputs, in particular the resuspension of iron-enriched sediments over the plateau, transported eastward by the Antarctic Circumpolar Current. However, the Cook Ice Cap's outlet glaciers may be another source of iron, transporting iron-enriched particles extracted from the bedrock downstream to the coast. Whether the circulation is able to connect the glacier outlets to the pelagic area, and which areas of the pelagic bloom can be influenced by glaciogenic iron, are two open questions that we address here. Using *in situ* and satellite data, we show the interannual persistence of a chlorophyll-enriched plume, driven by a horizontal advection of iron and connected to the Golfe des Baleiniers into which two glaciers flow. Using a Lagrangian methodology, we reconstruct the iron transport pathways from the Golfe and show that glaciogenic iron accounts for ~20% of the spatial extent of the open ocean bloom. We find that the new high-resolution SWOT observations allow a significant reduction in altimetry biases compared to previous products. Our study is particularly relevant in the context of the negative mass balance of ice caps observed on both Kerguelen and other Southern Ocean islands in the context of climate change.

**Keywords:** Glaciogenic iron supply; Open ocean Primary Production ; Fine scale biophysical couplings ; Lagrangian methodology ; Climate change impacts.

## Age Determination Techniques for Australia's Toothfish Fisheries from the Kerguelen Plateau

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**Abstract**

Fish in the Southern Ocean inhabit extreme environments and are integral to these unique, relatively poorly understood ecosystems. Age determination is vital to the study of fish population dynamics and fisheries management. Otoliths, calcium carbonate structures that act as gravity and auditory receptors located in the inner ear of all bony fish, contain growth increments analogous to tree rings. By examining these increments, researchers can obtain precise age estimates, even for slow- growing and long-lived species typical of the Southern Ocean. This presentation explores the application of the thin section method across key commercial species, emphasising its advantages in addressing the challenges posed by dense and complex otolith structures often associated with toothfish species. This method involves embedding otoliths in resin, sectioning with precision saws, and analysis under standardised magnifications. Results demonstrate high accuracy and reproducibility in age estimates between independent readers, providing insights into growth rates, longevity, and population dynamics. These findings underscore the method's significance for monitoring the impacts of fishing pressure on Southern Ocean fish. By enhancing age estimation accuracy, the thin section technique is a key contributor to sustainable fisheries management.

**Keywords**: Age Determination - Toothfish - Thin Section Method

**Modelling spatio-temporal dynamics of Patagonian toothfish spawning in Kerguelen waters using CPUE**

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**Abstract**

Spawning is a crucial phase in the life cycle of fish, with its duration, timing, and spatial distribution profoundly affecting reproductive success, larval survival and subsequent population dynamics. Patagonian toothfish (*Dissostichus eleginoides*) is a commercially exploited fish species within the nototheniidae family, inhabiting the southern Patagonian and Chilean shelves, as well as sub-Antarctic islands. As a K-selected species, the Patagonian toothfish is characterized by a late maturity and a slow growth, which are key considerations in its management and conservation. We investigated the spatio-temporal dynamics of Patagonian toothfish (*Dissostichus eleginoides*) spawning in Kerguelen region using fishery observer data, from 2020 to 2024. We mapped spawning locations and predicted seasonal trends using spatially- explicit Generalized Additive Models (GAMs) that modelled the spawner CPUE (Catch Per Unit of Effort). Predictions indicated distinct spawning periods for males and females, with female spawning concentrated in June and July, while male spawning extends from June to September. The results also revealed consistent spawning hotspots southwest of Kerguelen and depth preferences between 1500 and 1800 m and around 500 m. This sex-specific distribution suggests differing reproductive strategies, potentially influenced by environmental factors and fishing pressures. Our findings emphasize the importance of considering temporal fishery closures to protect spawning populations and promote sustainable management of the Patagonian toothfish, considering the potential impacts of environmental change on reproductive dynamics.

**Keywords**: spawning, toothfish, longline fishery, GAM, Southern Ocean

**Poker V: Key insights from Poker V and the Future of Scientific Surveys in the Kerguelen EEZ**

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**Abstract**

The northern region of the Kerguelen Plateau and Skiff Bank hosts a commercially exploited stock of Patagonian toothfish (*Dissostichus eleginoides*), which has been targeted by fisheries since the 1990s. The fishing grounds cover the majority of waters between 500 m and 2000 m depth, along the continental slope. In this context, the Poker I, II, III, and IV surveys, conducted in September-October 2006, 2010, 2013, and 2017, primarily aimed to estimate the biomass of benthic and demersal fish species in the area, specifically between 0- and 1000-meters depth. Given recent global variations in the productivity of Patagonian toothfish stocks, the latest Poker V survey aimed to provide updated insights into the status of juvenile toothfish demographics in 2024, focusing on the 0–500-meter depth range, which is not monitored by the commercial fishery. The primary goal of this new scientific survey is to establish an independent time series of recruitment data. It is designed to assess the biomass and abundance of juvenile Patagonian toothfish on the Kerguelen Plateau and Skiff Bank, enhance understanding of the life history traits and ecology of juvenile toothfish, characterize the marine habitats where juvenile toothfish reside, and evaluate the biomass of other species caught during the trawl survey. In this presentation, we will highlight the key findings from our latest scientific survey, and discuss the future of scientific surveys in the French Kerguelen EEZ.

**Keywords**: Scientific survey, juvenile, monitoring, recruitment, stock trajectory

**Diving into the sleep ontogeny of Southern elephant seals: from time on land to sea**

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**Abstract**

Sleep is a crucial physiological process part of the daily activity patterns of mammals. Sleep pattern is dependent of ecological constraints. For example, the presence of predators can reduce time of sleep. The Southern Elephant Seals (SES) represent a unique mammalian model for better understanding sleep ontogeny and management capabilities in the seal as they alternate between terrestrial (without predators) and aquatic habitats. We hypothesised their sleep pattern exhibits physiological adaptations across brain maturation and life cycle to adapt to environmental constraints. We recorded brain electrical activity of weaned pups and lactating adults on land. To characterise sleep at-sea during the foraging trips, we recorded movements and pressure over time. On land, as pups age, the time spent sleeping decreased (from 6.3 h to 5.1 h per day) and reached the amount observed in adults during lactation. The sleep pattern varied throughout the day, pups tending to sleep more during the day and the night than during twilight phases. At sea, daily sleep quotas were drastically lower than those recorded on land, although pups slept more than adults (pups: 1.3 ± 0.4 h per day vs adults: 0.9 ± 0.3 h per day). These daily amounts changed over the trip at sea and were correlated with foraging behaviour. Sleep patterns evolved with age, raising the following biological question whether sleep maturation is paralleled with brain vascular development?

**Keywords**: Phocids, electroencephalogram, sleeping behaviour, circadian rhythm, ontogeny

**Evolutionary origin and connectivity of the Kerguelen plateau benthos over space and time.**

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**Abstract**

The Heard and McDonald's Islands (HIMIs) and the Kerguelen archipelago are the last subaerial remnants of the sunken continent, the Kerguelen plateau. The plateau's unique volcanic geological history and oceanographic position, intercepting the Antarctic Circumpolar Current, contributes to an area of high primary productivity, supporting a rich and diverse benthic ecosystem. Research about the evolution and connectivity of these benthic invertebrates is limited to date. Many studies observe gene flow between benthic populations across HIMI, Kerguelen and the Southern Ocean, but little is known about their evolutionary origin and the drivers behind the observed connectivity. The available morphological and genetic literature will be synthesized to identify the evolutionary origin of the Kerguelen plateau benthic fauna. Through genetic evidence, their past and present-day genetic connectivity across the plateau with respect to the wider Southern Ocean and beyond will also be investigated. Due to its geographic position, the Kerguelen plateau can serve as a gateway between Antarctica and the rest of the world. Therefore, understanding the evolutionary origin and the degree of isolation of the benthos within is urgently required in light of current climate change.

**Keywords**: population connectivity, genetic, gene flow, benthic invertebrate, evolution

**Latitudinal shifts in trophic and size structure of lower trophic levels along the Kerguelen Plateau**

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**Abstract**

On the Kerguelen Plateau there is a latitudinal shift in trophic structure, whereby *E. superba*- dominated food webs south of the Polar Front are replaced in more northerly regions by copepod-fish food chains, salp-based chains and/or those driven by other species of euphausiids. We used $\delta^{13}C$ and $\delta^{15}N$ to describe lower to mid-trophic linkages along the southern Kerguelen Plateau (between the Fawn Trough and Princess Elizabeth Trough) and the northern Kerguelen Plateau (as part of PHOCIS). We also used ZooScan to compare normalised biomass size spectra (NBSS) at several sites across the sampling region. $\delta^{15}N$ and $\delta^{13}C$ values showed three distinct trophic levels between *Melanostigma* sp., classified at a high trophic level, and *E.* superba and *Salpa thompsoni*, whose isotopic profiles were only marginally distinguishable from particulate organic matter; i.e. these species were occupying low trophic levels and functioning as primary consumers. Mesopelagic fish, particularly myctophids, occupied a critical mid-trophic role. Of the other invertebrates, *Euphausia triacantha* and *Themisto gaudichaudii* showed site-specific differences in isotopic profiles, indicating dietary flexibility. The NBSS varied across the sampling region and showed some affinity with major fronts. Linear mixed models were performed to test the effects of temperature and chlorophyll a concentration on the NBSS, with mixed results highlighting the complex interactions between the thermal and food environments.

**Keywords**: pelagic, ecoregionalisation, bioindicators, myctophids, krill, salps

**Bioavailability of iron of glacial origin to marine microbial communities: A Kerguelen Island case study**

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**Abstract**

The trace element iron (Fe) limits phytoplankton primary production and $CO_2$ drawdown in large parts of the Southern Ocean (SO). Natural Fe fertilization leads to localized blooms, among which the Kerguelen bloom is one of the most documented. The sources of Fe and its bioavailability to marine microorganisms, remains, however, still puzzling. The Cook Ice Cap on Kerguelen Island has decreased in surface by 20% during the past 40 years and its disappearance is predicted by the end of the century. This glacial erosion could be a significant new source of Fe, but the influence of matter of glacial origin on ecosystem functioning is not well understood. Observations from incubation experiments carried out during the MARGO-cruise (February 2024) reveal that Fe in the form of glacial colloids (20-200 nm) stimulates bacterial and phytoplankton growth and leads to modifications in the composition of these microbial communities. Fe-related gene annotation showed a higher abundance of siderophore synthesis and transport genes in bacterial communities growing in the presence of glacial colloids as compared to unamended controls. These observations suggest that siderophores, produced by bacteria, could be one mechanism rendering Fe of glacial origin bioavailable, potentially leading to strong interactions between bacteria and phytoplankton. Our results shed light on the mechanisms

providing access to glacial Fe and the implications for the microbial food web functioning.

**Keywords**: max 5 keywords

Microbial communities, glacier melt, glacial iron, Fe-bioavailability, siderophores, phytoplankton-bacteria interactions

**Modelling spatio-temporal dynamics of Patagonian toothfish spawning in Kerguelen waters using Killer whale interactions with Patagonian toothfish longline fisheries on the Kerguelen Plateau**

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**Abstract**

Killer whales are among the species most often reported feeding on fisheries catches on fishing gear (i.e., the so-called "depredation" behavior) globally. On the Kerguelen Plateau, killer whales interact with the longline fisheries to depredate on Patagonian toothfish catches, but unlike in adjacent areas such as Crozet or Marion/Prince Edward, these interactions remain occasional. While mandatory move-on rules for vessels in response to depredation may partly explain such differences through a non-reward strategy limiting the reinforcement of the behavior, these may also by attributed to variation in the ecology of killer whales and/or in the suitability of environmental conditions for the species in the region. In this study, we combined observation with photo-identification data collected over 30 years to i) synthesize the available information on killer whales and their interactions with fisheries on the Kerguelen Plateau, and ii) examine the influence of movements of fishing vessels on the probability of the same killer whale individuals to repetitively interact with fishing vessels. The results indicate that killer whales involved in depredation on the Kerguelen Plateau included individuals from three out of the four ecologically distinct forms of killer whales documented in the region. These were a combination of both newly identified individuals and individuals known to interact with fishing vessels around Crozet.

**Keywords**: Cetaceans, Killer whales, Ecotypes, Fisheries Interactions, Depredation

## Habitat associations of key midwater fish taxa on the Southern Kerguelen Plateau

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**Abstract**

Myctophid and bathylagid fishes play a significant role in the ecology of the Southern Ocean, however there are major gaps in current understanding of the biophysical drivers of their distribution and abundance. We developed habitat models to map and predict the probability of biomass distribution of key midwater fish taxa across depth strata, and to understand the biophysical drivers of their distribution and abundance at the scale of the southern Kerguelen Plateau. Fish were sampled day and night from three depth strata (0–200 m, 200–600 m and 600–1000 m) and the dominant genera of myctophid and bathylagid families were grouped into three trophic guilds: zooplankton generalists, copepod specialists and gelatinous/zooplankton feeders. The relationships between midwater fish biomass and environmental predictors varied between trophic guilds, with the principal predictors being sea surface height, bathymetric gradient, and sea surface temperature. The habitat models revealed important bathymetric (continental slopes and shelf breaks) and frontal features (SACCF/SB) associated with high biomass areas for myctophid and bathylagid guilds. Importantly, in addition to showing observed areas of high/low biomass, the models highlighted areas with similar conditions beyond the sampling stations. Prediction maps also highlight important high biomass areas were not wholly distinct between trophic guilds, with clear overlap in some areas. This study provides the first comprehensive baseline for the biomass for key midwater fish taxa in the region.

**Keywords**: Midwater fish taxa; Depth strata; Southern Kerguelen Plateau: Habitat model; Predictions

**Climate change, fisheries management, and modelling changes in benthic fish community structure on the Kerguelen Plateau**

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**Abstract**

The Kerguelen Plateau is a biodiversity hotspot with many endemic fish species, it also has economic importance in supporting valuable fisheries. Furthermore, it is a climate change hotspot with changes in water temperatures and ocean currents. Most existing information on fish species and their distribution in this region is derived from annual random trawl surveys, fishery observations, and indirectly from research on fish predators. In this study we use trawl survey data and joint species distribution models to understand how the fish assemblages have changed through time and space. Using a joint species distribution modelling approach, we demonstrate that several species, including mackerel icefish, have realised large changes in their distribution and abundance through time. These changes are likely to be related to environmental factors such as sea surface temperature anomalies and southern annular mode. Our results indicate that the prevalence and abundance of many species, and overall species richness, have increased over the period 2003 to 2016. It is unclear if these changes reflect shifts in the fishery, management, or due to climate change. We found evidence of several species' distributions responding to temperature variability, and these species are potentially exposed to the ongoing impacts of climate change. This new information can be used by managers and policy makers to ensure sustainable fisheries and the protection of biodiversity into the future.

**Keywords**: demersal fish, climate change, community ecology, fisheries management, joint species distribution

**Recent developments in the fishery and stock assessment for Patagonian toothfish (*Dissostichus eleginoides*) at Heard Island and McDonald Islands**

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**Abstract**

The commercial fishery for Patagonian toothfish (*Dissostichus eleginoides*) at Heard Island and the McDonald Islands (HIMI) started in 1997 as a trawl fishery and has since transitioned to a longline fishery. Comprehensive data are collected in this fishery which include an annual random stratified trawl survey (RSTS), an observer program with 100% coverage on all vessels and fishing trips, and an extensive tagging program conducted during commercial fishing operations. The fishery has changed substantially since its inception, and this has affected how toothfish at HIMI is assessed and managed. Ongoing efforts to improve and refine the toothfish stock assessment model include (1) updating estimates of important biological parameters such as maturity, post-release tagging mortality, natural mortality and recruitment; (2) the development of a sex-based model; and (3) consideration of how stock structure and toothfish biology might be best represented within the assessment framework. In addition, there is a focus on investigating the influence of interannual variation in the spatial distribution of fishing and tagging effort, on stock assessment estimates.

**Keywords**: Fisheries, Toothfish, Stock assessment.

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