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SEASonality of the DRAKE Passage pelagic ecosystem: BIOdiversity, food webs, environmental change and human impact. Present and Past (DRAKE BIOSEAS)

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The Southern Ocean exerts a strong influence on global climate through the circulation of the Circumpolar Current and the seasonal shift of the sea-ice cover. While currently there are many different ways of assessing the intensity of phenomena associated with Climatic Change (ozone depletion, increase of temperature, CO2 and UV radiation), there is no single tool for measuring the indirect effects of these alterations, most of which are critical to the functioning of ecosystems. In the marine environment, changes in thermal gradients modify the global oceanic circulation pattern, thus bringing unpredictable consequences to the structure of communities, trophic relationships and biogeochemical cycling. The geographic distribution and abundance of plankton stem from a combination of factors that include the interaction between the life cycle of species, oceanic circulation, formation of eddies, the behaviour of frontal systems (e.g., advance and retreat of the sea-ice cover), and the abundance of vertebrate predators (fish, birds and marine mammals). Any alteration, natural and/or anthropogenic (e.g., fisheries), in the intensity of predation leads to a change in the structure of trophic webs, thus affecting biodiversity, concentration of key Antarctic species, nutrient loading and carbon fluxes to the deep-sea, often resulting in the general unbalance of the ecosystem. In order to examine within an integral framework this conjunction of factors, the present project will focus on the seasonality of one of the most peculiar areas of the Southern Ocean: the Drake Passage, a key open-ocean choke point for the Antarctic Circumpolar Current. The pronounced continental constriction between South America and the Antarctic Peninsula causes the northern deflection of the ACC and, jointly with the ENSO cycles, influences directly the Southwestern Atlantic in terms of oceanographic-atmospheric and biological processes. Drake Bioseas is intended to achieve a first step towards the understanding of these processes by covering aspects that range from the assessment of air-sea interactions to geochronological surveys of the sea bottom, and from organisms living in the pelagic realm to benthic communities and micro-paleonthological indicators, emphasising in the Magellan-Antarctic regions and the Atlantic-Pacific connections. Specific richness, population density, biomass and geographic distribution, shifts in community structure and biogeography, oxidative stress biomarkers and antioxidant defenses will be examined for bacteria, protozoa, planktonic algae, meso-and macrozooplankton, sea birds and marine mammals. Antarctic and subantarctic fishes will be examined only as to their systematic (morphological and molecular) and oxidative stress; this will allow elucidating the patterns of distribution of key species, migration processes and physiological responses to environmental changes. Special attention will be paid to dormant stages of microscopic organisms (non active bacteria, auxospore formation, cysts, resting propagules) as well as to factors controlling the timing of activation. The role of species within the trophic web will be evaluated, taking into consideration a wide spectrum of topics, including fluctuations in the nutritional mode of unicellular organisms, diet composition, energy content, interspecific food overlapping in top predators, etc. Previous information from land, coastal and open ocean communities, provided from scientists involved in the project and by official and private institutions dedicated to fisheries, will constitute the tools for comparisons of past and current conditions. Such objectives make Drake Bioseas directly link to CCAMLR, EBA SCAR and CAML projects. This will be the first time in which a multidisciplinary and integrated approach is made on waters of the Drake Passage and its surroundings, emphasizing on the seasonal and inter-annual dynamics (2007-2008) of marine communities in natural boundaries such as Subantarctic vs. Antarctic, neritic vs. oceanic, Pacific vs. Atlantic, summer vs. winter, low- vs. mid-latitude environments, and on trophic relationships (areas/seasons/years of dominance of net phytoplanktonic cells vs. DOM-based microbial food web, and of crustacean vs. gelatinous zooplankton) and the magnitude of ecosystem fluctuations due to frontal behaviour (Subantarctic Front, Polar Front, Ice-Edge, winter conjunction of Polar and Ice fronts). Manipulative experimental work (productivity, grazing, physiological responses) on board will be carried out to complement in situ studies. Besides its scientific goals, the priorities of this endeavour embrace the legacy of an Experimental Research Centre for multidisciplinary studies on cold-water organisms, and an Argentine icebreaker reconditioned for scientific purposes. These legacies are expected to significantly contribute to the formation of a new generation of "bio-seas" scientists.