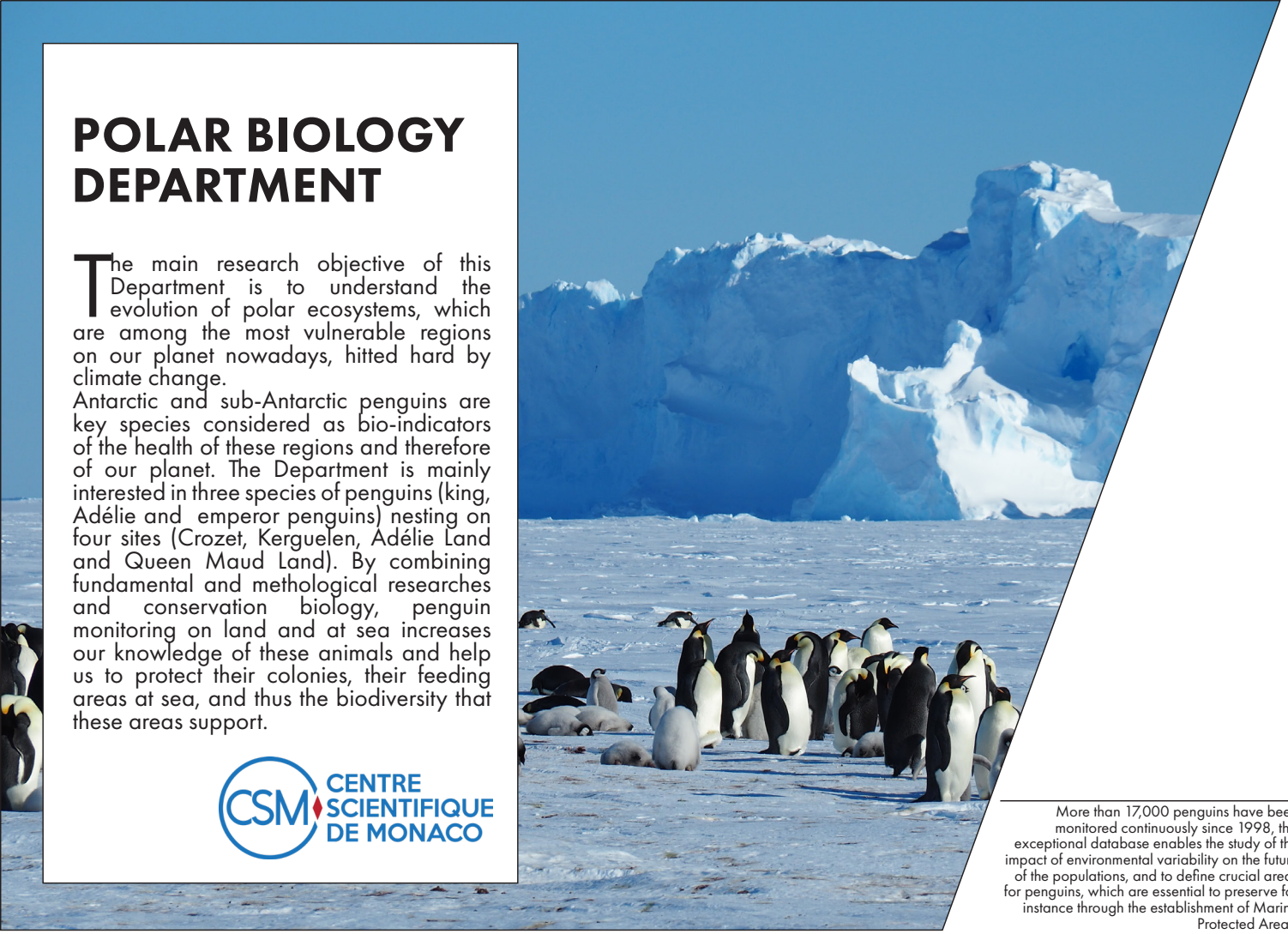
POLAR BIOLOGY DEPARTMENT

The main research objective of this Department is to understand the evolution of polar ecosystems, which are among the most vulnerable regions on our planet nowadays, hitted hard by climate change.
Antarctic and sub-Antarctic penguins are key species considered as bio-indicators of the health of these regions and therefore of our planet. The Department is mainly interested in three species of penguins (king, Adélie and emperor penguins) nesting on four sites (Crozet, Kerguelen, Adélie Land and Queen Maud Land). By combining fundamental and methological researches and conservation biology, penguin monitoring on land and at sea increases our knowledge of these animals and help us to protect their colonies, their feeding areas at sea, and thus the biodiversity that these areas support.

CSM CENTRE SCIENTIFIQUE DE MONACO



More than 17,000 penguins have been monitored continuously since 1998, this exceptional database enables the study of the impact of environmental variability on the future of the populations, and to define crucial areas for penguins, which are essential to preserve for instance through the establishment of Marine Protected Areas.

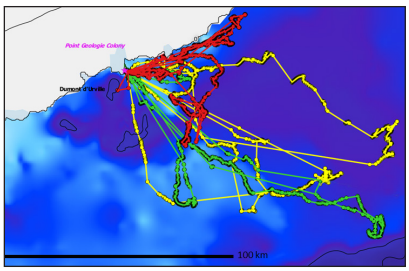
German research station Neumayer III (Queen Maud Land).

Isolated camp near the king penguin colony (Kerguelen).

Emperor penguin chicks.

King penguin chicks.

Automatic identification and weighing gateway.



Tracks of the movements of Adélie penguins at sea.

FIELD EXPEDITIONS

The logistical, financial and human resources support of the French (Paul-Emile Victor, IPEV) and German (Alfred Wegener, AWI) Polar Institutes enable the Polar Biology Department to continuously collect data and send scientists each year to the four study sites (two within subantarctic archipelagos and two around the Antarctic continent).

POPULATION TRENDS

The Department seeks to assess penguin responses and the limits of their adaptive capacity to global changes, both at sea feeding sites and on land-based breeding sites. To this end, individual behaviours and population trends are studied through the electronic tracking of many individuals whose history (e.g. age, experience, past reproductive output, position in the colony each year) is known.

TECHNOLOGICAL INNOVATIONS

Numerous innovative technologies are developed and used to observe the study species: automatic identification and weighing systems, robots and HD cameras continuously recording the movements of the individuals in the colony, miniaturized on-board sensors (e.g. GPS, Argos, TDR) to track penguins during their movements at sea. To manage and analyze massive digital databases collected in the field, the Department develops proprietary algorithms based on Artificial Intelligence and Machine Learning.

POLAR BIOLOGY DEPARTMENT

CENTRE SCIENTIFIQUE DE MONACO

1 TEAM

- **Ecology and Evolution**

The main objective of the researches carried out by the CSM in polar regions is to assess the adaptive capacities of king [1, 2, 10] (*Aptenodytes patagonicus*), Adélie [7, 9] (*Pygoscelis adeliae*) and emperor [3, 4, 5, 6, 8] (*Aptenodytes forsteri*) penguins to global changes through the study of functional mechanisms and microevolutionary processes.


1


2

This Department was created in 2010 as a partnership between the CSM and the CNRS-IPHC (Centre National de la Recherche Scientifique - Institut Pluridisciplinaire Hubert Curien and University of Strasbourg) and is based on the research programmes supported by the French (IPEV-137) and German (AWI-MARE/MARGEO) polar institutes.


3

- The objective of this Department is to identify the ecological and evolutionary processes that shape populations. In particular, we aim to explore the adaptive mechanisms of the organisms in response to their environmental constraints in order to highlight the limits of their adaptive capacities, through:
- the study of individual responses to changes in their environment,
- the projection of the evolution of these populations according to the climate change scenarios, and
- the development of innovative and non-intrusive methodologies for observation (automation to avoid disturbing animals in their natural environment), data collection, management, and processing.


4


5


6


7


8


9


10

Through a circumpolar network of long-term monitorings of penguin populations, these Polar Life Observatories are essential tools for the Antarctic Treaty System signed in 1959 and its Protocol established in 1991 (Madrid Protocol) to guarantee and strengthen environmental protection in Antarctica.

Photos Crédits: IPEV/AWI/CNRS/CSM (A. Houstin - C. Le Bohec - V. Planas-Bielsa - B. Vallas)

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