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## Penguin Life Observatories to monitor the health of the Southern Ocean ecosystems

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Long-term time series are essential to detect, understand and predict the impacts of anthropogenic pressures on ecosystems. This applies to both physical and biological data collections. However, systematic data collections on the biological component of the ecosystems are still scarce compared to Earth sciences, and biological time series are usually not sufficiently long to draw unambiguous inferences concerning trends. To fill this gap and assess the vulnerability of Antarctic and subantarctic ecosystems, but also develop tools for action plans to protect Southern Ocean, we aim (and already started) to setup a circumpolar network of Penguin Life Observatories. These upper-trophic-level seabirds can be considered as adequate bio-indicators of changes (due to e.g. climate change, overexploitation or pollution) occurring in the Southern Ocean food webs and ecosystems globally. Implementing cutting-edge technological innovations (e.g. automatic radiofrequency identification (RFID), weighing and camera-tracking systems, mobile RFID antennas deployable on site or mounted on remote-operated vehicles and biologgers), electronic Penguin Life Observatories gather information on land to assess population dynamics/trends, and at sea to explore their seasonal and inter-annual distribution and foraging strategies according to the environmental variability. In addition to increasing our knowledge on fundamental characteristics of these sentinel species, penguins play an important role as umbrella species, which offer us precious tools to map marine biological hotspots and design Marine Protected Areas (MPAs).