23. Seabirds

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Although they make up just 3% of the world's bird species, seabirds are found across all oceans, from the poles to the Equator. The constraints of the marine environments in which they live have provoked remarkable morphological, physiological and behavioural evolutions in these species. Climate change affects this biodiversity in different ways according to latitude: an increased number of species in temperate and subarctic regions, but local extinctions in tropical regions. Global change also exacerbates the negative impacts of human activities.

In long-living vertebrates, responses to environmental fluctuations through phenotypic plasticity are faster than microevolutionary responses, and therefore represent the first line of defence in the face of a changing environment. Evaluating how far ecological niche plasticity allows species and communities to mitigate the effects of climate change is therefore crucial for maintaining biodiversity. This question is being studied by numerous research teams.

Tools for studying seabirds

First, scientists attempt to establish whether populations are increasing or decreasing. To do this, they conduct censuses either on the ground or using aerial photographs. Drones are also becoming increasingly important in this kind of monitoring. Models of population dynamics are widely used, given the difficulty of counting bird populations precisely, everywhere, at every moment. To configure these models, researchers work on the ground to document the levels of reproductive success and identify birds by banding them, so that they can estimate lifespan, survival rates and fidelity to reproduction sites.

Next, to find out what the birds eat, in terms of quantity and quality, there are two types of approach. The first involves examining their stomach contents, in order to identify otoliths (small bones from the heads of fish), for example. These can be used to recognize the species consumed and count the number of prey. The second approach involves analysing isotope ratios (carbon, nitrogen or mercury) in the blood or feathers of birds, which can be used to trace the type of prey that the bird has consumed in recent months or weeks.

Finally, we need to know which zones the birds rely on for food. This field of research has undergone major developments over the last 30 years, thanks to technological advances, which have allowed the miniaturization of many measurement devices. Today, certain birds are equipped with GPS, accelerometers, dive recorders or video cameras to track their journeys at sea.

Fig. 1 – **Masked booby and artisanal fishing boat, Fernando de Noronha archipelago, Brazil.** © K. DELORD. ■

Fig. 2 – **Red-footed booby chick, Fernando de Noronha archipelago, Brazil. © S. BERTRAND. ■**

Interactions with fishing

Fishing can interact with sea birds in many ways. The first and most visible is birds being accidentally caught by fishing gears. Seabirds live a long time and have low reproduction rates, so the survival of adults only needs to drop by a few percent for populations to decline. The extent of this problem became apparent for the first time in the 1970s, when research showed that several hundred thousand birds were being killed accidentally every year in driftnets, which were subsequently banned in 1990. However, offshore fishing activity then transitioned to longline fishing. It is now albatrosses, petrels and another similar species that are accidentally caught.

As well as affecting the survival rate of adults, bycatch can exert pressure on the population in the form of evolutionary selection. Using models of population dynamics, researchers have found an explanation for the rise in the wandering albatross population on the Crozet islands. These birds can present different phenotypes in terms of their behaviour: some are more aggressive and forward, others more timid and less curious. Consequently, they do not all display the same attraction and behaviour towards fishing boats. The more curious birds are at greater risk of being accidentally caught, so their population decreases. Fishing therefore exerts real evolutionary pressure, resulting in the selection of certain individuals. This may appear advantageous in the short term, but we need to consider which evolutionary resources have been lost with the curious individuals.

Fishing may have more unexpected consequences for bird populations. In South Africa, faced with the decreasing population of their natural prey (small pelagic fish targeted by a purse seine fishery), cape gannets have learned to take advantage of the 'easy' food provided by discards from trawlers. Unfortunately, the fish species discarded by trawlers have far less nutritional value than the small pelagic fish, and the colonies forced to feed their young on this 'junk food' have higher chick mortality.

The third type of interaction that fisheries may develop with birds is that of direct competition for prey. For birds, the reproduction period is the most critical period in energy terms, because parents need to feed their chicks, as well as themselves. Meta-analysis (14 species in 7 ecosystems) has shown that when the abundance of prey fish is lower than a third of its historical maxima, the reproductive success of the birds plummets. The overall competition between birds and fishermen to get their share of the prey can also be exacerbated by local exhaustion effects. Birds need plenty of prey when raising young, but this must also be available near to the colony, because young chicks cannot survive the prolonged absence of their parents. In Peru, bird populations are in direct competition with the seine fishery for anchovies. A study has demonstrated that the opening of this fishery modified the birds' behaviour at sea, causing a significant increase in the effort needed to feed their chicks. In the small zone studied, the fishery was taking 250 times more anchovies per day than the birds! Therefore, even if the total quantity of anchovies had been enough for the birds that year, the local exhaustion effects meant that the prey was not necessarily available to the birds.

Situated at the top of the food chain, sea bird populations integrate the fluctuations in the ecosystems that they occupy, making them true indicators of the effects of global change in marine environments. It is therefore essential to study them, both for the conservation of their species, and for the insight they give us into the mutations currently sweeping through marine ecosystems.

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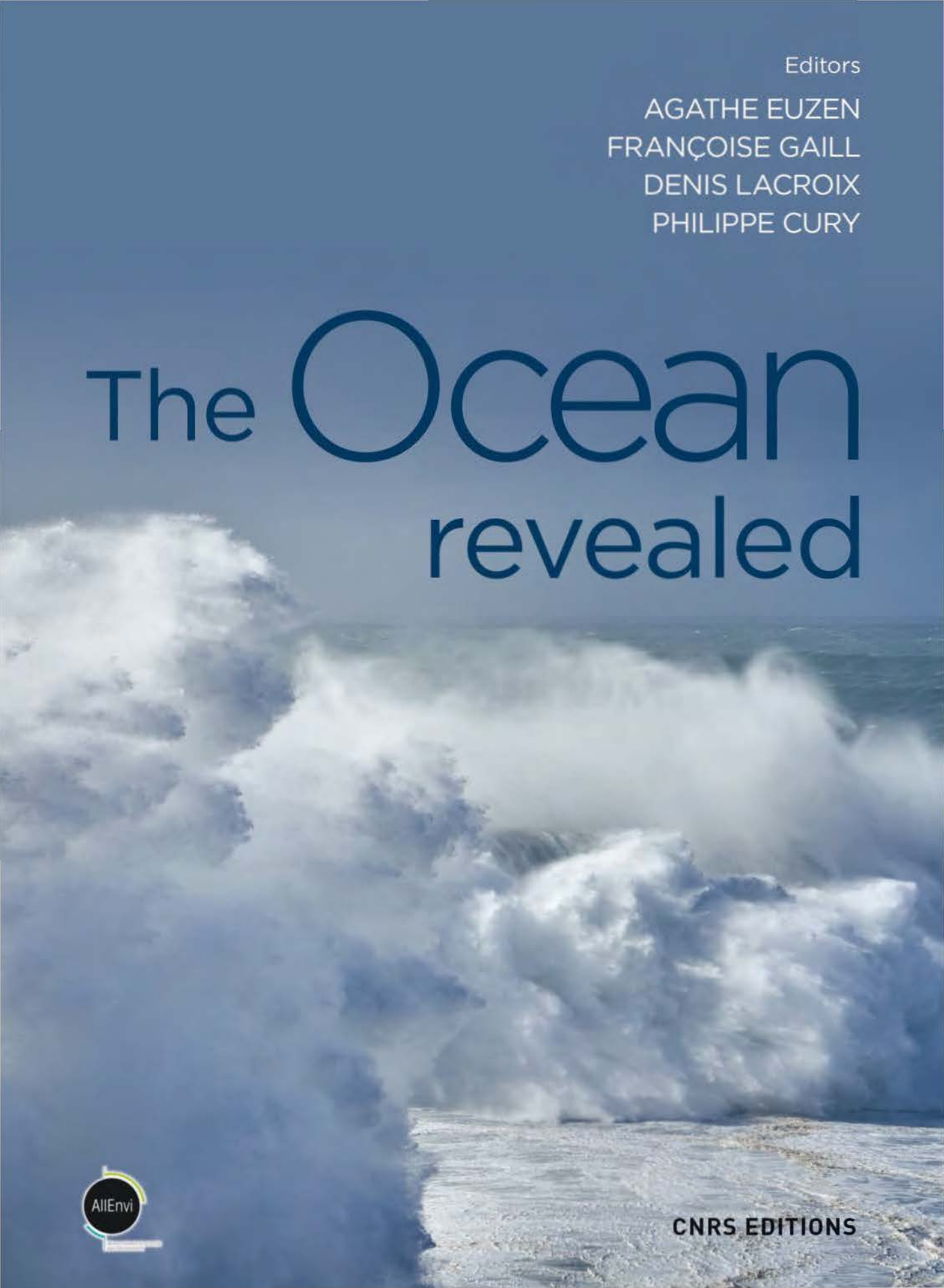
The Ocean revealed



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