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Marine biology

Population dynamics in lesser black-backed gulls in the Netherlands reveal no response to North Sea regime shift: comment on Luczak *et al.* 2012

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Ecosystems may respond to changes in environmental conditions by abruptly switching between alternative stable states [1], yet the mechanisms underlying these changes are poorly understood. In the North Sea, the distribution and abundance of species across several trophic levels have changed markedly over the last few decades, suggesting several regime shifts [2]. Recently, Luczak *et al.* [3] suggested that the consequences of an ecosystem regime shift in the North Sea in the mid-1980s, could be traced from decapods to lesser black-backed gulls (*Larus fuscus*), with potential ramifications for coastal ecosystems. This conclusion was inferred from statistically significant correlations between abundance in off-shore swimming crabs and gull populations, in France and Belgium from 1978 to 2009 and in the North Sea region between 1986 and 2000. There is no direct evidence of a causal relationship between the two. For a breeding population to increase, fecundity and recruitment must exceed mortality rates [4]. In seabirds with a wide food-spectrum, a mechanism that would trigger a population increase based on a single prey type is difficult to imagine.

The demography, breeding and foraging ecology of lesser black-backed gulls in the southern North Sea have been studied since the late-1980s using a range of techniques [5–8], and we use these studies to show why we have concerns about the conclusions drawn by Luczak *et al.* [3]. Lesser black-backed gulls colonized the southern North Sea in the 1920s, but the breeding population remained very small until the mid-1960s. Between the late-1960s and 2005, the population increased exponentially and this increase commenced well before the aforementioned regime shift in the North Sea [9,10]. Dietary analyses in the 1980s, 1990s and in 2006 through 2012 revealed that lesser black-backed gulls consumed mainly marine fish. The top five prey items in frequency of occurrence included round fish (62%), flat fish (50%), crustaceans (22%), insects (18%) and polychaetes (15%), but by mass, fish comprised approximately 80–90% of the diet [6]. All common North Sea crab species were consumed (*Liocarcinus holsatus*, *Liocarcinus navigator*, *Liocarcinus pusillus*, *Necora puber*), but warm water species such as *Polydora henslowii*, indicative for the reported regime shift, were not encountered. The relative contribution of crabs to gull diets in mass or energetic value [11] was low throughout.

The southern North Sea population of lesser black-backed gulls has been increasing exponentially since the late-1960s, and we have no evidence that a regime shift in the late-1980s in the North Sea has influenced this trend. Numerous drivers affect population dynamics concurrently and most effects are indirect, through changes in fecundity, survival, recruitment, immigration and behavioural plasticity [12]. As a result, not all populations should be expected to exhibit the same relationship with changes in food availability. While it is attractive to accept that consequences of a regime shift can be

traced through multiple trophic levels, and at large spatial scales, a more critical exploration of the potential drivers that have influenced gull population dynamics over the last few decades is needed. Studies that link behavioural and

physiological information at the individual level with demographic information could provide more insight into the relative importance and potential consequences of profound changes in regional ecosystems.

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