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Short Note

First Record of a Grey Seal (*Halichoerus grypus*) Predating a Tope Shark (*Galeorhinus galeus*) in the UK

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Predatory interactions between managed or threatened species present a challenge for conservation. Novel or emerging predator–prey relationships in this context need to be understood quickly for the purposes of modelling potential impacts to predator and prey populations, food web dynamics, ecosystem linkages, (Estes et al., 1998; Lundberg & Moberg, 2003; Schreiber et al., 2011), and the adaptation of existing management systems.

Grey seal (*Halichoerus grypus*) populations in the UK and Europe have increased since legislative protection addressed drastic, anthropogenic population declines (Brasseur et al., 2015; Special Committee on Seals [SCOS], 2017). Grey seal interaction with UK commercial fisheries is a contentious issue, often resulting in seal culling (Butler et al., 2011; Graham et al., 2011; Bowen & Lidgard, 2013; Cronin et al., 2014; Tverin et al., 2019). Tope sharks (*Galeorhinus galeus*) are moderately sized, migratory sharks listed as Critically Endangered globally (Walker et al., 2020) and Vulnerable in Europe (McCully et al., 2015). On 15 September 2018, an angler observed and photographed a grey seal spending several minutes catching, killing, and then consuming a free-swimming tope off Gotto Wharf, Belfast (54° 37.1' N, 5° 54.7' W) (Figure 1). To the best of our knowledge, this represents the first report of a grey seal killing and consuming a shark species in the UK. Herein, we explore scenarios why this is the first such recorded observation and its potential ecological ramifications.

Grey seals are opportunistic, adaptable predators (Hammond et al., 1994; Pierce & Santos, 2003), and it is possible that this predation was a rare or one-off event. Two percent of UK adults participate in recreational sea angling (Armstrong et al., 2013); and with the advent of waterproof cameras and the ubiquity of camera phones, this kind of data capture is now more feasible than ever.

Grey seals are known to exhibit individual dietary specialisation (Graham et al., 2011), and ontogenetic and sexual differences in prey choice (Beck et al., 2007; Ridoux et al., 2007). Shark predation could be a relative rarity in grey seals in general, only conducted by a select few individuals or demographic groups. Individual specialisation for habitats and prey can also be driven by limitations in resources (Kobler et al., 2009), which may be the case in this scenario (see below). Dietary specialisation in even a few individual predators can have significant effects on food webs and their stability (Estes et al., 1998; Schreiber et al., 2011), as well as implications for ecosystem linkage (Quevedo et al., 2009; McCauley et al., 2012; Nifong et al., 2015).

Sharks have not previously been detected in the European grey seal diet studies (Prime & Hammond, 1990; Hammond et al., 1994; Pierce et al., 2006; Ridoux et al., 2007; Brown et al., 2012), but this may be due to the methods used. Faecal analysis to search for fish otoliths has been suggested as the best method to study the UK grey seal diet (Prime & Hammond, 1990; Hammond et al., 1994), but elasmobranchs can only be identified if all hard parts are analysed (Laake et al., 2002), and bias remains due to digestive factors (Bowen & Iverson, 2013). Seal diet analyses are also particularly lacking in the Irish and Celtic Seas (Brown et al., 2012). Stable isotope and fatty acid analyses can provide more insight into the grey seal diet than faecal or stomach content analyses alone and can detect elasmobranchs (Lerner et al., 2018; Tverin et al., 2019). A combination of these tissue chemical markers with animal-borne video cameras (Hooker et al., 2008) would be especially

Figure 1. Photograph of the first recorded predation of a tope shark (*Galeorhinus galeus*) by a UK grey seal (*Halichoerus grypus*) (*Photo credit:* Justin Ferran)

powerful in cases in which shark stomach content signals may obfuscate the chemical signal of the sharks themselves (Bowen & Iverson, 2013). If shark carcasses are discovered with potential grey seal-induced injuries, a rapid DNA detection method from grey seal bite wounds has also been developed (Heers et al., 2018).

As significant components of grey and common seal diets exhibit overlap (Brown et al., 2012), increases in the grey seal population (Brasseur et al., 2015; SCOS, 2017) may have amplified intraspecific and interspecific competition for prey. Similarly, protection of seals and tope may have also facilitated competition between the species due to their significant dietary overlap (Ellis et al., 1996), including species that are also important in commercial fisheries (Prime & Hammond, 1990; Hammond et al., 1994; Brown & Pierce, 1998; Pierce et al., 2006). Intraguild competition and predation between phocid seals and sharks have precedence (Lance & Jeffries, 2006; Askin et al., 2012; Lance et al., 2012).

There are multiple recent, novel observations of grey seal predatory interactions and similar observations in other recovering pinniped populations. For example, following population recovery in recent decades, Cape fur seals (*Arctocephalus pusillus pusillus*) in South Africa have significantly intensified their predation of seabirds (Makhado et al., 2006) and have very recently been recorded predating blue sharks (*Prionace glauca*) for the first time (Fallows et al., 2015). Both of these dietary changes could be influenced by scarcity of more typical prey due to both overfishing and an increased seal population (Makhado et al., 2006; Coetzee et al., 2008; Fallows et al., 2015). Australian fur seals (*Arctocephalus pusillus doriferus*) have experienced a recovery similar to Cape fur and grey seals (Kirkwood et al., 2010) and have also, relatively recently, been recorded predating a shark species for the first time—the ornate wobbegong (*Orectolobus ornatus*; Allen & Huveneers, 2005). In Europe, cannibalism (Bishop et al., 2016) and predation of harbour porpoises (Haelters, 2012; Bouveroux et al., 2014; van Bleijswijk et al., 2014; Leopold et al., 2015; Stringell et al., 2015; van Neer et al., 2015) and harbour seals (van Neer et al., 2015) have also recently been recorded for the first time. Taken individually, these may be the result of increased recording efforts and capabilities or they may be rarities. However, a recent study of North Sea grey seals revealed a multi-decadal dietary shift, likely due to the well-documented North Sea regime shift and loss of commercially exploited gadids (Wouters et al., 2015; Hanson et al., 2018). In this context, it seems possible that these separate instances may be symptomatic of wider trophic shifts.

It is important for us to elucidate the processes underlying grey seal predation of tope and, given the discussed body of evidence, why novel predatory interactions in pinniped populations around the world are being recorded (i.e., increased recording capability vs increased competition for resources due to overfishing, regime shifts, and/or increased competition) and what effects these may have on ecosystems and food web dynamics worldwide.

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