Landscape change promotes the emergence of a rare predator-prey interaction

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A B S T R A C T

Diet studies provide basic natural history information to understand food web dynamics. However, measuring the dietary breadth of rare, elusive species is extremely challenging due to their scarcity and/or cryptic behavior. We document, for the first time, an uncommon predatory interaction–nest predation–between two of the most elusive and rare species in Europe, the Iberian lynx (Lynx pardinus) and the red-necked nightjar (Caprimulgus ruficollis). Data on individually tagged nightjars and photo-traps were analysed together to investigate the underlying conditions that might have facilitated the fatal encounter. Human-induced changes in the landscape in 2014–2016 forced nightjars to travel relatively large distances (1–2 km) from the nest to find food, which translated into considerably longer nest absences compared with previous years (2011–2012). This fact, together with a drastic decline in wild rabbit populations (the main prey of lynx), might lead lynxes to search for alternative food resources, such as unaccommodated and easily detectable—bird nests. Our results provide new data about the trophic ecology of this threatened predator and suggest that anthropogenic landscape changes may affect predator-prey relationships in unexpected ways.

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Predator-prey interactions have long inspired a large amount of ecological research. However, most of our current knowledge is based on indirect observations because actual predation events are rarely witnessed. Most often, diet studies are based on time and labour-intensive analysis of faecal samples, prey remains or stomach contents (Hyslop 1980; Trites and Joy 2005). However, these diet studies typically provide limited resolution of prey and may be insufficient to detect rare innovations or changes in prey use (Trites and Joy 2005). Recent DNA-based approaches potentially provide more accurate methods for identification of prey in dietary studies, but these techniques often involve expensive laboratory work and molecular markers targeting uncommon species that may not yet be developed (Pompanon et al. 2012). During the last decades, photo-trapping techniques have been incorporated in many field studies proving to be a very useful, non-invasive method for detecting cryptic interactions between predators and prey (Burton et al. 2015; Cove et al. 2017). Here we document an encounter between two of the most elusive and rare species in Europe, the Iberian lynx (Lynx pardinus) and the red-necked nightjar (Caprimulgus ruficollis), recorded by a camera trap in the Doñana Natural Park (SW Spain).

The Iberian lynx is a highly threatened top predator endemic to the Iberian Peninsula. Lynxes are specialized almost exclusively upon rabbits (Oryctolagus cuniculus; up to 80–99% of its diet, Ferreras et al. 2010) but, when the abundance of rabbits is reduced, they may shift to alternative prey including birds, rodents, small ungulates, and even livestock (Delibes 1980; Garrote et al. 2013). Lynx diet has been the subject of a vast amount of scientific literature (Delibes 1980; Gil-Sánchez et al. 2006). However, to the best of our knowledge, no records of the lynx eating bird eggs have been documented before. New knowledge on the lynx’s diet now emerges at the expense of the red-necked nightjar, a nocturnal insectivorous bird restricted to warm dry regions of the Iberian Peninsula and North Africa.

Like many other ground-nesting birds, red-necked nightjars are predisposed to nest predation due to their accessibility to terrestrial predators (Aragónés 2003). It is known that nightjars may become an important alternative prey for a range of predators when the abundance of their main prey decreases (Camacho et al. 2017) and, as shown in the photos, the Iberian lynx is no exception. Local breeding density of nightjars is very high (1.25 pairs/10 ha) and 90% of first clutches are laid within a 2-week period (Camacho 2013); therefore, nightjar eggs represent an abundant and predictable resource in our study area. Nest-predation experiments actually showed that a large proportion (33%) of simulated nightjar nests were lost to predators in 72 h (Camacho 2013). However, because of the opportunistic nature of our sampling, whether nightjar eggs make up an important part of the lynx diet remains unclear.

Nest predation has decisively shaped the nightjar’s anatomy and behavior. Nightjars are characterized by an amazingly cryptic plumage and secretive behavior that improve their camouflage and maximize...
Nightjar eggs had been depredated by an adult Iberian lynx (Fig. 1), responsible for the destruction of the nest, even at the individual level. After checking 87 photos, we could easily identify the predator predation (e.g. eggshell fragments) and no sign of the parents or June. On the last day, we found the nest empty with some signs of (ScoutGuard model SG550V) placed in the nest between 8 and 14 consecutive days in June 2016 was one of the many nightjars indirectly affected by landscape change, as evidenced by a camera trap from an already overexploited aquifer (Green et al. 2017) and, as a consequence, nest survival depends largely on the time adults spend sitting on the nest hiding the eggs from visual predators. Like in most bird species, the time spent outside the nest is directly proportional to the time required for feeding, which is in turn strongly determined by the proximity of the foraging sites (Camacho et al. 2014). Hence, the greater the distances between nests and foraging sites, the longer the duration of adults’ nest absences, and the greater the feeding opportunities for predators. Nightjars are sit-and-wait foragers that feed on aerial insectivores, primarily moths. From dusk to dawn, they come to agricultural roads and tracks to forage, as they provide birds with an open space where they can easily detect flying prey and launch into the air to pursue them (Jackson 2003). By following radio-tagged individuals during the 2011 and 2012 breeding seasons, we found that nightjars had to travel, on average, a distance of only 0.3 ± 0.02 km (SE) to access roads from their nests (see Camacho et al. 2014 for details). Feeding sites within roads were usually located close to water sources, such as irrigated crops and ponds where insects are most abundant, especially in dry years (Camacho et al. 2014). In this way, any modification of crucial landscape elements for nightjars may force birds to search for new foraging areas and thus adjust their time allocation decisions.

Since 2014, an intensive forestry activity has occurred throughout the study area in and around the Doñana World Heritage Site, including forest clearance for both economic and conservation purposes. Unfortunately for nightjars, one of their main foraging sites, a 1000 ha irrigated orange tree plantation, was removed in order to reduce water extraction from an already overexploited aquifer (Green et al. 2017) and, as a consequence, the availability and spatial configuration of functional habitats for nightjars changed dramatically. Monitoring of individually marked nightjars with GPS-data loggers (GiPsy-5, Technosmart, Italy) in 2016 revealed that nightjars changed their habitat selection pattern, presumably as a response to landscape change and, as a result, travelled considerably longer distances than in 2011–2012 to access food.

A female adult nightjar that had been tagged with a GPS during two consecutive days in June 2016 was one of the many nightjars indirectly affected by landscape change, as evidenced by a camera trap (ScoutGuard model SG550V) placed in the nest between 8 and 14 June. On the last day, we found the nest empty with some signs of predation (e.g. eggshell fragments) and no sign of the parents or young. After checking 87 photos, we could easily identify the predator responsible for the destruction of the nest, even at the individual level. Nightjar eggs had been depredated by an adult Iberian lynx (Fig. 1), just 2 days before the expected hatching day. Based on the comparison of our photos with those of the photo-identification catalog from the Life Lynx project (http://www.lifelince.org/public/Catalogo_foto_identificacion3_LIFE2010.pdf), we were able to determine that it was a 10-year-old female.

Two unrelated events apparently acted additively to the nightjar detriment. First, drastic changes in landscape configuration likely forced the nightjar to move away from the nest and travel comparatively greater distances (1.7 ± 0.07 km from the nest; mean ± SE) to find food, which translated into considerably longer nest absences. Overall, 209 nighttime locations were available from the data logger, corresponding to 16.7 h. To our surprise, we found that the female spent 72.5% of the nighttime (170 locations, 12.1 h) outside of the nest, sometimes being absent for more than 8 h (range: 8.15–0.05 h; mean = 0.71, SE = 0.48). Mild nocturnal temperatures in Doñana during the breeding season of nightjars (22.2–22.7 °C; Camacho et al. 2017) allow adults to be absent from the nest for long time periods with low risk of egg mortality. Even though male nightjars may occasionally relieve their mates from incubation duties (Camacho et al. 2014), temporary nest abandonment by the female probably provided the lynx time to find the exposed eggs. Second, the changes in landscape structure coincided with a sharp decline in rabbit populations due to the arrival of a new variant of viral hemorrhagic disease (Guerrero-Casado et al. 2016) which, as suggested by the image, may have forced lynxes to search for alternative food resources, such as unconcealed and easily detectable bird nests. Taken together, our current and previous research in this study system (Camacho et al. 2014, 2017) strongly suggest that human-induced changes in the landscape may have unintended, but important, effects on predator-prey relationships, although the incidence of prey shifts on red-necked nightjar populations remains to be determined.

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Appendix A. Supplementary data

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References


