**Interspecific relationship between a carnivore community and two potential preys presents in Doñana Natural Park**

**Abstract**

**Introduction**

*Knowledge the interspecific relationship of the species for the management of their conservation against perturbation*

Mammal carnivores play a very key role in ecosystems as influencers and regulators of food webs, they are part of the highest trophic levels where they can directly (predation) or indirectly (“top-down” trophic cascades) influence the other levels (Schmitz et al., 2000; Terborgh et al., 1999). In addition, mammal carnivores can act as umbrella species and its conservation promotes the conservation of many other species which coexist naturally (Roberge & Angelstam, 2004). The conservation of carnivore assemblages with high species richness allows for the capture of high functional and phylogenetic diversity, which leads to improved ecosystem resilience (Dalerum, 2013). Understanding the different coexistence mechanisms developed by carnivore communities is crucial to develop effective conservation plans.

Also, due to the ecological similarities between carnivore species, they are a very interesting group for the study of interspecific relationships (Roemer et al., 2009).

*Partition of the ecological niche for the coexistence between species*

Considering the principle of competitive exclusion, two ecologically similar species cannot coexist in the same space, unless they develop strategies and adaptations that allow them to diverge or coexist in their ecological niche, either to the spatial, temporal and/or trophic level (Hardin, 1960; Schoener, 1974). Within various dimensions of the ecological niche, species can engage in distinct competitive interactions, including exploitative competition and interference competition. Exploitative competition posits that a unit of resource exploited by one species becomes unavailable to others (Linnell & Strand, 2000a; Wiens, 1993). Conversely, interference competition involves direct interactions such as predation among predators, including instances of intraguild predation, which significantly influences resource utilization among species (Linnell & Strand, 2000b; Polis et al., 1989).

, and if the resource is limited, depending on the species, a differentiation of the foraging mechanisms can be generated

*Temporal partitioning as interspecific coexistence.*

Although, in the past, the models explaining species coexistence emphasize that the trophic and spatial dimensions of the ecological niche are the axes that best explain interspecific relationships (MacArthur & Pianka, 1966), however, it has been found that temporal niche segregation allows for interspecific coexistence (Ferreiro-Arias et al., 2021; Monterroso et al., 2014a; Schoener, 1974; Torretta et al., 2016).

*Interspecific relationships predator/predator and predator/prey.*

Especially, in carnivore communities, the hierarchy of the species has an influence on the use of resources, e.g., the subordinate species tend to avoid exploiting the same resources as the dominant species, in this way, the structure and population density of the species subordinates can be directly affected (Linnell & Strand, 2000c).

However, these interactions between predators are not always the same, depending on the availability of resources and the structure of the community concerned (Ritchie & Johnson, 2009).

*AI used in camera trap images*

Currently, one of the most widely used methods for the study and monitoring of mammals is the use of camera traps, these devices provide observational information on the species through the remote and automatic capture of images and videos (Rovero et al., 2013). In this way, the use of camera traps has facilitated the study of species coexistence processes to evaluate niche partitioning at the temporal, spatial, spatiotemporal and trophic levels (Bianchi et al., 2016; Garvey et al., 2022; Hearn et al., 2018; Watabe et al., 2022). However, this method has a limitation linked to the process of classification by researchers due to the enormous number of images that can be obtained in these studies. Currently, the development and use of artificial intelligence algorithms, specifically convolutional neuronal networks, for the recognition and classification of photo-trapping images is increasing, allowing researchers to facilitate the extraction of information to make ecological inferences about species (Tabak et al., 2019; Whytock et al., 2021; Willi et al., 2019).

*Mesocarnivores in Doñana*

In southwestern Spain there is a high diversity of sympatric carnivores, of which different competitive interactions have been reported (Fedriani et al., 1999; Monterroso et al., 2014a; Palomares et al., 1996). This region is influenced by a Mediterranean climate, where carnivore species coexist with niche segregation in both homogeneous and heterogeneous ecosystems (Pereira et al., 2012; Soto & Palomares, 2015a). The carnivore community in Doñana is represented by five medium size species which live in sympatric coexistence: Red fox (*Vulpes vulpes*), European badger (*Meles meles*), Common genet (*Genetta genetta*), Egyptian mongoose (*Herpestes ichneumon*) and Iberian lynx (*Lynx pardinus*). The first four species are generalist, and one is a diet and habitat specialist. The red fox and the European badger are generalist in their habitat and diet exploitation (Soto & Palomares, 2015b). Moreover, some studies suggest that coexistence between this pair of species is related to temporal habitat segregation (Monterroso et al., 2014b; Vilella et al., 2020). The Egyptian mongoose has been reported as a species with a diurnal activity pattern, generalist but opportunistic to the most abundant prey (Ferreiro-Arias et al., 2021; Palomares, 1993). The common genet is a nocturnal and opportunistic carnivore with a euryphagous diet, found especially in areas where micromammals are more available (Serge Lariviere & Calzada, 2001; Vilella et al., 2020). On the other hand, the Iberian lynx is a diet and habitat specialist species which feeds on rabbits, *Oryctolagus cuniculus*, and inhabits only the Mediterranean habitat, and that plays a top predator role among the mesocarnivore community (Fedriani, 1997; Palomares et al., 1996, 1998; Soto & Palomares, 2015b).

*Hypothesis and goals*

We based our hypothesis on niche partitioning, whereby we expect that ecologically similar species will present a spatial, temporal and/or spatiotemporal segregation since these were the niche axes we evaluated. For example, badger and genet have been reported to have similar circadian cycles, while badger and fox have similar trophic requirements (Ferreiro-Arias et al., 2021). We therefore expect that there is a spatial or habitat segregation between these two pairs of species. On the other hand, as the ecological niche of carnivores is influenced by resource availability, we expect species such as fox and badger, which have preferences for consuming lagomorphs, to exhibit high temporal, spatial and habitat overlap. In this study we observed the interspecific relationships of the entire mesocarnivore community, and two potential prey species present in Doñana National Park. We describe the activity and habitat preference patterns of all species over the course of a season and estimate whether there is overlap or segregation in spatial, temporal and spatiotemporal niche size.

1. **Methods**
   1. **Study area**

Diagrama

Descripción generada automáticamente

**Figure 1.**

* 1. **Field study and data collection**
  2. **Statistical analyses**

1. **Results**

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