

Small but fierce: invasive ants kill Barolo Shearwater (*Puffinus lherminieri baroli*) nestling in Cima islet (PORTO SANTO, MADEIRA ARCHIPELAGO)

Pequenas, mas ferozes: formigas invasoras predam cria de Pintaínho (*Puffinus lherminieri baroli*) no ilhéu de Cima (PORTO SANTO, ARQUIPÉLAGO DA MADEIRA)

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ABSTRACT

Invasive vertebrate species are known to be a major cause of seabird nestling mortality in oceanic islands. On the other hand, avian nestling predation by invasive ants has seldom been recorded probably due to the confusion of the role of ants as predators or decomposers and the lack of specific studies on this subject. Here, we report the predation of a Barolo Shearwater nestling *Puffinus lherminieri baroli* by the invasive Argentine Ant *Linepithema humile* in Cima islet (Porto Santo, Madeira archipelago). Ants were found in very high abundance in this islet and the recorded attack started immediately as the nestling was hatching. Within a few hours the nestling was overwhelmed by the ants and was dead the next day. Our finding aims to call attention for an overlooked cause of seabird nestling mortality that may be important in areas heavily infested by invasive ants, particularly in island ecosystems.

Keywords: biological invasions, crevice-nesting seabirds, *Linepithema humile*, nestling predation, oceanic islands.

RESUMO

As espécies invasoras de vertebrados constituem uma das principais causas de mortalidade de crias de aves em ilhas oceânicas. Por outro lado, pouco se conhece sobre os impactos das formigas invasoras nas crias de aves, uma vez que o seu papel ecológico de predador ou decompositor é dificilmente distinguido, mas também pela escassez de estudos sobre esta temática.

Aqui, documentamos a predação de uma cria de Pintaínho *Puffinus lherminieri baroli* pela Formiga-argentina *Linepithema humile* no ilhéu de Cima (Porto Santo, Arquipélago da Madeira). Estas formigas invasoras ocorrem em elevada abundância neste ilhéu e o ataque à cria começou imediatamente após a eclosão. A cria foi subjugada pelas formigas em poucas horas, tendo a sua morte sido confirmada no dia seguinte. Com este registo pretendemos destacar uma causa de mortalidade de crias de aves marinhas ainda pouco conhecida, mas que poderá ser importante em áreas infestadas por formigas invasoras, particularmente em ecossistemas insulares.

Palavras-chave: invasões biológicas, aves marinhas que nidificam em fendas rochosas, *Linepithema humile*, predação de crias, ilhas oceânicas.

Introduction

Islands are important breeding locations for many seabird species and play a major role on their conservation at global level (Mulder et al. 2011). During the last centuries, human activities have intensified dramatically at a global scale even reaching the most remote oceanic islands. Consequently, the native island biotas have experienced both direct and indirect effects of human activities, which invariably led to native species declines and extinctions (Blackburn et al. 2004, Wood et al. 2017).

A major cause of the marked decline of seabird populations in islands is the presence of invasive species, particularly cats, rats and mice that prey upon eggs, nestlings and even adult birds (Blackburn et al. 2004, Jones et al. 2008, Towns et al. 2012). The severe impacts of invasive vertebrate species on seabirds breeding in islands are well-documented and are being mitigated all over the world through population control and eradication initiatives (Veitch et al. 2011, Dunlevy et al. 2012, DIISE 2015, Jones et al. 2016). In contrast, there is little information on the impact of invasive invertebrates on seabird popula-

tions (Plentovich et al. 2018). Here we report the predation of a Barolo Shearwater *Puffinus lherminieri baroli* nestling by invasive Argentine ants *Linepithema humile* at Cima islet (Porto Santo, Arquipélago da Madeira). This finding and the recent observations made in Desertas Islands (Boieiro et al. 2018) are to our knowledge the first records of avian nestling predation by invasive ants in Europe.

Method

The observation of the ant attack to the nestling was made on 9 April 2011 at the southwest side of Cima islet (33° 03' N, 16° 17' W), when we were developing surveys to locate nest sites. The visits to Cima Islet were conducted from 6 to 10 April coinciding with the beginning of the hatching period. During 2011, only 8 nests with nestlings of Barolo Shearwater were found.

The Cima islet has a small surface area (0.32 km²) mostly covered by coastal vegetation dominated by *Artemisia argentea* or *Mesembryanthemum spp.*, and is distanced

450 m from the main island of Porto Santo (Madeira archipelago; Alves et al. 2015). It is included in the recently created Network of Marine Protected Areas of Porto Santo, being legally protected since 2008. Thenceforth, it has been the target of several restoration activities to eradicate invasive species (e.g. mice, rabbits and several plant species), recover natural habitats and promote the conservation of threatened species, such as seabirds and endemic snails (Alves et al. 2015). This islet holds small breeding populations of Cory's Shearwater *Calonectris borealis*, Bulwer's Petrel *Bulweria bulwerii*, Band-rumped Storm Petrel *Hydrobates castro* and Barolo Shearwater (Fig. 1).

Barolo Shearwaters nest in natural crevices in dense rubble composed of small to medium (10-100cm diameter) sized rocks (Fagundes et al. 2016). On Cima islet this habitat is found along a narrow strip at the base of cliffs mainly along the southwestern shore. The Barolo Shearwater population for Cima islet is estimated at 129-148 breeding pairs (I. Fagundes, unpublished data).

Results

During the survey to the Barolo Shearwater colony of Cima islet, we noticed high activity of Argentine ants near the nesting

Figure 1 - Barolo Shearwater (*Puffinus lherminieri baroli*) in its nest at Cima islet.

Figura 1 - Pintaínho (*Puffinus lherminieri baroli*) no seu ninho no ilhéu de Cima.



sites. The ants were foraging at the soil surface level, moving along trails or randomly searching for food items. In one nest of Barolo Shearwater, we observed many ants moving over and around an egg that was starting to hatch. During the hatching process, the ants began feeding on the fluids that were released from the egg and later were observed entering the egg. Ant activity kept increasing until the nestling was overwhelmed by a swarm of ants that led to its death, probably as a result from the combination of biting and suffocation. The next day we confirmed that the nestling had been killed by the invasive ants. The nestling was found still inside the egg and was

covered with ants feeding on its remains. During our stay in Cima islet we monitored other nests with recently hatched nestlings, but no further ant attacks were observed. We found that there were previous reports of ants disturbing (Fig. 2) and feeding upon Yellow-legged Gull *Larus michahellis* nestlings at Cima islet, but in these latter cases, ants were assumed to be acting as scavengers (I. Silva, pers. comm.). In fact, to be sure that Argentine ants are able to prey upon seabird nestlings, the killing process must be recorded given that ants may play the dual role of predator and scavenger. So, unless specific work is conducted, it will be difficult to document this behaviour as predatory.

Figure 2 - Argentine Ants attacking a nestling of Yellow-legged Gull (*Larus michahellis*).

Figura 2 - Ataque de formigas-argentina a uma cria de Gaivota de patas amarelas (*Larus michahellis*).



Discussion

The lack of previous records of avian nestling predation by the Argentine Ant in Madeira archipelago is unexpected, considering that this invasive ant was introduced in the mid-18th century (Wetterer et al. 2006, Queiroz & Alves 2016). However, the isolation of the islets where this species is highly abundant, the cryptic nesting habits of seabirds (e.g. crevice-nesting species) and the apparently sporadic nature of the ant attacks may have contributed to its late documentation. There are only a few other worldwide reports of Argentine Ant predation on avian nestlings, but they confirm the generalist feeding behaviour of this invasive ant: the ants may prey upon geese (*Branta sandvicensis*), petrels (*Bulweria bulweri*), gulls (*Larus michahellis*), terns (*Sterna antillarum*, *S. hirundo*) and passerines (*Junco hyemalis*, *Poliophtila melanura*, *Serinus canaria*; Krushelnysky et al. 2001, 2005, Suarez et al. 2005, Boieiro et al. 2018).

The drivers of Argentine Ant attacks to avian nestlings remain unclear. This invasive species is found in very high abundance at Cima islet when compared to the main island of Porto Santo (over 30 times more abundant in the former; Boieiro, unpublished data from pitfall trapping), probably benefiting from low competition and predation pressure on the simplified islet ecosystem. However, as suggested by other authors (e.g. Plentovich et al. 2009), the key factor that seems to trigger the attack of several invasive ant species to avian nestlings may be related with the variation in environmental factors and/or food resource depletion. Further studies targeting the interactions between ants and seabirds are needed to identify the drivers of nestling predation by ants and their impact on avian reproductive success. These studies are more important when we consider that Barolo Shearwater is among the less known seabirds in the North Atlantic and the data from the authors suggests a decline on the Madeira archipelago

population due to several factors, including environmental conditions at sea, lack of suitable breeding habitat and nest-site competition with Bulwer's Petrels and Cory's Shearwaters (Fagundes et al. 2016).

During the last decade, there have been several reports on the direct impact of invasive ants, particularly the Yellow Crazy Ant *Anoplolepis gracilipes* and Fire ants *Solenopsis* spp, on avian nestling condition and survival in a few oceanic islands (Matsui et al. 2009, Plentovich et al. 2009, 2011, 2018, DeFisher & Bonter 2013). These studies were very important by highlighting the negative impacts of invasive ants on nestling growth and survival, also providing evidence of seabird population decline in the infested areas. Thus, it became evident that seabird conservation in oceanic islands should consider the monitoring of invasive ant species impacts on avian reproductive success and the need to make decisions concerning their control.

The findings from Madeira archipelago, the first on European territory, show that the impact of invasive ants on seabird nestlings may be a more widespread phenomenon than previously thought. Given the difficulty in detecting ant aggressive behaviours, their impact on seabird reproductive success remains underestimated throughout the world.

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