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## Potential impact of the Alien American Mink (*Neovison vison*) on Magellanic woodpeckers (*Campephilus magellanicus*) in Navarino Island, Southern Chile

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**Abstract** The American mink (*Neovison vison*) has been described as one of the worst invasive species in the northern hemisphere. Although some studies on the mink exist for the southern hemisphere, aside from impacts on marine and freshwater birds, its effect on other components of the biota is not well understood. Here, as a result of 3 different studies, we report evidence for the mink as a predator of the Magellanic woodpecker (*Campephilus magellanicus*). To our knowledge, these are the first evidences of predation on this charismatic and endemic woodpecker and indicate that mink might have a more widespread impact on forest birds than was initially suspected.

**Keywords** American mink · *Campephilus* · Cape Horn · Invasive · *Neovison* · Predation · Subantarctic forests

### Introduction

The American mink (*Neovison vison*) is a small-sized semi-aquatic carnivore (Lariviere 1999). Due to repeated escapes or intentional releases from fur farms, American mink has extensively spread on landmasses other than their native North America, including Europe, Asia, and South America (Lariviere 1999; Macdonald and Harrington 2003). Their ecological and life history traits make mink a successful invader (Previtali et al. 1998; Bonesi and Palazon 2007; Lockwood et al. 2007). Traits enhancing the invasiveness of American mink are their high reproductive performance, high movement ability through upland terrain and water bodies, being extremely adaptable and opportunistic in diet and habitat preferences, and have little fear to people (Lariviere 1999; Macdonald and Harrington 2003; Schüttler et al. 2009). Consequently, American mink becomes an efficient exotic predator outcompeting other native predators and impacting local populations of native prey (Macdonald and Harrington 2003 and references therein).

Since its introduction in southern South America in the 1930s (Jaksic et al. 2002), the American mink has

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successfully invaded Chile from the Cautín River (38°S) (Medina 1997) and Argentina from Lanín National Park (39°S) (Peris et al. 2009; Pescador et al. 2012), south to the Cape Horn Biosphere Reserve (CHBR) (Rozzi and Sherriffs 2003). Despite this successful invasion throughout Patagonia, the impacts of mink on local biotas are not entirely understood. Several studies in lakes and lagoons addressed mink predation as one of the main ecological factors explaining the recent decline in richness and abundance of wetland birds (Peris et al. 2009; Pescador et al. 2012). However, little is known about its effects on main inland avian populations.

Here, we report for the first time substantial evidence on the American mink as a threatening predator of a forest specialist species, the Magellanic woodpecker (*Campephilus magellanicus*) on Navarino Island (55°S), located in the CHBR. Magellanic woodpeckers are endemic to the temperate forests of South America and recognized as a vulnerable (SAG 2009) and charismatic species and the largest extant woodpecker in the Americas (Arango et al. 2007). Mink arrived to Navarino Island apparently in the late 1990s (Rozzi and Sherriffs 2003), and currently, they are widespread on the island, abundant, and found in diverse habitat types, including freshwater bodies, marine coasts, and in upland forest habitats, up to 400 m in altitude (Schüttler et al. 2010; Crego and Jiménez unpublished data). Mammals and birds compose more than 70 % of mink's diet on Navarino Island; birds are its main source of food during the summer (Ibarra et al. 2009; Schüttler et al. 2008). Similarly, studies in Europe assessed mink diet plasticity, showing that they can consume more terrestrial prey when forced by intra- or inter-species competition (Bodey et al. 2010; Bonesi et al. 2004). Although mink is described as the main predator of aquatic birds in the CHBR (Schüttler et al. 2009), their effects on forest species in this region remain completely unknown.

## Methods and results

During the austral breeding season of 2012–2013, we gathered direct and indirect information on predation events by mink on Magellanic woodpeckers in subantarctic forests of the Omora Park, on Navarino Island. Our gathered information derives from three

independent sources: (1) a radio-tracked male woodpecker whose carcass was found inside a mink den; (2) direct observations of a male woodpecker being attacked by a mink; and (3) records from a camera-trap study showing microhabitat co-use by mink and woodpeckers. Details of these evidences are explained as follow:

### Dead radio-tracked woodpecker

As part of a behavioral study on *C. magellanicus* that we are conducting at Omora Park, when tracking one of our six radio-tagged male woodpeckers, on November 20, 2012, we were puzzled to obtain a radio-signal from the base of a 99-cm-DBH and 15-m-tall Magellanic coigue (*Nothofagus betuloides*) at about 160 m from the Róbaló River. The tree had two burrow entrances (12 × 18 and 10 × 16 cm) at ground level and 27 typical mink feces (7–9 mm diameter and 5–9 cm in length) scattered around the entrance. We returned to the site on January 20, 2013, and the transmitter was still emitting a strong signal from the interior of the tree base. By following the signal strength, we could recover part of the chewed Teflon harness, as well as some Magellanic woodpecker breast and tail feathers, which were some 60–90 cm deep into the burrow, but could not recover the beeping transmitter that was out of our arms reach. Our interpretation of this finding is that a mink killed this woodpecker and dragged it into its active den. This woodpecker was first radio-tagged on January 26, 2012, and the tree location was within the bird's home range. The last time we saw the woodpecker alive was on November 13, 2013. It was seen with a female, incubating and behaving normally. The only other casualty we had during this year was from a radioed woodpecker from another family that was found dead (713 m away) on the snow on July 27, 2012, with no signals of external physical damage or emaciation according to the diagnostics of DVM Cristian Celis. Nevertheless, we cannot rule out the scavenging of the carcass.

### Observed predatory attack

On January 30 at 10:35 AM, while studying a male Magellanic woodpecker feeding on a log at 20 cm off the ground (ca. 2,000 m away from the male killed by the mink), an observer of our team (IR) witnessed a

mink quickly, but silently approaching this Magellanic woodpecker from behind. When the mink was circa 30 cm apart from the bird and ready to pounce, to avoid the potential kill, IR scared the woodpecker with a loud call and by waving his hands. The bird flew in the opposite direction to a nearby tree and the mink escaped in the same direction it first approached. Even though this attack was interrupted, it would have likely ended in a dead bird. It is important to note that the mink, while sorting out logs and using them to remain out of sight, and approaching the woodpecker from behind, was never perceived by the bird. The woodpecker took flight when it was scared away by IR.

#### Camera-trap study records

As part of a study conducted by RC to detect mink on Navarino Island, using 58 camera stations that run for 16–24 days during February/March 2013, we obtained pictures of mink and Magellanic woodpeckers on grounded logs at two stations in the Omora Park (3.4 %, Fig. 1). At one of these stations, 13 visits of mink were recorded at different times of the night or day, where animals were pictured moving along on a ca 8-cm-diameter dead branch on the ground. On exactly the same branch, a male Magellanic woodpecker was recorded on March 11 at 13:21 (Fig. 1a), having only 31 min of difference from the mink records on a different day. At another camera station, two minks moving on the ground were detected on March 3 at 00:08 and March 6 at 04:39. Only 3 m away from this ground site, on March 11 at 18:07, a female Magellanic woodpecker was pictured feeding on a downed log of ca. 50 cm in diameter. Its male also showed up in the same picture feeding on a similar log at ca. 6 m from where the mink had been (Fig. 1b). This evidence confirms the frequent habit of Magellanic woodpeckers feeding on the ground on Navarino Island and emphasizes that the probability of close encounters between a mink and a woodpecker—and likely the predation risk—is relatively high.

#### Discussion

Our observations are consistent with the patterns described for island bird species, which have been shown to be sensitive to terrestrial introduced predators by lacking adaptations to escape or avoid them

(Blackburn et al. 2004; Lockwood et al. 2007). The long isolation of ground-nesting birds on mammalian-free predator habitats in Navarino Island may have resulted in a lack of behavioral responses to ground predators (Schüttler et al. 2009). In fact, on the other side of the Beagle Channel, on Tierra del Fuego, where other terrestrial predators exist, birds are a secondary prey of mink (Gomez et al. 2010), suggesting that birds could present anti-predator behaviors given their long-term coexistence with native predators. Even there is no evidence of Magellanic woodpecker isolation in Navarino Island, behavioral observations suggest that these birds do not present anti-predator responses, putting them as a high risk to mink predation.

Predation on woodpeckers has rarely been documented (Winkler and Christie 2002); however, it is generally accepted that woodpeckers can be preyed upon by raptors when moving in the forest or by mammalian predators such as mustelids when in their nests (Gorman 2011). At Omora Park, we have observed predator avoidance behavior by Magellanic woodpeckers when confronted with Crested caracaras (*Caracara plancus*) and a Chilean hawk (*Accipiter chilensis*), but did not observe attacks. Indeed, none of the published studies of mink diet for South America have reported Magellanic woodpeckers (or any other woodpecker) in the diet (Medina 1997; Ibarra et al. 2009; Previtali et al. 1998; Schüttler et al. 2008). To our knowledge, this is the first report that documents mink predation on this species and the first study describing predation on the Magellanic woodpecker.

The behavior exhibited by Magellanic woodpeckers of feeding on the ground, or very close to it, exposes them to mink. In 146 out of 764 (19.1 %) independent observations of six radio-collared woodpeckers at Omora Park, birds were recorded within 1 m of the ground (J.E.J. et al. unpublished data). When this behavior was observed in a familiar group, often the woodpecker's pair, and the accompanying juveniles (if any), came down to the ground to feed on the same log or on one nearby. Although woodpeckers foraging on the ground appeared as vigilant as when feeding on trees, the large amount of accumulated dead wood on the floor (Lombardi et al. 2011) probably limited the distance over which their predatory-scanning behavior could be effective. Indeed, mink may be efficient at capturing woodpeckers on the ground as they are secretive, move fast, and hide under



**Fig. 1** Camera-trap pictures showing the occurrence of Magellanic woodpeckers and American minks recorded at the same two camera trap stations in Navarino Island during February and

March of 2013. The *arrows* on (b) show the position of two individuals of Magellanic woodpecker, a male (*left*) and a female (*right*)

the understory vegetation and logs (Larivière 1999). The intensive ground feeding behavior of Magellanic woodpeckers on Navarino Island has never been reported on the mainland, where they are exposed to an array of three fox species, two felids, two native mustelids, and other feral exotic carnivores, including the mink. Only Chazarreta et al. (2012) evaluated feeding behavior for this species on the mainland and found that Magellanic woodpeckers sporadically feed below 5 m from the ground. Therefore, the frequent ground feeding behavior on Navarino Island—unlike what occurs on the mainland—and the large accumulation of woody debris in subantarctic forests (Lombardi et al. 2011) may have resulted in an increased risk of mink predation for woodpeckers.

Although our findings are based on a few field records, they call attention to the impact that mink can have on the avifauna of the remote islands south of Tierra del Fuego. Mink not only could prey on adult woodpeckers, but also by having the ability to climb trees (Larivière 1999), they may also prey on woodpecker's nests. Hence, given the fact that woodpeckers live at low densities (ca. one family/km<sup>2</sup>, J.E.J. et al. unpublished data), reproduce slowly (only one chick per brood in the best years, Ojeda 2004), and show weak anti-predatory behavior, may lead to a population decline in Navarino Island. These facts recommend broadening the current management actions to control the spread of mink population, to reduce its impacts on the coastal

avifauna of these austral islands and potentially benefitting other forest bird species as well.

As a warning parallel regarding the sensitivity of *Campephilus* woodpeckers to habitat disturbance and hunting pressures, the closely related ivory-billed (*C. principalis*) and imperial woodpeckers (*C. imperialis*) were exterminated within less than 100 years of European settlement in North America (Jackson 2004; Snyder et al. 2009). In addition, forest bird species other than woodpeckers, such as the thorn-tailed rayadito (*Aphrastura spinicauda*) and Austral thrushes (*Turdus falcklandii*), may also be highly vulnerable to mink as in Navarino Island they tend to nest on the ground, whereas in the mainland habitats they usually nest on trees (McGehee et al. 2010; Rozzi and Jiménez 2013). Another ground-nesting bird, the Magellanic tapaculo (*Scytalopus magellanicus*), was frequently recorded at Omora Park until 2002 (Rozzi and Jiménez 2013). However, it stopped to be recorded in the lower areas of the park since 2003, few years after minks arrived on Navarino.

The evidence presented here, and the high estimated probability of a mink finding and killing a woodpecker, should alert conservation authorities about the potential decline of the Magellanic woodpecker population on Navarino Island. The decline and eventual extinction of the southernmost population of *Campephilus magellanicus* would have consequences for the conservation of this species, and its cultural, economic, and ecological roles. Aside from the loss of the most charismatic species with great potential for eco-tourism (Arango et al. 2007) and the emblematic species of the Cape Horn Biosphere Reserve, may have far reaching consequences for forest nutrient cycling, insect populations, and the maintenance of the community of secondary cavity nesting birds on Navarino Island. Urgent management actions as well as further research are recommended to control mink populations on Navarino Island, so that the largest woodpecker of South America, and perhaps other less noticed species, will not be driven to extinction.

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