The American mink (*Neovison vison*) is a competent host for native European parasites

Martínez-Rondán, F.J.; Ruiz de Ybáñez, M.R.[1*]; Tizzani, P.[2]; López-Beceiro, A.M.[3]; Fidalgo, L.E.[3]; Martínez-Carrasco, C.[1]

[1]Department of Animal Health, Regional Campus of International Excellence "Campus Mare Nostrum", University of Murcia, Murcia, Spain.

[2]Department of Veterinary Sciences, University of Turin, Grugliasco, Turin, Italy.

[3]Department of Clinical Veterinary Sciences. University of Santiago de Compostela, Lugo, Spain.

ABSTRACT

The American mink (*Neovison vison*) is a mustelid native to North America that was introduced in Europe and the former USSR for fur farming. Throughout the last century, accidental or deliberate escapes of mink from farms caused the establishment of stable feral populations. In fact, the American mink is considered an invasive alien species in 28 European countries. The present study evaluates the gastrointestinal and cardiopulmonary helminth fauna of the American mink in Galicia (NW Spain) to understand its role as a potential reservoir for parasites affecting other autochthonous mustelids. In the period 2008-2014, fifty American mink (35 males and 15 females) of different ages (22 immature and 28 adults) from the provinces of Lugo, Ourense and Pontevedra were captured and sacrificed. Eight parasite species were found (6 nematodes and 2 trematodes) with the following prevalences: *Molineus patens* (68%), *Aonchotheca putorii* (54%), *Crenosoma melesi* (10%), *Aonchotheca annulosa* (8%), *Angiostrongylus daskalovi* (6%), *Aelurostrongylus* spp. (2%), *Troglotrema acutum* (2%)

and an unidentified trematode (2%). Eighty-two per cent of the mink harboured helminths, including 15 animals (30%) infected by only one parasite species, 19 (38%) by two species, 5 (10%) by three species and 2 mink (4%) by four species. All helminth species identified are native to European mustelids. Statistical models were used to evaluate if animal characteristics (age, sex and weight), date and capture area influenced the prevalence, intensity or parasite richness. Statistical differences were detected only in models for intensity of *M. patens*, *A. putorii* and *C. melesi*. This is the first report of *Angiostrongylus daskalovi*, a cardiopulmonary nematode, and *A. annulosa*, a gastrointestinal nematode specific of rodents, in American mink. Moreover, although the fluke *T. acutum* has already been cited in American mink, to our knowledge, the present study represents the first report of this trematode in the lung.

Key words: *Neovison vison*, American mink, helminth, allochthonous, Galicia, Spain

1 INTRODUCTION

The American mink (*Neovison vison* Schreber, 1777) is a semi-aquatic mustelid native to North America, widespread in this area with the exception of the Arctic Circle, the southern of United States and Mexico (Banfield, 1974; Linscombe *et al.*, 1982; Melero and Palazón, 2011). It was introduced in Europe and the former USSR in the early 20s of last century for fur industry purposes (Vidal-Figueroa and Delibes, 1987; Dunstone, 1993; Melero and Palazón, 2011). In Spain, first fur farms were established during the late 1950s (Bravo and Bueno, 1992). Accidental or deliberate releases consecutive to accidents (fires, windstorms, etc.), limited security measures and/or cessation of farm's activity led to the establishment of feral populations (Vidal-Figueroa and Delibes, 1987; Palazón and Ruíz-Olmo, 1997). In fact, the American mink is considered an invasive species in 28 European countries (Bonesi and Palazón, 2007). In Spain, the first feral mink was reported in Central Spain (Segovia) in 1978 (Delibes and Amores, 1978) and, since then, this mustelid has progressively colonized Southwest of Galicia (Vidal-Figueroa and Delibes, 1987), Northeastern Catalonia (Ruíz-Olmo, 1987) and Central Spain (Bueno and Bravo, 1990). Currently, three other core populations are established in Cantabria, North of Galicia and Teruel-Castellón (Ruíz-Olmo *et al.*, 1997).

American mink is a generalist and opportunistic species which consumes a wide spectrum of both aquatic and terrestrial preys. Its diet varies depending on the habitat, the prey availability and the presence of other competitor species (Bonesi *et al.*, 2004). Fragmented landscapes, with a wide variety of habitats and food resources, favor its presence (Rodríguez and Zuberogoitia, 2011). This mustelid preferably inhabits territories with well-structured riparian vegetation (Zuberogoitia *et al.*, 2006; Zabala *et al.*, 2007; Melero *et al*., 2008b; Melero and Palazón, 2011).

American mink can cause adverse effects on autochthonous prey populations (Bonesi and Palazón, 2007), such as European crayfish (*Austropotamobius pallipes*), Pyrenean desman (*Galemys pyrenaicus*), water vole (*Arvicola sapidus*) and Mediterranean water shrew (*Neomys anomalus*) (Palazón and Ruíz-Olmo, 1997, Bergmans and Blom, 2001, Palomo and Gisbert, 2002, García-Díaz *et al*., 2013). Moreover, it could have a negative impact on the populations of other carnivores, such as the European mink (*Mustela lutreola*), the otter (*Lutra lutra*) and the European polecat (*Mustela putorius*), due to the competition for space or food resources (Sidorovich *et al.*, 1999; Melero *et al.* 2012). Furthermore, the introduction of an invasive species can have unpredictable epidemiological consequences, because it can carry alien agents potentially pathogenic for native host species or, alternatively, the same alien species can act as a new reservoir for autochthonous infectious agents (Sepúlveda *et al*., 2014; Sherrard-Smith *et al*., 2015). For all these reasons, a national specific regulation was published in Spain, and the Ministry of Agriculture, Food and Environment developed the program "Management strategy, control and eradication of the American mink in Spain".

The American mink´s control programs in mainland areas are quite complex and, moreover, the area from which the species is removed can be easily recolonized (Bryce *et al*., 2011). For these reasons, this carnivore is likely to persist in Spain over a long period of time. Therefore, it is important to acquire further information about the epidemiological role of this mustelid in the maintenance and diffusion of infectious pathogens. The aim of this study was to describe the gastrointestinal and cardiorespiratory macroparasites of the American mink in Galicia (NW Spain), an area where the species is present since the 1980s.

2 MATERIAL AND METHODS

2.1 Sampled animals

American mink included in this study were caught in river basins from Lugo, Ourense and Pontevedra provinces (Galicia, northwest Spain). The climate in Galicia is predominantly oceanic. The average annual rainfall is 1180 mm, with a homogeneous distribution throughout the year, and the average annual temperature is 13.3°C, with limited yearly variations (Castillo-Rodríguez *et al.*, 2007).

Between 2008 and 2014, fifty American mink (the sample distribution by sex, age and month of capture is shown in Table 1) were captured during the official control plan implemented by the Galician administrative authority (Consellería de Medio Ambiente, e Ordenación do Territorio).

Captured mink were sent to the Wildlife Recovery Centers of O Veral (Lugo), O Rodicio (Ourense) and Cotorredondo (Pontevedra), where animals were euthanized by the veterinary staff, under current Spanish and European Animal Welfare Legislation.

2.2 Laboratory procedures

Digestive and cardiorespiratory tracts of the necropsied mink were removed and individually stored in labelled plastic bags. All samples were frozen (-20°C) and sent to the Veterinary Faculty of Murcia for parasitological evaluation.

The digestive viscera (stomach, small and large intestine, liver and esophagus) were analyzed. Sections of the alimentary tract were longitudinally opened and scraped, the content was washed over a sieve (mesh size 0.3 mm diameter), and both content and mucosa were observed under a stereomicroscope to detect helminth specimens. Liver parenchyma was sliced and bile ducts and gallbladder were opened and also examined using a stereomicroscope. Heart, pulmonary veins and pulmonary arteries were carefully separated from trachea and lungs. Trachea, bronchial tree and pulmonary blood vessels were longitudinally opened, washed over a sieve 0.3 mm diameter and, subsequently, the retained material was observed by stereomicroscope. To investigate the presence of lung larvae, the filtrated liquid was collected and examined using the Baermann larval migration technique. Once completed the examination of the lung parenchyma by stereomicroscope, this tissue was also analyzed with the same technique. In cases where bronchopulmonary larvae were detected, lung parenchyma was cut into small stripes (approximately 0.5 cm diameter) and, subsequently, enzymatically digested in freshly prepared 1.5% (w/v) pepsin (1:10000 activity) and 1.5% (w/v) chlorhydric acid in distilled water in order to isolate adult nematodes. Digestion was carried out at 40ºC for 1h under gentle shaking, after which the undigested remains were filtered through a sieve of 63 µm diameter to collect the nematodes. Finally, the heart chambers and the major blood vessels were carefully opened, washed, and the resultant liquid was filtered through a 63 µm sieve before stereomicroscopic examination of the retained material.

2.3 Parasite identification

Parasites collected from each American mink were washed in distilled water, counted and stored in tubes with 70% ethanol for further examination. For taxonomic identification purposes, nematodes were cleared with lactophenol, while flukes were stained with Semichon's acetic carmine (Schmidt, 1986). Parasites were morphometrically identified attending Skrjabin (1964), Skrjabin and Petrow (1928), Yamaguti (1971), Butterworth and Beverley-Burton (1980), Janchev and Genov (1988), Mascato *et al.* (1993), Popiolek *et al.* (2009) and Gherman *et al.* (2016).

2.4 Statistical analyses

Prevalence, intensity and abundance were calculated for each parasite genus or species according to Bush *et al*. (1997), as well as parasite richness (number of parasite species per host). Data obtained from parasitological analysis (prevalence, intensity, richness – considered as dependent variables) and host characteristics (sex, age, weight, capture area, month and season of trapping – considered as risk factors) were analysed using a Generalized Linear Models (GLM).

Different distribution families were used for the GLM analysis, according to the distribution of the dependent variable. A binomial distribution was used to analyse prevalence, both Poisson and negative binomial distributions were tested for intensity and, finally, a Poisson distribution was used for richness. The multivariate analysis for prevalence was carried out only for the species whose prevalence was higher than 10%, while the analysis of intensity and richness considered all parasite species. A stepwise approach and the "Akaike information criterion (AIC) were used to select the best model " (Akaike, 1974). Significant level was considered for $p<0.05$

Statistical analysis was performed using the software R 3.1.0 (R Core Team, 2014). The package MASS was used to apply the negative binomial GLM.

3 RESULTS

Six nematode and two trematode species were recovered. Eighty-two percent of mink (41/50, C.I. 95% = 70.9-93) harbored at least one helminth species, 52% (26/50, C.I. 95% = 37.6-66.3) were infected with two or more species, and a maximum of four species were detected in 4% of mink (2/50, C.I. 95% = 0-9.6%).

Prevalence, median intensity and median abundance of these helminths are shown in Table 2. *Angiostrongylus daskalovi*, *Aelurostrongylus* spp., *Troglotrema acutum* and the unidentified trematode were found only in male mink. *Aelurostrongylus* spp. was found only in one adult mink, whereas *T. acutum* and the unidentified trematode were only found in one immature animal, respectively.

Statistically significant influence of some risk factors were detected in models only for intensity of *Molineus patens* and*, Aonchotheca* (*Capillaria*) *putorii*. Concretely, the best model explaining the intensity of *M. patens* selected the sex and season (AIC=253.6; explained variance = 46.6%), with males and spring showing a lower *M. patens* intensity. Regarding *A. putorii*, the best models selected the age and season, detecting the lower intensity in subadult mink and in winter (AIC=192.34, explained variance = 31.5%); specifically, mink captured in July showed higher intensity of this nematode species ($p<0.001$).

No significant effect of the studied factors was observed for prevalence and parasite richness.

4 DISCUSSION

The overall prevalence of helminths in our study is similar to the one described in American mink from Southwest of France (81%) (Torres *et al.*, 2008) and Belarus (78%) (Shimalov and Shimalov, 2001). However, it should be noted that the number of parasitized animals in our study differs considerably from the results described by Torres *et al.* (2003) in American mink from 12 Spanish provinces; these authors divided their sample in two groups: one including American mink from areas where European mink was present, and the other group with American mink captured in areas where the European mink was absent. In this study, the prevalence was significantly lower than in our study (respectively 35.5% and 48.0%).

Moreover, parasite richness (eight species) and helminths identified in our study differ from the values recorded in other European areas. Concretely, Shimalov and Shimalov (2001) found higher parasite richness (19 species) in Belarus. In the same country, Sidorovich and Anisimova (1997) found a higher richness in American mink captured in less polluted areas than in those from contaminated ones (17 and 12 species, respectively). Our results are closer to those described in Torres *et al.* (2008) in France (richness of nine species) and to the seven species that had been previously described in American mink captured in Spain (Torres *et al.*, 2003). According to these authors, a greater number of species may be associated to an earlier host adaptation to the area. In this sense, American mink has been described as invasive species in Belarus since the 50s of last century (Sidorovich, 1993) and, therefore, this nonindigenous mustelid has shared habitat for a longer time with the native parasite fauna than the American mink in Galicia. However, this wide parasite richness also includes some helminths that could have been introduced in Belarus carried by the American mink from its natural distribution area, as may happen with *Baylisascaris devosi, Capillaria mustelorum, Metorchis albidus* and *Apophallus donicus* (Anisimova, 2004). Furthermore, differences in parasite richness between Galicia and Belarus could be due to the wide expansion of American mink in Belarus, since parasite richness tends to increase when the host species is distributed along greater territories (Morand, 2015). In this sense, according to Bonesi and Palazón (2007), American mink is much more spread in Belarus than in Spain. So, it is reasonable to assume that, if American mink continues its expansion across the Iberian Peninsula, it could increase its parasite richness, acquiring a new epidemiological role in the maintenance and diffusion of parasites shared by other autochthonous mustelids.

So far, all the helminth species found in American mink captured in Spain are native from European mustelids (Torres *et al.*, 2003, 2006), as also in our study. These findings suggest that American mink lost their original helminths during its adaptation to Iberian environments (Torchin *et al.*, 2003) or, as the feral populations comes from animals raised in fur farms, it is possible that these American mink were treated against parasites, eliminating their specific parasites. It is well known that, in the case of alien invasive species released without previous antiparasitic treatment, it is possible the parasite adaptation to new habitats and autochthonous hosts; for example, Tizzani *et al.* (2011) found *Obeliscoides cuniculi* in European brown hare, probably introduced by the invasive Eastern cottontail rabbit (*Sylvilagus floridanus*) in areas where both lagomorphs live in sympatry (Tizzani *et al.*, 2011, 2014). Our results suggest that American mink from Galicia is currently playing an epidemiological role in the maintenance of the life cycle of native European parasites, but fortunately not of alien parasites whose establishment in the invaded areas could have unpredictable consequences on European mustelids, with the risk of changes in the composition of host-parasite communities, and the incidence of polyparasitism within individual hosts (Polley and Thompson, 2015).

Molineus patens was the most prevalent parasite in our study (68%). This gastrointestinal nematode is frequently found in Iberian mustelids (Feliú *et al.*, 1991; Motjé, 1995; Torres *et al.*, 1997). In the authors knowledge, this is the greatest record described in European studies to date: 50% in France (Torres *et al.*, 2008), 9.7% in Spanish areas where American mink share habitat with European mink and 36% in the rest of Spain (Torres *et al.* 2003), and 8% in Belarus (Shimalov and Shimalov, 2001). According to Poulin and Mouillot (2003) and Sherrard-Smith *et al*. (2015), nonindigenous host species that have lost their natural parasites tend to acquire generalist parasites from other local host species. Our results indicate that American mink is a competent host for *M. patens*, a parasite common to Palearctic mustelids, contributing to its transmission and natural nidality in Galicia. In our study, males showed a significantly lower *M. patens* intensity than females, and spring was the season with a lower intensity. However, the heterogeneity of the sample not allow to establish any conclusion, and therefore further studies are necessary in order to improve the knowledge of these and other epidemiological aspects.

We also found the gastric nematode *A. putorii*, one of the most common parasite of mustelids worldwide. Although host's infection is usually associated to the direct ingestion of this parasite's eggs, it has also been described the role of earthworms as paratenic hosts (Anderson, 2000). Prevalence of *A. putorii* recorded in Galicia was considerably higher than the ones observed in other European areas: 25.8% in American mink captured in shared areas with European mink in Spain, and 12% in other Spanish territories (Torres *et al.*, 2003); 20% in Belarus (Shimalov and Shimalov, 2001); and 18.42% in France (Torres *et al.*, 2008). As in the case of *M. patens*, the high prevalence of *A. putorii* indicates that American mink is a well host involved in the natural nidality of this parasite in Galicia. In our study, the intensity of parasitic infection by *A. putorii* was significantly lower in subadult mink and in winter but, as in the above-mentioned case of *M. patens*, we have no sound arguments to justify these results that should be contrasted with future studies.

Crenosoma melesi is the third more prevalent (10%) parasite found in American mink from Galicia. Until now, this cardiorespiratory nematode has been cited only in American mink captured in Europe (prevalence of 2%) by Torres *et al.* (2003), but not in America. It has also been described in badger and other Iberian mustelids (Torres *et al*., 1997, 2001). This parasite has an indirect life cycle with slugs and snails as intermediate hosts (Anderson, 2000), indicating that these gastropods are part of the trophic resources of American mink in Galicia (Melero *et al.*, 2008a). The remarkable prevalence found in our study suggests that American mink is a competent host for *C. melesi*, and provides evidence that this alien mustelid could impact on native mustelid populations by means of a spillback effect (Kelly *et al*., 2009).

To our knowledge, this is the first report of a nematode belonging to the genus *Angiostrongylus* in American mink. The enzymatic digestion of lung parenchyma has probably facilitated the isolation of this cardiorespiratory nematode since it is frequently found into the small vessels of lungs. In addition, this procedure is highly useful to avoid the underestimation of mustelid's respiratory helminths due to the scarce amount of pulmonary tissue usually obtained, allowing the detection of most of these small nematodes. The morphometric characteristics do not adjust to those of *A. vasorum*, a parasite recovered from domestic and wild canids worldwide (Segovia *et al.*, 2001; Conboy, 2004; Bourque *et al.*, 2008; Morgan *et al.*, 2008; Gerrikagoitia *et al*., 2010; Eleni *et al.*, 2013), and also described in Eurasian badger (*Meles meles*) from Spain (Miquel *et al*., 1993; Feliú *et al*., 1996; Torres *et al.*, 2001). Specimens isolated in our study were identified as *A. daskalovi* according to Janchev and Genov (1988) and Gherman *et al.* (2016). This nematode has been previously cited in pine marten (*Martes martes*), stone marten (*Martes foina*) and badger from Bulgaria (Janchev and Genov, 1988), and in badgers from Spain and Romania (Gerrikagoitia *et al*., 2010; Gherman *et al.*, 2016). Our findings are consistent with the hypothesis that an alien host species can be a competent host for native parasites, increasing the risk of transmission to other indigenous mustelids by parasite spillback (Kelly *et al.*, 2009). In other words, American mink is a new host that participates in the indirect life cycle of *A. daskalovi*, acting as reservoir host that could change the epidemiological dynamics of this parasite and, consequently, producing a negative impact on native mustelids.

We have also identified *Aelurostrongylus* spp. in one adult American mink. Morphometric characteristics of the unique specimen found do not match with *Aelurostrongylus pridhami*, the species previously described in Eurasian badger (Torres *et al.*, 2001) and European mink (Torres *et al.*, 2003). Unfortunately, the nematode was cleared in lactophenol for the morphometric exam and it was not possible to analyze by PCR. *Aelurostrongylus* shows an indirect life cycle with slugs and snails as intermediate hosts (Anderson, 2000). As for *A. daskalovi* and *C. melesi*, the presence of this respiratory nematode in American mink indicates that it is a well-adapted host for native metastrongyloid species present in Galicia, participating in its life cycle owing to the abundance of gastropods in riparian areas, which probably form part of the mink's diet.

In our study, *A. annulosa* was isolated from the small intestine of four mink, even though this capillarid nematode is usually located in the small intestine of various species of rodents (Mascato *et al.*, 1993; Feliu *et al*., 1997). Taking into account that rodents are part of the diet of American mink (Melero *et al.* 2008a; Morales *et al.*, 2010), the finding of *A. annulosa* in this mustelid could be considered as a pseudoparasite due to the ingestion of infected rodents. However, nematodes in our study did not show any kind of degradation attributable to the digestion process, and all specimens were found in the small intestine (the usual microhabitat of *A. annulosa*), but not in stomach or large intestine; moreover, fertile female nematodes (with eggs inside) were recovered, as a proof of the species viability and its reproductive capacity into the small intestine of the American mink. In fact, *A. annulosa* has been previously described in other mammals different to rodents; in this sense, Umur *et al.* (2012) found *A. annulosa* in a Hamadryas baboon (*Papio hamadryas*) from a zoo in northern Turkey, attributing the infection to the ingestion of infective eggs expelled in the feces by a rodent. In our opinion, the finding of *A. annulosa* in the American mink indicates that this mustelid could have acquired the infection through the ingestion of embryonated eggs or invertebrates infected with third-stage larvae (Anderson, 2000). It could be interpreted as further evidence that native parasites are able to take advantage of the mink´s presence to acquire a new host in the invaded habitat.

This is the first time that *T. acutum* is recorded in American mink from the Northwest of the Iberian Peninsula. This trematode was detected in one immature mink. Considering that we did not have the opportunity to examine the head of mink, our results probably underestimate the prevalence of *T. acutum* in Galicia, because its usual anatomical location are the nasolacrimal sinuses (Koubek *et al.*, 2004; Torres *et al.*, 2006). According to Koubek *et al.* (2004), the European polecat is the main definitive host, although other mustelid species could act as hosts and may contribute to the maintenance of this cranial fluke in the environment (Ribas *et al*., 2012), whose life cycle includes prosobranch snails and amphibians as intermediate hosts (Vogel and Voelker, 1978; Koubek *et al.*, 2004). This parasite causes suppurative osteomyelitis and severe injuries to the skull bones (Jubb and Kennedy, 1963; Koubek *et al.*, 2004; Torres *et al.*, 2008). In Europe, the highest prevalences of *T. acutum* in American mink have been recorded in France (33%) by Torres *et al.,* 2008) and in Álava (North of Spain), where the prevalence was 30.4% (Torres *et al.*, 2006). In our study, we found seven specimens of *T. acutum*, all of them collected from the lung parenchyma. Since three of these trematodes were mature specimens, this finding indicates that *T. acutum* is able to originate ectopic foci and, moreover, to complete its development in the lung parenchyma of the American mink. This anatomical location could drive to even more severe pathological consequences than those assumed so far; unfortunately, the histopathological study to confirm the tissue damage could not be carried out as lung tissue was not preserved after dissection.

We found only one species of digestive trematode in our study. Concretely, twenty-seven immature specimens were isolated from the liver and the small intestine of a mink but, unfortunately, the morphometric identification was not completed due to their poor preservation status. In Europe, *Ascocotyle* spp., *Euparyphium melis*, *Pseudamphistomum truncatum* (whose intermediate hosts are fish) and *Euryhelmis squamula* (with amphibians as intermediate hosts) have been detected in American mink (Shimalov and Shimalov, 2001; Torres *et al*. 2008; Hawkins *et al*. 2010). In Spain, *E. squamula* is the only trematode species cited in American mink, showing a low prevalence (2-3.2%) (Torres *et al*., 2003). Despite fish and amphibians have been described as a main component of the diet of American mink in Galicia (Vidal-Figueroa and Delibes, 1987), recent studies (Romero, 2013; 2015) have demonstrated that its diet is focused mainly on rodents and other terrestrial animals, reducing the ingestion of aquatic and riparian preys in habitats where otter populations are expanding (Bonesi *et al*., 2004). So, the scarcity of digestive flukes in American mink from Galicia could be due to the diet of this allochthonous mustelid.

Any of the analyzed American mink was parasitized by cestodes. However, *Taenia martis* and *Taenia tenuicollis* have been previously cited in this mustelid from Spain with a prevalence of 2% and 3.2%, respectively (Torres *et al*., 2003). In France, Torres *et al*. (2008) found *T. tenuicollis* in European polecat (12.1%), but not in American mink. In Belarus, Shimalov and Shimalov (2001) detected *T. mustelae* (synonym *T. martis*) with a low prevalence (4%), and *Spirometra erinacei* larvae (10% prevalence) in American mink. According to Vidal-Figueroa and Delibes (1987) and Romero (2013, 2015), the diet of the American mink in Galicia includes small mammals (the intermediate hosts of all these tapeworms) but, as mentioned above, these helminths were not detected in our study. These results could indicate that cestodes are not frequent in the mustelid species present in Galicia.

As shown in the present study, American mink is an invasive species that can acquire parasites from the indigenous host species with which this mustelid shares habitat, and thus, may achieve a relevant epidemiological role on these parasites' natural nidality. Moreover, our results pointed to an unpredictable environmental impact of these adaptive phenomena, mainly in other mustelid species that inhabit the same area, since parasites from different host species are included, as happens with *A. daskalovi*. The American mink can contribute to the dispersion of these parasites among populations of native mustelids in Spain. This can turn into a severe conservation challenge for endangered species such as the European mink. In this sense, we recommend the parasite monitoring of American mink populations in habitats where this allochthonous mustelid are present, mainly in new areas of invasion.

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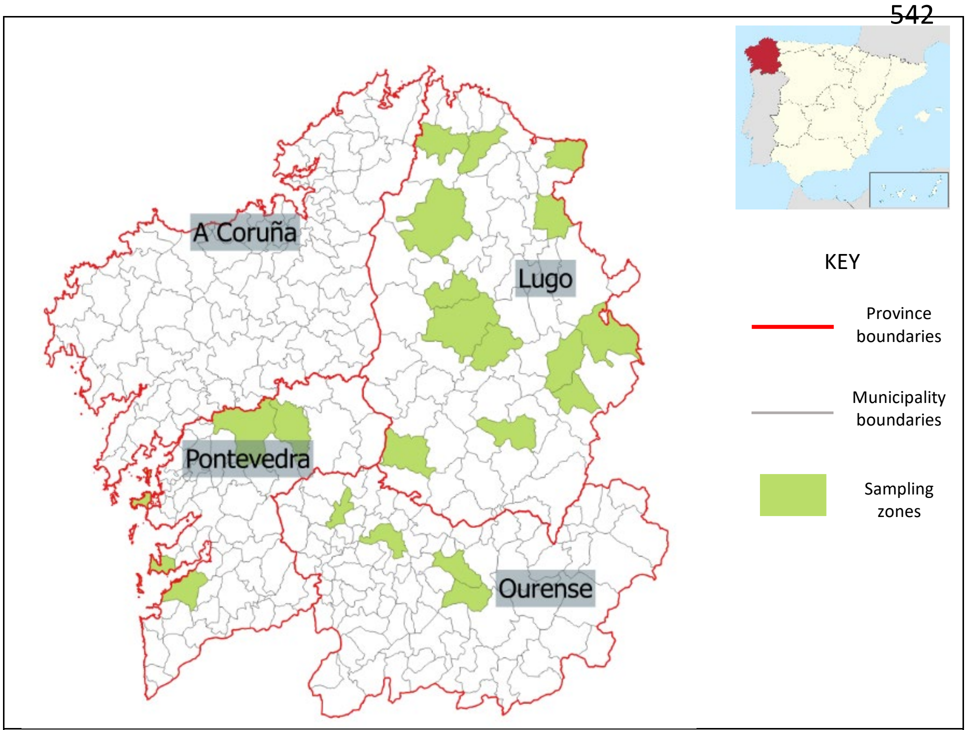

Figure 1
Map showing the sampling zones in Galicia (northwestern Spain).

Table 1
Distribution of the American mink (n=50) by month of capture, sex and age.

Month	Number of mink				
	Sex		Age		Total
	Male	Female	Immature	Adult	
January	1	0	0	1	1
February	10	2	5	7	12
March	6	2	3	5	8
April	1	0	1	0	1
May	4	2	2	4	6
June	0	2	2	0	2
July	3	4	5	2	7
August	2	0	0	2	2
September	2	0	0	2	2
October	1	0	0	1	1
November	3	2	2	3	5
December	2	1	1	2	3
Total	35	15	21	29	50

Table 2

Gastrointestinal (*) and cardiorespiratory (**)parasites recovered from 50 American mink captured in Galicia, Spain.

	Prevalence % (95% C.I.)					Range	Median intensity ±SD	Median abundance ±SD
	Total	Sex		Age				
		Male	Female	Immature	Adult			
*Molineus patens**	68 (54.6-81.3)	77 (62.5-91.7)	46.6 (18.0-75.2)	59.0 (36.7-81.4)	75.0 (57.9-92.0)	1-193	8.0±33.6	5.0±28.8
*Aonchotheca putorii**	54 (39.6-68.3)	57.1 (39.8-74.3)	46.6 (18.0-75.2)	50.0 (27.3-72.6)	57.1 (37.6-76.6)	1-83	5.0±21.7	1.0±17.1
*Crenosoma melesi***	10 (1.3-18.6)	11.4 (0.3-22.5)	6.6 (0.0-20.9)	9.0 (0.0-22.1)	10.7 (0.0-22.9)	1-42	1.0±18.2	0.0±5.9
*Aonchotheca annulosa**	8 (2-15.7)	8.5 (0.0-18.3)	6.6 (0.0-20.9)	4.5 (0.0-13.9)	10.7 (0.0-22.9)	2-29	10.5±11.7	0.0±4.6
*Angiostrongylus daskalovi***	6 (0-12)	8.5 (0.0-18.3)	0	9.0 (0.0-22.1)	3.5 (0.0-10.8)	1-3	2.0±1.0	0.0±0.52
Aelurostrongylus spp.**	2 (0-6)	2.8 (0.0-8.6)	0	0	3.5 (0.0-10.8)	1	-	-
*Troglotrema acutum***	2 (0-6)	2.8 (0.0-8.6)	0	4.5 (0.0-13.9)	0	7	-	-
Trematode spp. † *	2 (0-6)	2.8 (0.0-8.6)	0	4.5 (0.0-13.9)	0	27	-	-

† Genus was not determined due to the poor preservation status of these specimens

547