

A survey of recent introduction events, spread and mitigation efforts of mynas (*Acridotheres* sp.) in Spain and Portugal

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Abstract

A survey of recent introduction events, spread and mitigation efforts of mynas (Acridotheres sp.) in Spain and Portugal.— The common myna *Acridotheres tristis* is listed among the world's 100 worst invasive alien species. We combined previous records with a field survey to update the extent and fate of myna introductions in Spain and Portugal. Results suggest that there have been at least 22 independent accidental introductions of three myna species throughout the Iberian peninsula and three archipelagos since the early 1990s. While bank mynas (*A. ginginianus*) did not become established elsewhere, common mynas reached breeding populations on four islands. Eradication efforts allowed the extirpation of these breeding island populations, but common mynas continue to breed in the Tagus Estuary (continental Portugal). In this region, there is also a breeding population of crested mynas (*A. cristatellus*), which was undergone an exponential population growth in the last decade. To avoid further accidental introductions, eradication campaigns should be combined with preventive actions aiming to stop the trade of these species in Europe.

Key words: Bank myna, Common myna, Crested myna, Eradication, Introduction pathways

Resumen

Un estudio sobre los recientes episodios de introducción, la propagación y las iniciativas de mitigación de los minás (Acridotheres sp.) en España y Portugal.— El miná común, *Acridotheres tristis*, está catalogado entre las 100 especies más invasoras del mundo. En el presente artículo combinamos las observaciones ya existentes con un estudio de campo para determinar los procesos de invasión de tres especies de minás en España y Portugal. Los resultados sugieren que hubo al menos 22 introducciones accidentales e independientes desde comienzos de los años 90 en la península ibérica y en tres archipiélagos. Si bien el miná oscuro (*A. ginginianus*) no ha llegado a establecerse, hay poblaciones reproductoras de miná común en cuatro islas. Las iniciativas de erradicación permitieron eliminar esas poblaciones insulares, pero la especie se mantiene en el estuario del Tajo (Portugal). En esta región existe también una población reproductora de miná crestado (*A. cristatellus*), que ha crecido exponencialmente en la última década. Es necesario combinar las campañas de erradicación con acciones preventivas, cuyo objetivo sea detener el comercio de estas especies en Europa, para evitar nuevas introducciones accidentales.

Palabras clave: Miná oscuro, Miná común, Miná crestado, Erradicación, Vías de introducción

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Introduction

Mynas (Family Sturnidae) are medium-sized, omnivorous passerine birds native to south east Asia (Feare & Craig, 1998). The common myna (*Acridotheres tristis* Linnaeus 1766) has been traded worldwide as a cage-bird species and was often deliberately introduced to control insect plagues. It has been introduced in at least 15 continental countries and 17 archipelagos and is considered among the world's 100 worst invasive alien species (Lever, 2005). The introduction of common mynas is of great concern. Besides being considered a crop pest, it spreads invasive plant species, and may contribute to the decline and even extinction of native bird species through competition for food and nest sites, predation of eggs and nestlings, and transmission of parasites and diseases (Feare & Craig, 1998; Lever, 2005). These ecological and economic impacts have led to the common myna being listed among the world's 100 worst invasive alien species (Lowe et al., 2004). Although much less intensively, up to six other myna species have been introduced outside of their native ranges during the last two centuries, in many cases resulting in established populations (Lever, 2005). Some introductions are relatively recent, such as the introduction of crested mynas (*Acridotheres cristatellus* Linnaeus 1766) in 1982 in Argentina, an event which resulted in an established and further spread population (Bassó et al., 2012).

While the fate of early introductions of mynas and other bird species has been reported in detail (Lever, 2005), continuing introductions and changes in vectors of transport mean that catalogues of introduced bird species are becoming increasingly outdated (Blackburn et al., 2010). Accounts of recent introduction events and established populations are thus needed to avoid biases when inferring patterns and processes of avian invasions (Blackburn et al., 2010). Such information is crucial when dealing with species like mynas that potentially cause serious impacts because early detection of newly introduced populations makes them easier to control and eradicate (Edelaar & Tella, 2012). Information on myna species introduced in Europe is scarce and outdated (Lever, 2005), and there is a continuous risk of accidental introductions because these birds are available in pet shops in several European countries (Carrete & Tella, 2008; author's unpublished information). Here, we explore the spatial distribution and spread of mynas in Spain and Portugal as well as the success of efforts taken to mitigate this invasion. We used an intensive search of ornithological resources, completed with a field survey, revealing multiple introduction events, the control and eradication of some populations and the spread of others, for three species of mynas (common myna, crested myna, and bank myna *A. ginginianus* Latham 1790) introduced in recent decades. The aim of this study was to briefly inform on the spatial distribution and fate of recent introductions in these two southern European countries.

Methods

We attempted to compile all published and unpublished records of myna species in Spain and Portugal, thus covering the entire Iberian peninsula and the Canary, Balearic, Madeira and Azores archipelagos. We searched observations of non-native species in Spain and Portugal from 1912 to 2012 (see Sanz-Aguilar et al., 2014 for the same approach). Our search involved a systematic review of two national peer-reviewed journals (*Ardeola* from Spain and *Airo* from Portugal), five national and regional bird atlases, 26 regional ornithological yearbooks and monographs, and 11 websites that compile bird observations or photographs of birds in Spain and Portugal (two of them devoted to exotic birds). Records were completed using our own data and unpublished observations from 45 experienced ornithologists. All localities were geo-referenced, and the data recorded included date, number of individuals observed, and any evidence of proven reproduction (e.g., active nests, fledglings accompanied by parents). As a demonstration of the robustness of the searching effort, we compiled > 13,000 observations (involving almost 76,000 individuals) from > 370 species of non-native bird species observed in the wild in Spain and Portugal (contrasting with the just nearly 60 species recorded for the same countries by the most recently updated European catalogue; DAISIE, 2015). All this information and searching sources will be published elsewhere (Abellán et al., in prep.). Regarding records of myna species ($n = 247$), 77% were obtained from web sites, 15% from printed sources, and 8% from our own observations. The three myna species are easily identifiable in the field and the compiled observations were often accompanied with photographs. Moreover, 15 localities where mynas were reported were visited by the first author, allowing us to confirm the identity of the species. Therefore, we feel the data compiled here are reliable.

Based on the compiled records, we planned a field survey in the area with most of the recent observations of mynas (surroundings of Tagus Estuary, Portugal) during the 2011 breeding season. The survey was conducted between June 3 and June 17, visiting 11 sites with previously known presence of mynas to obtain baseline information on their distribution and rough estimates of their minimum population sizes. We looked for mynas by walking across urban and peri-urban areas where the species were previously observed. To obtain a minimum population estimate, we noted the maximum number of birds simultaneously observed at each site, thereby avoiding double-counting. Our aim was to obtain a first population assessment and to infer whether populations were increasing in an area where no control/eradication actions were undertaken.

Results

We compiled 133 observations of common mynas (involving at least 405 individuals) in Spain and Portugal. Records (the first obtained in 1993) were scattered in

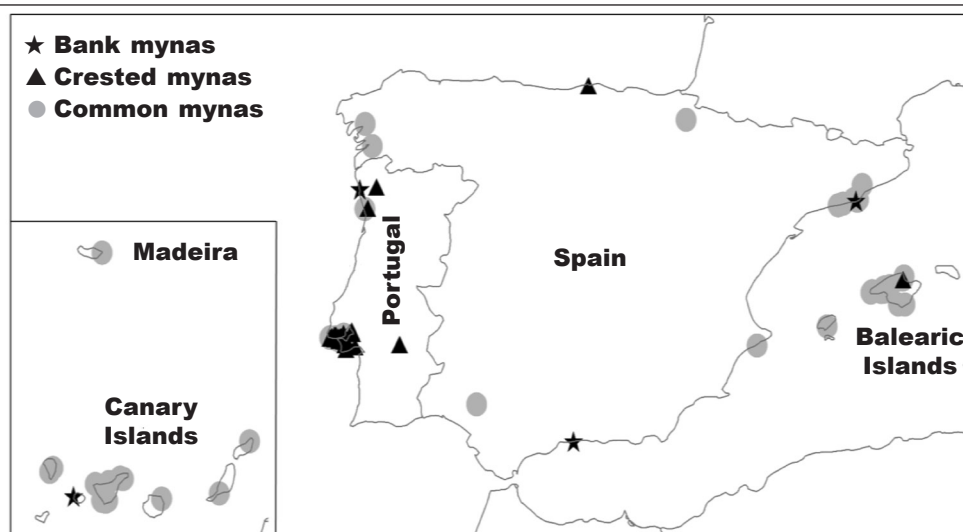


Fig. 1. Distribution of records of common mynas, crested mynas, and bank mynas in Spain and Portugal.

Fig. 1. Distribución de los registros de minás comunes, minás crestados y minás ribereños en España y Portugal.

space and time throughout the Iberian Peninsula, and from eight islands in the Balearic and Canary archipelagos and Madeira (fig. 1), suggesting they were the result of independent introduction events. The first confirmed reproduction was reported in 1993 in Tenerife, followed by reports in Gran Canaria in 2002, Fuerteventura in 2006 (islands within the Canary archipelago), and Mallorca (in the Balearic archipelago) in 2001. Several control campaigns were conducted on these incipient breeding populations between 1999 and 2008, leaving only four free birds after removing 24 individuals in Fuerteventura (a further expedition to the island in 2010 verified that there were no free mynas), seven in Mallorca after removing 10 individuals (the remaining seven birds were later shot by regional wildlife authorities in April 2007), and two in Tenerife after removing 10 individuals by 2009 (these two were not seen again). No further records of the species have been reported for Fuerteventura, Gran Canaria (where the three free-living individuals were removed) or Mallorca, where the species no longer exists. However, two fledglings accompanying an adult myna were observed in Tenerife in 2012 and were shot by regional wildlife authorities in 2013.

In continental Spain, observations of common mynas seem to correspond to isolated and independent introduction events (fig. 1) and reproduction has not been confirmed. In continental Portugal, however, observations of the species were continually reported from 2001 to 2012 ($n = 23$ reports, groups of up to five individuals), suggesting that there is a breeding population in the estuary of the Tagus River (fig. 2). Reports correspond to urbanized areas of Lisbon, Belem, Cascais, Oeiras, Corroios and Caparica

(fig. 2). During our field survey in June 2011 (see results in appendix 1), we observed a group of about 10 individuals in a colony of crested mynas nesting in a limestone cliff in Caparica. These birds were observed in the breeding colony in three separate days (7, 15–17 VI 11), and thus their reproduction in the colony was highly probable. Moreover, a photograph from an observer in Oeiras in 2008 showed an intermediate phenotype between common and crested mynas, potentially representing the natural hybridization of these species in the area.

The number of records obtained for crested mynas ($n = 103$) from 1997 to 2012 was similar, involving a larger number of observed individuals ($n = 772$). Contrary to the widespread distribution of localities occupied by common mynas, most records of crested mynas came from the surroundings of the Tagus Estuary, Portugal (figs. 1, 2). Both the number of records and the number of individuals of crested mynas observed have increased dramatically in recent years in this area (inset in fig. 2). Our survey conducted in June 2011 (appendix 1) rendered a minimum population of 239 individuals, with about 100 individuals counted in Corroios, about 100 in a cliff-nesting colony in Caparica, 26 in Oeiras, nine in Belem, and four in Estoril. The true population is likely higher because time constraints impeded a thorough survey of the entire potential area occupied by the species as well as a more accurate census. We confirmed the reproduction of the species in Caparica, Oeiras, and Belem (appendix 1), mostly through the observation of adults feeding chicks in nests found in buildings and on a large limestone cliff in a periurban area. Only seven records of crested mynas were obtained outside this area (fig. 1), one

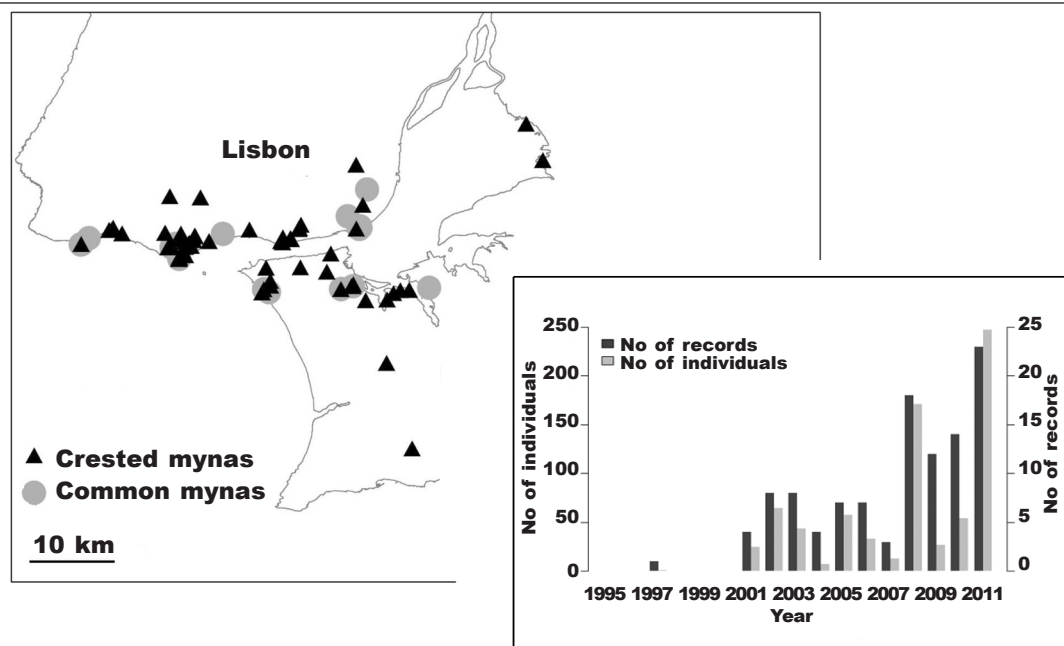


Fig. 2. Detailed distribution of crested and common mynas in the Tagus Estuary, Portugal. Inset: increase in the number of records and of observed individuals of crested mynas obtained through compiled records.

Fig. 2. Distribución detallada de los minás crestados y comunes en el estuario del Tajo, en Portugal. Recuadro: aumento en el número de registros y de individuos de miná crestado observados obtenidos a través de los registros recopilados.

in Evora (PO, 2006), one in Porto (PO, 2012), one in Braga (PO, 2012), three in Santander (SP, 2004, 2007–2008), and one in Mallorca (Balearic Islands, SP, 2002), all corresponding to single individuals and suggesting independent accidental escapes of cage birds.

Only 11 records, involving 21 observed individuals, were made of bank mynas between 2003 and 2010. These records were from three continental sites—one in Portugal and two in Spain—and one site in the Canary Islands (La Gomera) (fig. 1). All but one record corresponded to two individuals, and the other to a single individual. The spatio-temporal distribution of records also suggests independent, accidental introductions of this species. There is no evidence of reproduction in any locality. However, three individuals captured during eradication activities in Gran Canaria in 2006 showed a phenotype that suggested the hybridization between bank and common mynas.

Discussion

The global compilation of introduced bird species made by Lever (2005) reported only two old records of common mynas breeding on two Spanish islands, and Saavedra (2010) summarized the eradication attempts of the species in the two Spanish archipelagos. The Delivering Alien Invasive Species Inventories for Europe (DAISIE, 2015) lists the common myna

as unestablished in Spain and the crested myna as established in Portugal, with no additional information on their introduced populations. Here, we show a larger spatial and temporal scale for the introduction of up to three species of mynas, together with their population trends. Most introductions took place in the last decade, and several reproduction events were subsequently reported. The relative temporal synchrony and widely spaced distribution of records (fig. 1) suggest that there were at least 22 independent introduction events. Contrary to the previously reported deliberate introductions of mynas elsewhere (Lever, 2005), we did not find evidence of intentional introductions in Spain and Portugal. Wild-caught mynas of the three species were traded from their native ranges to Spanish and Portuguese cage-bird markets until 2005, and the accidental escapes of wild-caught birds may explain their successful establishment in the wild (Carrete & Tella, 2008; Cabezas et al., 2013). The lack of observations of individuals banded with closed rings (typical of captive-bred birds) provides further evidence of their wild-caught origin. Moreover, three introductions could be attributed to escapes from owners after buying the birds in pet-shops and one from a zoological garden on four Spanish islands (Saavedra, 2010), and further records compiled here confirm the escape from a zoo on another island and the escape from a particular owner in continental Spain.

The relatively rare introductions of bank mynas did not result in established populations. The common myna, however, have established breeding populations on four Spanish islands and, despite eradication efforts (see details in Saavedra, 2010), one pair was again breeding in Tenerife in 2013 and one individual appeared on another Canary island (Lanzarote) in 2013. Moreover, there is sufficient evidence to suggest that the species is breeding in the Tagus Estuary (Portugal) where it has been observed since 2001 and where we found up to ten individuals in a breeding colony of crested mynas. Continuous breeding of this small nucleus together with further accidental releases may increase population sizes in the future. The crested myna, however, is today of greater concern since it is now widely distributed throughout the Tagus Estuary and the number of records and of observed individuals has dramatically increased during the last decade. Given the typical lags in population growth of introduced exotic bird species (Aagaard & Lockwood, 2014), the continued growth and spread of the species throughout the Iberian Peninsula is expected in the absence of management action.

Eradication and control campaigns of common mynas occur worldwide due to their recognized ecological and economic impacts (e.g., Saavedra, 2010; Grarock et al., 2014). However, most impacts have been identified on islands (Lever, 2005) and the negative effects of mynas could be smaller in urbanized continental environments (Haythorpe et al., 2014). Introduced mynas often behave as urban exploiters and thus may have little impact on native communities (Sol et al., 2012; Orchan et al., 2013). However, recent work has shown that a typical urban dwelling exotic bird (the ring-necked parakeet *Psittacula krameri*) outcompetes most native species through aggressive interactions and may be the cause of the decline of two threatened species in a Spanish city (Hernández-Brito et al., 2014). During our short field survey, we circumstantially observed several instances of aggressions of crested mynas foraging in urban environments towards a variety of native species, from smaller-sized (barn swallow *Hirundo rustica*, white wagtail *Motacilla alba*, house sparrow *Passer domesticus*) to similarly-sized (black starling *Sturnus unicolor*, blackbird *Turdus merula*) and much larger-sized species (Eurasian kestrel *Falco tinnunculus*, yellow-legged gull *Larus michahellis*). Moreover, mynas have the potential to spread throughout rural environments where their impact may extend to a wider array of native species (Pell & Tidemann, 1997) and agriculture. While dedicated research is needed to assess the real and potential impact of common and crested mynas in Portugal, and taking into account that the impacts of invasive species are often missed (Davidson & Hewitt, 2014), the application of the Precautionary Principle calls for the eradication of these populations before it becomes unfeasible or economically much more costly (Edelaar & Tella, 2012). In the case of mynas, eradication campaigns has proved to be highly effective when populations are still small (i.e., < 50 individuals), as they were on Spanish islands, but not when populations reach thousands of individuals

as was the case of St. Helena and Ascension Islands (see details on eradication efforts and their results in Saavedra, 2010). These eradication campaigns were preceded by citizen awareness campaigns to achieve a favorable public opinion (Saavedra, 2010). Moreover, eradication of mynas should consider its effects on other coexisting introduced species which may also require management. For example, Shwartz et al. (2009) suggested that common mynas may reduce the breeding success of the also invasive ring-necked parakeet, which in turn impacts on urban mammals and birds (Hernández-Brito et al., 2014a, 2014b), and thus the eradication of mynas might favor population growth of parakeets where these species may coexist (as occurs in Portugal).

Eradication campaigns may be not sufficient to avoid the establishment and spread of mynas if they are not combined with preventive measures. Since 2013, all myna species (*Acridotheres* sp.) have been included in the Spanish Catalogue of Invasive Alien Species, with their possession, release and commercial trade forbidden by law (Real Decreto 630/2013). This greatly helps to reduce the risk of further accidental releases in Spain, but there is no similar legislation in Portugal. Mynas are offered for sale in Portuguese and Dutch pet-shops and online through specialized websites, and are directly shipped to Spain without administrative control (J. L. Tella, unpubl. data). Therefore, a common European legislation against the trade of these and other invasive species is needed to successfully avoid introductions at a national scale.

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Appendix 1. Results of a baseline survey conducted in the Tagus Estuary, Portugal, in 3–17 VI 2011. The maximum number of birds observed from each species of myna in each surveyed site is shown for different dates, as well as whether breeding evidence (B) was found. Numbers for Caparica are approximated, given the difficulties to accurately census the breeding colony.

Apéndice 1. Resultados de un muestreo realizado en el estuario del Tajo, Portugal, 3–17 VI 2011. Se indica el número máximo de individuos observados de cada especie de miná en las diferentes localidades y fechas, así como si se encontraron indicios de que estuvieran reproduciéndose (B). El número de aves en Caparica es aproximado, dadas las dificultades para censar con precisión la colonia reproductora.

Date	Site	Locality	Species	N° birds	B
03 VI 2011	Sana Hotel	Estoril	<i>A. cristatellus</i>	1	
05 VI 2011	San Julia Hotel	Estoril	<i>A. cristatellus</i>	3	
07 VI 2011	Caparica	Almada	<i>A. cristatellus</i> + <i>A. tristis</i>	100 + 10	yes
09 VI 2011	Boca do inferno	Oeiras		0	
09 VI 2011	Train Station Carcavelos	Oeiras	<i>A. cristatellus</i>	4	
10 VI 2011	Cemetery of Oeiras	Oeiras	<i>A. cristatellus</i>	2	yes
10 VI 2011	Ajuda Palace	Belem	<i>A. cristatellus</i>	6	yes
10 VI 2011	Jerónimos Monastery	Belem	<i>A. cristatellus</i>	0	
10 VI 2011	Empire Square	Belem	<i>A. cristatellus</i>	1	
10 VI 2011	Navy Museum	Belem	<i>A. cristatellus</i>	0	
10 VI 2011	Archeological Museum	Belem	<i>A. cristatellus</i>	0	
11 VI 2011	Cemetery of Oeiras	Oeiras	<i>A. cristatellus</i>	2	yes
12 VI 2011	Jerónimos Monastery	Belem		0	
12 VI 2011	Tropical garden	Belem		0	
12 VI 2011	Botanic garden	Belem		0	
12 VI 2011	Ajuda Palace	Belem	<i>A. cristatellus</i>	2	
12 VI 2011	Empire Square	Belem		0	
13 VI 2011	Train St. Carcavelos	Oeiras	<i>A. cristatellus</i>	0	
13 VI 2011	Conde Oeiras school	Oeiras	<i>A. cristatellus</i>	0	
13 VI 2011	Train Station St. Oeiras	Oeiras	<i>A. cristatellus</i>	0	
14 VI 2011	Benfica	Seixal	<i>A. cristatellus</i>	3	
15 VI 2011	Caparica	Almada	<i>A. cristatellus</i> + <i>A. tristis</i>	100 + 10	yes
16 VI 2011	Molino de Mare	Corroios	<i>A. cristatellus</i>	2	
16 VI 2011	Residual water facility	Corroios	<i>A. cristatellus</i>	100	
17 VI 2011	Nato Headquarters	Oeiras	<i>A. cristatellus</i>	4	yes
17 VI 2011	Caparica	Almada	<i>A. cristatellus</i> + <i>A. tristis</i>	100 + 10	yes

