

## The distribution and expansion of the Common Waxbill (*Estrilda astrild*) in the Iberian Peninsula

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**SUMMARY** - The Common Waxbill (*Estrilda astrild*) is a resident species in large parts of Africa, occurring in most areas south of 10° N. However, it has been introduced in many other countries. In Europe it was first introduced in Portugal in 1964; since then, it has spread to much of the country, most likely helped by several new releases. Currently it occurs in Spain in the regions of Galicia, Extremadura, Andalucía, Comunidad de Madrid, Comunidad Valenciana and Catalonia. The data collected on the occurrence of the Common Waxbill in Iberia were used to map its distribution change since 1969 on a five-year basis. Using the 20x20 km grid, at least six release nuclei can now be identified. From there the species initially expanded its range following river valleys and the coastline. Nowadays, in Portugal it is distributed along all the coastline, becoming increasingly scarce in the North. In Spain it occupies only restricted areas. Geographic expansion speed was calculated and analysed from 1969 to 1994. The large success of Waxbill's naturalisation process is due to a high reproductive rate, the species being capable of breeding all year round in certain regions. Although it has been recorded feeding on the same plant species as on the regions of origin, it has adapted to new food resources like agricultural crops. Initially dependent on wetlands, the species has occupied a wide variety of habitats now, but most typically occurs in farmland mosaic with hedges.

**RIASSUNTO** - **Distribuzione ed espansione del Bengalino *Estrilda astrild* nella Penisola Iberica.** Il Bengalino (*Estrilda astrild*) è specie residente in ampie zone dell'Africa, risultando molto diffuso al di sotto dei 10°N. Questa specie è però stata introdotta in molti paesi. In Europa è stato introdotto per la prima volta in Portogallo nel 1964; da allora si è espanso in gran parte del paese, molto probabilmente aiutato in ciò da immissioni successive, ed ora è presente in Spagna in Galicia, Extremadura, Andalucía, Comune di Madrid, Comune di Valencia e Catalonia. I dati raccolti sulla distribuzione del Bengalino in Iberia sono stati utilizzati per mappare i mutamenti del suo areale distributivo a partire dal 1969, ed in base a periodi di 5 anni. Utilizzando una griglia di 20x20Km, possono ora essere identificati almeno sei siti di rilascio. Da qui la specie ha inizialmente espanso il proprio areale utilizzando valli fluviali e coste. In Portogallo la specie è distribuita lungo tutte le coste, risultando più scarsa al nord, mentre in Spagna essa occupa solo aree limitate. E' stata calcolata ed analizzata la velocità di espansione geografica nel periodo 1969-1994. Il grande successo del processo di naturalizzazione del Bengalino è dovuto ad un alto tasso riproduttivo, essendo la specie in grado di riprodursi durante l'intero corso dell'anno in alcune regioni. Sebbene sia stato osservato alimentarsi sulle stesse specie vegetali presenti nella sua regione di origine, il Bengalino si è adattato a nuove fonti di alimento quali alcune produzioni agricole. Inizialmente dipendente dalle zone umide, la specie ha occupato un'ampia varietà di habitats, tra i quali soprattutto aree agricole a mosaico con siepi.

### INTRODUCTION

The Common Waxbill *Estrilda astrild* is a small passerine native of the Tropical and southern Africa (Cramp & Perrins 1994). It inhabits open country with long grass, reed stands near water, cultivated areas, forest edges and the vicinity of human habitations (Goodwin 1982).

It has been introduced in many countries becoming naturalised in Brazil, California, Oahu (Hawaii), Tahiti, Puerto Rico, Ascension, St. Helena, Mauritius, Reunion, Rodriguez, Seychelles, Amirantes, New Caledonia, Bermuda, São Tomé and Príncipe and Cape Verde archipelago. It was also introduced in the Azores, Madagascar and Comoros, where it was extirpated (Serle & Morel 1977, Voous 1977, Long 1981, Goodwin 1982, Ridgely & Tudor 1989, Sibley & Monroe 1990, Smallwood & Salmon 1992, Maclean 1993, Clement *et al.* 1993, Cramp & Perrins 1994).

In Europe it was first introduced in Portugal in 1964 (Xavier 1968, Vicente 1969). Since then it spread over a large part of the country and into Spain (Reino & Silva 1996, Guerrero *et al.* 1989). In Spain, the species was also introduced in some areas.

When first seen in Portugal, birds were misidentified as Red-eared Waxbills *Estrilda troglodytes*, being correctly identified for the first time by Heinzel & Wolters (1970). It is not certain how the species turned up in Portugal but it is known that during the 1960's, flocks of Waxbills were released in at least three different locations in western Portugal - Oeiras, Óbidos and Vila Franca de Xira (Vicente *pers. comm.*).

In this paper the Common Waxbill expansion is described in space and time by mapping its distribution for different time periods since 1964 up to 1996.

### METHODS

The species distribution is mapped on a four-year basis and plotted using the UTM grid with 20x20 km squares.

Published data (Teixeira 1981, Ferreira 1980-81, 1982, 1984, DZFBV 1987, Guerrero *et al.* 1989, Rufino 1989, Alba & Garrido 1990, Campinho *et al.* 1991, Alba 1991, Urios *et al.* 1991, Pinto 1993, Garcia & Paterson 1994, Gomez *et al.* 1994, Pimenta & Santarém 1996), personal communications, and



field work conducted by the authors during the last few years have been used to produce the maps. Records from locations where the establishment is known to have failed have not been considered.

The occupied area was calculated based on the grid squares. The expansion speed was calculated as the slope of the linear regression of the distance from nuclei as function of time. This was done for two different directions.

## RESULTS

Figure 1 shows the spread of the Common Waxbill in Iberia in the last 33 years at four years intervals.

It was initially introduced in western Portugal spreading into the Tagus valley and, shortly after, into the Sado and Mondego valleys. An isolated record in the Algarve (southern Portugal) in 1978 is probably due to a local introduction (Teixeira 1981, Ferreira 1984).

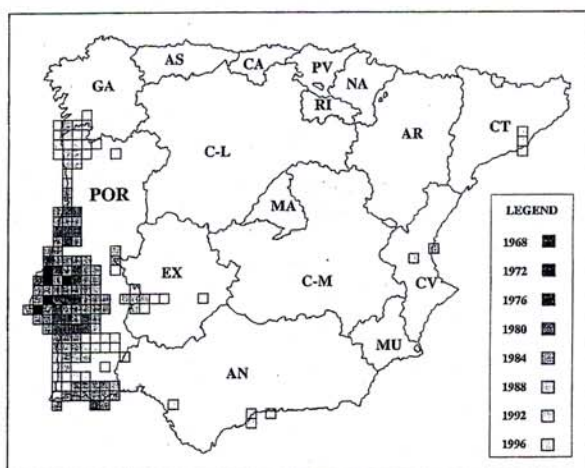


Figure 1 - Distribution and expansion of the Common Waxbill *Estrilda astrild* in Iberian Peninsula since its first introduction in 1964 (western Portugal) to 1996. POR: Portugal, Spanish communities: GA: Galicia; AS: Asturias; CA: Cantabria; BC: Basque Country; RI: Rioja; NA: Navarra; AR: Aragon; CT: Catalonia; C-L: Castilla-Leon; MA: Madrid; VC: Valencian Community; EX: Extremadura; C-M: Castilla-La Mancha; MU: Murcia; AN: Andalusia.

After 1980, the Common Waxbill expanded further in all directions, achieving a complete colonisation of the Tagus and Sado valleys (central and southern Portugal). Also in the Algarve there was a marked expansion, however with a lack of continuity between the two nuclei. The species obtained a continuous distribution in central Portugal and a more localised one further north and south.

In the early 90's there was a marked spread in the south achieving a more continuous distribution. The gap that can be seen in this region (Figure 1) corresponds to the dry plains of Castro Verde/Mértola. In northern Portugal, where the coast had already been

fully colonised, birds have appeared inland as well.

In Spain, it occurs in the following regions:

**Andalucía** - occurs near the Portuguese border from where it probably spread and in three other locations;

**Catalonia** - since 1990 has been recorded in the outskirts of Barcelona;

**Extremadura** - first recorded in 1986 probably as a result of its expansion from Portugal, and seems to be spreading quickly;

**Galicia** - it has been recorded since at least 1988, and occurs as far north as the Ria de Vigo (Pontevedra) which represents the northernmost location for this species;

**Comunidad Valenciana** - recorded since 1985 at two locations.

In figure 2 the square root of the occupied area is charted as function of time. Initially, directly after its introduction, the increase in range was slow. From 1976-84 the expansion rate increased dramatically and in the last period, 1992-96, has accelerated again.

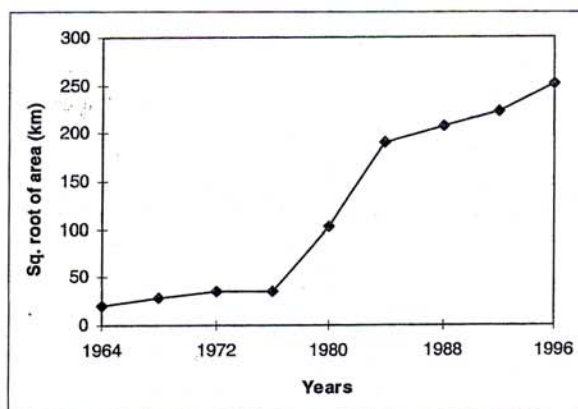


Figure 2 - Variation of the square root of the occupied area by the Common Waxbill in Iberia.

The calculation of the expansion speed of the population that originated in the western part of Iberia was performed through the determination of the slope of the linear regression of the distance-from-origin vs time graph (see Figure 3). The expansion rate for the north front (north coast of Portugal and Galicia) was 13.02 km/yr, while for the south front was 5.84 km/yr.

## DISCUSSION

The spread of the Common Waxbill along the coast has been faster northwards than southwards (see Figure 3). This is probably related to the existence of more wetlands associated with rivers further north (7 important river mouths versus 3 to the south). Additionally in the south there are two large estuaries (Sado and Tagus) which might imply longer



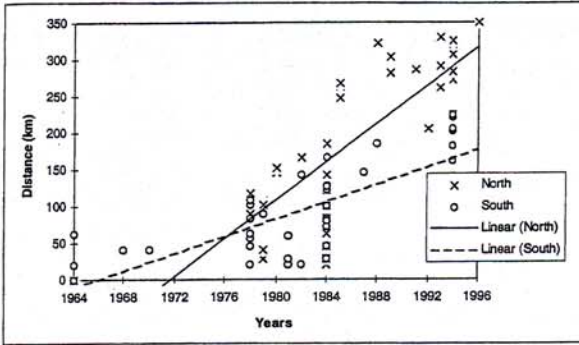


Figure 3 - Distance from first introduction point of the north and south front as function of time, calculated for the western Population (Portugal-Galicia). In continuous is the regression line for the north front ( $y = 13.02x - 25671$ ,  $R^2 = 0.616$ ,  $P < 0.01$ ), in dotted is the regression line for the south front ( $y = 5.84x - 11479$ ,  $R^2 = 0.557$ ,  $P < 0.01$ ).

time for the species to colonise all available habitats, hence leading to a slower spreading rate.

The average expansion speed of the westernmost nucleus in the north and south direction are 13.02 km yr<sup>-1</sup> and 5.84 km yr<sup>-1</sup> (see Figure 3). This value was comparable, although in the lower range, to expansion speeds of other introduced bird species (Table 1).

It is worth comparing the present distribution to the bioclimatic stages, because climatic factors are commonly physical limiting factors in a species distribution (Rivas-Martinez 1987). In 1996 the distribution overlaps with the termomediterranean and mesomediterranean bioclimatic stages of the mediterranean bioclimatic region and is invading the coline stage of the eurosiberian region (Rivas-Martinez 1987) which indicates a preference for the Atlantic-type climate. Together with the climatic conditions, the avail-

able habitat plays an important role in conditioning its geographic distribution (Reino & Silva 1996).

The topographical diversity of Iberia can be mentioned as a limiting factor to the expansion and colonisation of new areas. For example, Ferrer *et al.* (1991) suggest that for the Starling *Sturnus vulgaris*, the low rate of expansion in Iberia is explained by geographic barriers.

Reproductive biology is an important factor as well. Waxbills can breed almost throughout the year (at least between February and December) and can have several broods, with 5 to 7 chicks per brood (Ferreira 1982, Rufino 1989).

**Habitat use**

When first introduced in Portugal the species was normally associated with wetland edges, namely reedbeds of *Phragmites communis* and overgrowth areas (Neves *pers. comm.*). Presently, although it shows preference for these kind of habitats, it can be found in a wide variety of open habitats, preferably near the water, like mosaic farmland with small fields and edges.

It breeds in a variety of habitats, such as reedbeds, stands of *Arundo donax* and riverine vegetation with dense bushy cover and several types of hedges in cultivated land (Höller & Teixeira 1983, Rufino 1989, Ferreira 1991, Leitão 1993). Damp and grassy ground, vegetation which can support nest building together with abundance and variety of seeds, are essential for any site to be used for breeding by the Common Waxbill (Ferreira 1991). In the Baixo Alentejo during the winter the most used biotopes are, in decreasing order of number of records: riverine vegetation, reedbeds, rice stubble

	Reference	Expansion speed	Used method
Common Waxbill in Iberia - south front	The present study	5.8 km/yr	slope of regression (see methods)
Common Waxbill in Iberia - north front	The present study	13.0 km/yr	slope of regression (see methods)
House sparrow <i>Passer domesticus</i> in North America	Van den Bosch <i>et al.</i> 1992	16.8 km/yr	Fisher-Skellam
House sparrow <i>Passer domesticus</i> in Europe	Van den Bosch <i>et al.</i> 1992	27.9 km/yr	Fisher-Skellam
Collared Dove <i>Streptopelia decaocto</i> in Europe	Van den Bosch <i>et al.</i> 1992	43.7 km/yr	Fisher-Skellam
Starling <i>Sturnus vulgaris</i> in North America	Van den Bosch <i>et al.</i> 1992	91.6 km/yr	Fisher-Skellam
Cattle egret <i>Bubulcus ibis</i> in North America	Van den Bosch <i>et al.</i> 1992	106.2 km/yr	Fisher-Skellam

Table 1 - Expansion speeds of several introduced bird species.



and various types of hedge.

As shown, the introduction of the Common Waxbill in Iberian Peninsula has been quite successful. This fact is particularly noticeable due to the fact that there have been few cases of invasions by alien birds in the Mediterranean Basin (Blondel 1991).

The Common Waxbill appears to be a harmless species in its native range, but it has caused significant problems in at least two of the areas in which it has become naturalised (Lever 1994): in Cape Verde Islands it has been reported to damage tomato crops (Bannerman & Bannerman 1968); and more recently in Seychelles it has caused a significant impact in some crops (Penny 1974). More in-depth studies on this species in the Iberian Peninsula are needed in order to evaluate the possible impact on native species and on agriculture, which remains unknown until now.

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### REFERENCES

- ALBA E. & GARRIDO M., 1990 - Noticiário Ornitológico. *Ardeola*, 37: 351.
- ALBA E., 1991 - Noticiário Ornitológico. *Ardeola*, 38: 349.
- BANNERMAN D. A. & BANNERMAN W. M., 1968 - Birds of the Atlantic Islands, vol. IV. History of the Cape Verde Islands. Oliver and Boyd, London.
- BLONDEL J., 1991 - Invasions and range modifications of birds in the Mediterranean Basin. In: Groves R.H. & Di Castri F., (eds) Biogeography of Mediterranean Invasions: 311-326. Cambridge University Press, Cambridge.
- CAMPINHO F., LOURENÇO J. & RODRIGUES P., 1991 - O Bico-de-lacre *Estrilda astrild* no Noroeste de Portugal. *Airo*, 2: 21.
- CLEMENT P., HARRIS A. & DAVIS J., 1993 - Finches & Sparrows. An Identification Guide. Christopher Helm, London.
- CRAMP S. & PERRINS C. M. (eds.), 1994 - The Birds of the Western Palearctic, vol. VII. Oxford University Press, Oxford.
- DEPARTAMENTO DE ZOOLOGIA DE LA FACULTAD DE BIOLOGIA DE VALENCIA, 1987 - Pico de Coral (*Estrilda astrild*). In Noticiário Ornitológico. *Ardeola*, 34: 292.
- Ferreira L. F. F., 1980-81 - Contribuição para o conhecimento da distribuição de *Estrilda astrild* (L.) [Aves-Estrildidae] em Portugal. *Boim. Soc. Port. Ciênc. Nat.*, 20: 19-23.
- Ferreira L. F. F., 1982 - Novos dados sobre a biologia de *Estrilda astrild* (L.) [Aves-Estrildidae] em Portugal. Relatório de Estágio Científico. Universidade Clássica de Lisboa, Faculdade de Ciências, Lisboa.
- Ferreira L. F. F., 1984 - Breves notas sobre a ocorrência de *Estrilda astrild* (L.) [Aves-Estrildidae] no Algarve. In: Textos das comunicações do 3º Congresso sobre o Algarve, vol. I: 569-574.
- Ferreira L. F. F., 1991 - Estudo da Avifauna de um Agro-Ecosistema. Curso de Mestrado em Produção Vegetal. Universidade Técnica de Lisboa, Instituto Superior de Agronomia, Lisboa. (unpublished report).
- FERRER X., MOTIS A. & PERIS S. J., 1991 - Changes in the breeding range of starlins in the Iberian Peninsula during the last 30 years: competition as limiting factor. *J. Biogeogr.*, 18: 631-636.
- GARCIA E. & PATERSON A., 1994 - Dónde observar aves en España meridional, Andalucía, Extremadura y Gibraltar. Omega (ed), Barcelona.
- GOODWIN D., 1982 - Estrildid finches of the world. British Museum (Natural History). Oxford University Press, Hampshire.
- GOMEZ F. T., CORREA J. A. H., CAZORLA C. E. S., RAMOS S. V. & FERRER M. A., 1991 - La avifauna nidificante en la Vega de Motril. Anuario de Estudios de la Costa Granadina, 2. *Passeriformes*, 3: 65-96.
- GUERRERO J., DE LOPE F., & DE LA CRUZ C., 1989 - Un nouvel Estrildae nicheur dans le sud-ouest de l'Espagne: *Estrilda astrild*. *Alauda*, 57: 234.
- HEINZEL H. & WOLTERS H. E., 1970 - Wellenastrilde (*Estrilda astrild*) in Portugal. *J. Orn.*, 111: 497-498.
- VAN DEN BOSCH F., HENGEVELD R. & METZ, J. A. J., 1992 - Analysing velocity of animal range expansion. *Journal of Biogeography*, 19: 135-150.
- HÖLLER C. & TEIXEIRA A. M., 1983 - Die derzeitige Verbreitung des Wellenastrilds (*Estrilda astrild*) in Portugal. *Die Vogelwarte*, 32: 81-82.
- LEITÃO D., 1993 - Aves dos terrenos agrícolas do Estuário do Tejo: comunidades e padrões específicos de distribuição. Relatório de Estágio da Licenciatura de Recursos Faunísticos e Ambiente. Faculdade Ciências de Lisboa, Lisboa. (unpublished report).
- LEVER C., 1994 - Naturalized Animals. T & AD Poyser Natural History, London.
- LONG J. L., 1981 - Introduced Birds of the World. David & Charles, Newton Abbot, London.
- MACLEAN G. L., 1993 - Roberts' Birds of Southern Africa. Sixth Edition. John Voelcker Bird Book Fund, Cape Town.
- PENNY M., 1974 - Birds of Seychelles. Collins, London.
- PINTO P., 1993 - In: Neves R., Noticiário Ornitológico. *Airo*, 4: 78-80.
- PIMENTA M. & SANTARÉM M. L., 1996 - Atlas das Aves do Parque Nacional da Peneda-Gerês. Instituto da Conservação da Natureza-Parque Nacional da Peneda-Gerês, Porto.
- REINO L. M. & SILVA T., 1996 - Distribution and expansion of the common waxbill *Estrilda astrild* in Portugal. In: Holmes J. S. & Simons J. R. (eds.), The introduction and naturalisation of birds: 103-106. HMSO, London.
- RIDGELY R. S. & TUDOR G., 1989 - The Birds of South America. The Oscine Passerines, vol. I. Oxford University Press, Oxford.
- RIVAS-MARTINEZ S., 1987 - Memoria del mapa de series de vegetación de España. 1:40000.-Valladolid. M.A.P.A.-ICONA, Madrid.
- RUFINO R. (coord.), 1989 - Atlas das aves que nidificam em Portugal Continental. Serviço Nacional de Parques Reservas e Conservação da Natureza, Lisboa.

- SERLE W. & MOREL G. J., 1977 - A Field Guide to the Birds of West Africa. Harper Collins, London.
- SHISEGADA N. & KAWASAKI K., 1997 - Biological Invasions: Theory and Practice. Oxford University Press, Oxford.
- SIBLEY C. G. & MONROE B. L. JR., 1991 - Distribution and Taxonomy of the Birds of the World. Yale University Press. New Haven, Conn.
- SMALLWOOD K. S. & SALMON T. P., 1992 - A rating system for potential exotic bird and mammal pests. *Biol. Conserv.*, 62: 149-159.
- TEIXEIRA A. M., 1981. Importância ornitológica dos caniçais. Secretaria de Estado do Ambiente. Centro de Estudos de Migrações e Protecção de Aves (CEMPA), Lisboa.
- URIOS V., ESCOBAR J. V. PARDO R. & GOMEZ J. A., 1991 - Atlas de las aves nidificantes de la Comunidad Valenciana. Conselleria d' Agricultura I Pesca, Generalitat Valenciana, Valencia.
- VAN DEN BOSCH F., HENGEVELD R. & METZ J.A. J., 1992 - Analysing velocity of animal range expansion. *J. Biogeogr.*, 19: 135-150.
- VICENTE R. O., 1969 - A new introduced species in Europe: The Red-eared Waxbill. *Ibis*, 111: 614.
- VOOUS K. H., 1977 - List of recent Holarctic bird species. Second Edition. The British Ornithologists' Union.
- XAVIER A., 1968 - Bicos de Lacre em Óbidos. *Cyanopica*, 1: 77-81.

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