

**Species Action Plan for the Azores bullfinch *Pyrrhula murina*
in the European Union (2009 - 2019)**



Prepared by:



On behalf of the European Commission



Species action plan for the Azores bullfinch *Pyrrhula murina* in the European Union

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Milestones in the Production of the Plan

First SAP was adopted by the EU in 1996

Two evaluations of the implementation were made (2001 and 2004)

28 - 30 January 2009, Workshop LIFE Laurissilva Sustentável/ Priolo SAP, Nordeste

26 May 2009, scientific meeting on the SAP, Lisboa

First draft submitted to EC: 30 June 2009

Second draft submitted to EC: 01 November 2009

Consultation workshop with main stakeholders, Ponta Delgada: 17 November 2009

Final draft: 31 January 2010

International Species Working Group

n/a

Reviews

This Action Plan should be reviewed and updated every ten years (first review in 2019).

An emergency review should be undertaken if there is a sudden major change liable to affect the populations.

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Geographical scope

São Miguel Island, Azores, Portugal

Azores Bullfinch (*Pyrrhula murina*) distribution

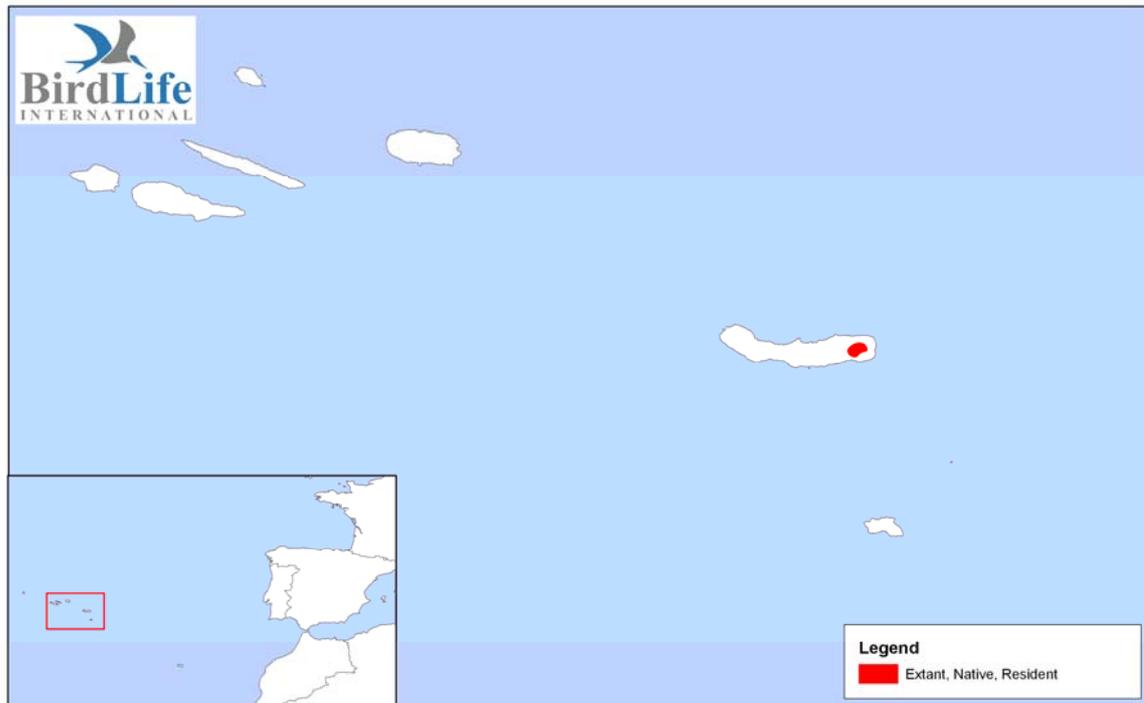


Figure 1. Distribution of the Azores bullfinch

Table of contents

0 - EXECUTIVE SUMMARY.....	5
1 - BIOLOGICAL ASSESSMENT.....	6
<i>Taxonomy and biogeographic populations</i>	6
<i>Distribution throughout the annual cycle</i>	6
<i>Habitat requirements</i>	7
<i>Survival and productivity</i>	7
<i>Population size and trend</i>	8
2 - THREATS.....	9
<i>General overview</i>	9
<i>List of critical and important threats</i>	9
3 - POLICIES AND LEGISLATION RELEVANT FOR MANAGEMENT.....	12
<i>International conservation and legal status of the species</i>	12
<i>National policies, legislation</i>	13
<i>Ongoing activities for conservation of the species</i>	14
4 - FRAMEWORK FOR ACTION.....	15
<i>Aim</i>	15
<i>Objectives</i>	15
<i>Results</i>	15
<i>Actions</i>	15
5 - REFERENCES.....	19

0 - EXECUTIVE SUMMARY

The Azores bullfinch *Pyrrhula murina*, also known as the São Miguel bullfinch or Priolo, is a very distinct species occurring only in the east of the island of São Miguel in the Azores archipelago (Portugal). It is included in Annex I of the EU Wild Birds Directive. The species' habitat is Laurel forest, which, is listed as a priority habitat in Annex I of the EU Habitats Directive (45.61 to 45.63 Macaronesian Laurel Forests). Human use of Laurel forest for cattle grazing and agriculture, along with the introduction of aggressive invasive exotic plants that are now widespread, has degraded this habitat and consequently led to the reduction of the species' range and population size. To complete the annual cycle, the species needs a mosaic of several vegetation types. This is reflected in their home-ranges, which are determined by the seasonal variation in the availability of preferred food sources. The birds move from area to area following the fruiting of food plants. This action plan is based on the evaluation of the implementation of the first EU action plan for this species (Ramos 1996).

Prior to restoration actions, there were virtually no native laurel forest areas within the Azores bullfinch range that were free from the invasive tree species *Clethra arborea*. Recent studies suggest that *Woodwardia radicans*, *Pteris incompleta*, *Culcita macrocarpa*, *Ilex azorica* and *Prunus azorica* were most likely the original winter food resources consumed by the Azores bullfinch prior to the invasion of *Clethra arborea* in the 1950s. Management of these five species should be carefully considered in restoration efforts of very large areas.

Breeding occurs from mid-June to late August. The observed adult/juvenile ratio in late summer suggests that average breeding success is lower than 2 fledglings per pair. The earliest available population size estimates point to 30–40 pairs in the late 1970s, 100 pairs in 1989 and between 60 and 200 pairs (mean 120) in 1991, 1992 and 1993. Based on re-sightings of ringed birds (during 25 months from 2005 to 2007), the mean population size (mean \pm SE) was 1608 ± 326 individuals. In 2008 the 1st Priolo Atlas presented a population size estimate of 1064 (608-1824) individuals. These results suggest that the population is no longer in significant decline, although the main threats remain. These threats are limited availability of suitable habitat and ongoing habitat degradation caused by invasive vegetation.

The **aim** of this action plan is to remove the Azores bullfinch *Pyrrhula murina* from the IUCN Red List of threatened species in the long term. As the species is an island endemic, this implies the maintenance of stable population, range and habitat. The **objective** of the action plan is to increase and maintain the population of Azores bullfinch *Pyrrhula murina* on the Island of San Miguel to at least 1,000 breeding pairs within the next 10 years.

Through adopting legislation on invasive alien species and implementing habitat restoration actions, the action plan should lead to the following results:

- Result 1:** Legal and management measures in place to restore and maintain sufficient area of breeding habitat in favourable condition.
- Result 2:** A long term monitoring programme for the species implemented and relevant research completed.
- Result 3:** Visitors and local public on the Azores recognizing the value of the native forest and the Azores bullfinch.

1 - BIOLOGICAL ASSESSMENT

Taxonomy and biogeographic populations

Phylum: Chordata

Class: Aves

Order: Passeriformes

Family: Fringillidae

Genus: *Pyrrhula*

Species: *Pyrrhula murina* (Godman, 1866)

The Azores bullfinch *Pyrrhula murina*, also known as the São Miguel bullfinch or Priolo, is a very distinct species occurring only in the east of the island of São Miguel in the Azores Archipelago (Portugal).

Distribution throughout the annual cycle

The cutting of Laurel forest for grazing and agriculture, and the introduction of aggressive exotic plants that are now widespread, has degraded the species' habitat and consequently led to reduction of its range in the Pico da Vara/Ribeira do Guilherme area and high altitude areas around Salto do Cavalo (Furnas) and above Monte Simplício (Povoação). The summer range of the Azores bullfinch was mapped for the first time in 2008 during the Priolo Atlas (Fig.1). The area of occupancy during the breeding season exceeds the boundaries of *Pico da Vara/Ribeira do Guilherme* SPA (redefined in 2005) and includes 83 units of 1km² (Ceia 2008).

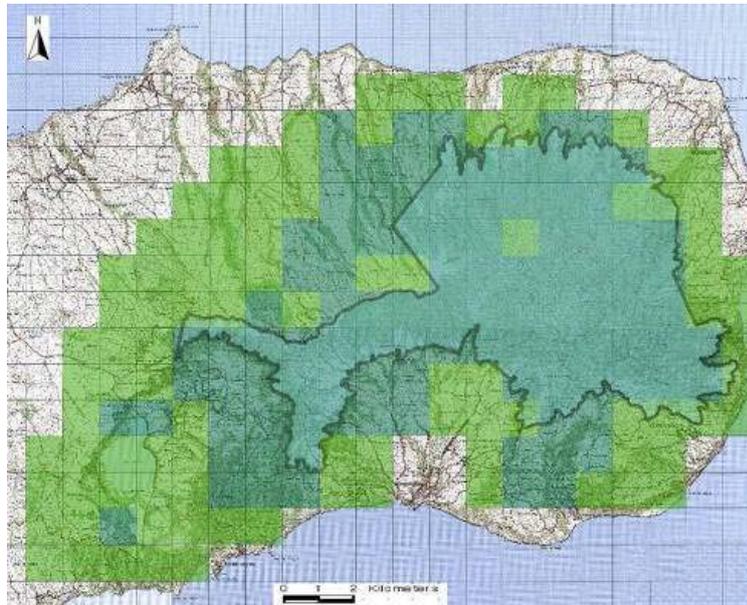


Figure 2. Study area of the 2008 Priolo Atlas over Pico da Vara/Ribeira do Guilherme SPA boundaries. The dark-green units are areas where the Azores bullfinch was detected.

Habitat requirements

The species has been shown to significantly prefer native vegetation to exotic vegetation (Ceia et al. 2009) but some important seasonal variations in diet and habitat selection can be noted. In summer, the birds select bare ground, short vegetation (less than 2m tall) and forest margins, including exotic plantations of *C. japonica*. In winter, from January to April, ca. 90% of the bird records were in native vegetation (Ramos 1996a).

To complete the annual cycle birds require a mosaic of several vegetation types. This is reflected in their home-ranges, which are determined by seasonal variation in the availability of preferred food sources. The birds move from area to area following the fruiting of food plants. There is active movement between Algarvia's native forest patch and the central patch of Serra da Tronqueira that appears to be seasonal in some birds. These movements can extend for 6000 m (Ceia 2008) and are more frequent during summer (June–September) because they have to cross areas of exotic forest that are unsuitable for foraging.

The species seems entirely dependent on native trees as food sources during certain months of the year. Native vegetation comprises the majority of the species' diet in August/September (*Leontodon filii* and *Vaccinum cylindraceum*) and in April (*Ilex azorica*). The availability of native vegetation may be a limiting factor for the population, due to the proliferation of invasive plants. The species' diet shows marked seasonal variation and comprises at least 37 different plants species, both native, and of which only 13 are known to be important (Ramos 1995).

Prior to ongoing restoration actions, there were virtually no native laurel forest areas within the Azores bullfinch range that were free from *Clethra arborea*. Recent studies suggest that *Woodwardia radicans*, *Pteris incompleta*, *Culcita macrocarpa*, *Ilex azorica* and *Prunus azorica* were probably the original winter food resources consumed by the Azores bullfinch before the invasion of *Clethra arborea* in the 1950s (Arosa et al. 2009). Management of these five species should be carefully considered in the restoration efforts of very large areas.

Forest margins at lower altitudes with herbaceous plants and fleshy-fruit-producing shrubs should be considered as valuable habitats for this bird. Fruit orchards are no longer important as a habitat for this species as they are small and far from the native forest.

Survival and productivity

The breeding season occurs from mid-June to late August, with an average clutch size of 3 eggs (based on a sample size of 4 nests; R. Ceia pers. obs.).

A high and constant monthly survival probability was observed during 2005-2008 for all age classes (0.96). On the basis of this estimate, an annual survival rate of 0.62 was calculated (Monticelli et al. in press). Higher recent survival rates may be, to some extent, a result of increases in native food sources due to the eradication of alien plants carried out by the LIFE Priolo restoration project (Monticelli et al. in press). The relatively stable climate on the island suggests that weather fluctuations are not likely to affect the species (Monticelli et al. in press).

From a sample of four Azores bullfinch nests, obtained between 2005 and 2007, only one was found to be successful. Predation of the species by rats and Mustelidae is reported to be on eggs and nestlings, not on flying birds (Ceia 2008).

The observed adult/juvenile ratio in late summer suggests that average breeding success is lower than 2 fledglings per pair (Ramos 1994a; Ceia 2008). In 2008, breeding success was higher than in 2006 and 2007, with these annual variations possibly being reflected in the population size.

Population size and trend

The earliest available population size estimates indicate 30–40 pairs in the late 1970s, 100 pairs in 1989 and 60–200 pairs (mean 120) in 1991, 1992 and 1993 (Ramos 1996a). In 2008 the population was studied using distance sampling methods with an estimated ca. 775 individuals recorded (minimum: 607 individuals; maximum: 990 individuals; Ceia 2008). The population size appeared to be higher during 2006–2008 compared to 1991–1996 and 2002–2005. These results suggest that the population is no longer in significant decline (Ceia 2008).

Based on re-sightings of ringed birds, the number of adult Azores bullfinches in the population was calculated for a 25 month period. Monthly abundances varied between a minimum of 296 individuals in June 2006 and a maximum of 6983 individuals in January 2007. However, when these two outliers were excluded, abundance estimates ranged from 500 to 2000 individuals in all other months. The mean population size (mean \pm SE) recorded was 1608 ± 326 individuals, i.e. 804 pairs considering an unbiased sex-ratio (Monticelli et al., submitted). In 2008, the Priolo Atlas was conducted - a study investigating the geographic range of the Azores bullfinch, using distance sampling methods. This study presented a population size estimate of 1064 (608–1824) individuals (95% Confidence Intervals; unpublished data). An improved annual monitoring scheme began in 2009 based on point counts stations used in the Priolo Atlas (Ceia 2009). The Atlas study will be repeated ever four years, monitoring the population trends and range size of the species.

Table 1. Population size and trend of the Azores bullfinch

Country	Breeding numbers	Quality	Year(s) of the estimate	Breeding Population trend in the last 10 years (or 3 generations)	Quality
Portugal	500 - 800 pairs	Good	2008	Increasing	Medium

2 - THREATS

General overview

The main threats to the Azores bullfinch are the limited area of suitable habitat and continuing habitat degradation caused by invasive vegetation. Nest predation is likely to be a contributing factor to lower productivity.

List of critical and important threats

Habitat degradation

The remaining native forest (ca.1300 ha divided into several patches of variable size), although highly degraded, supports a significant proportion of the Azores bullfinch population. Loss of native forest and large-scale invasion by exotic plant species seem to be the major factors explaining the historic contraction of the Azores bullfinch range and current low population levels. The majority of the exotic vegetation species are not suitable food sources for the Azores bullfinch.

Impact: Critical

Food shortage in winter

The diet of the Azores bullfinch was found to be very limited in both cleared and non-cleared areas during the month of December; being composed almost entirely of fern sporangia in cleared areas, and *Clethra arborea* seeds in non-cleared areas. Fruits and buds of native shrubs/trees and herbaceous seeds are not widely available during this month, as fruit production appears to have ceased by December (Ramos 1995) and flower buds appear only in late January (unpublished data). The preference for non-cleared areas in December is not completely prevalent, as a considerable proportion of the population uses cleared areas in the first winter after management, without access to *C. arborea* seeds. This result is encouraging, as it seems unlikely that the short-term impact of restoration can jeopardize the long-term benefits from the recovery of native vegetation (Heleno et al. 2009).

More importantly, the rate of removal of invasive vegetation is in the order of a few tens of hectares per year, and the rate of native forest recovery is apparently fast relative to this time-scale (Heleno et al. 2009). Therefore, by the time *C. arborea* is becoming very scarce in the area, significant parts of native forest will have been restored for several years, and will likely be providing more food resources into the December period. At low altitudes, fern spores mature and are released earlier than at high altitudes (Arosa 2008), and so in a more mature forest, extending from low to high altitudes, fern sporangia and flower buds will be available for a longer period (Arosa in press). This indicates the need to restore areas of native laurel forest at lower altitudes in order to increase seeding periods of native plants (Ramos 1995; Heleno et al. 2009). In addition, it is probable that following several years of restoration, fleshy fruit production will increase sufficiently to provide a food source through into mid-winter.

Impact: High

Predation

Nest monitoring from different species, predominantly in native forest, found that nest predation occurred in 60% of 10 monitored nests between 2005 and 2007. From a sample of four Azores bullfinch nests, obtained between 2005 and 2007, only one was successful. Predation of the species by rats and Mustelidae is reported to be on eggs and nestlings, not on flying birds (Ceia 2008). Rats were present over the total distribution area, which may reduce the productivity of the species.

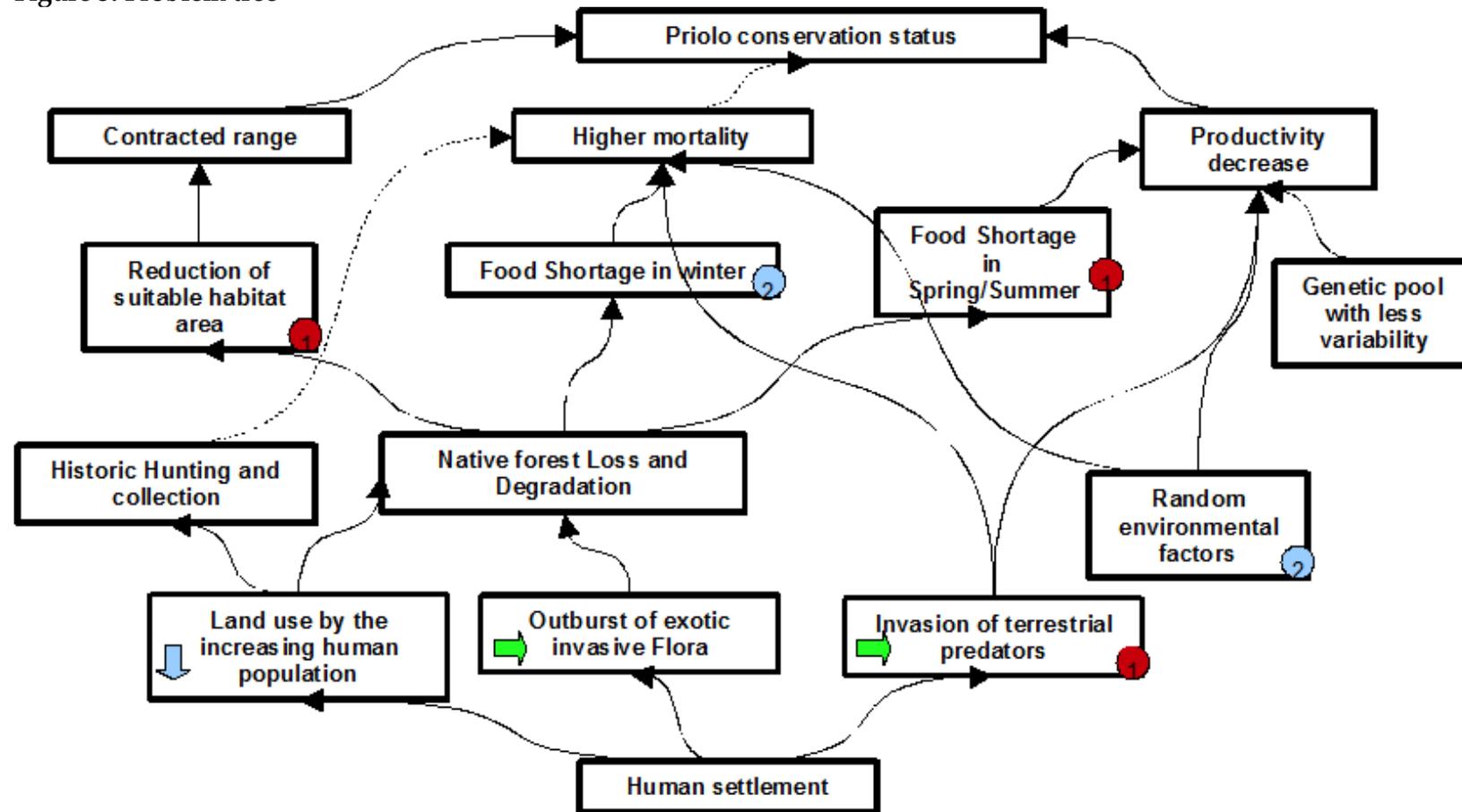
Impact: Potentially high/unknown

Limited area of suitable habitat

The area of remaining native forest (about 1300 ha divided into several patches of different size) has not changed significantly in previous decades (although it has become increasingly invaded by invasive flora). However, the current area is only a small proportion of the original native forest, prior to human encroachment. The reduction in native forest suffered in past centuries is certainly a severe constraint to the recovery of the population and will be a limiting factor in the increase of the Azores bullfinch population.

Impact: Critical

Figure 3. Problem tree



Legend
 ↓ - low priority threat
 → - ongoing threat
 ● - critical impact ● - high impact

3 - POLICIES AND LEGISLATION RELEVANT FOR MANAGEMENT

International conservation and legal status of the species

The species is included in Annex I of the EU Wild Birds Directive. Laurel forest, the habitat of this species, is listed as a priority habitat in Annex I of the EU Habitats Directive (45.61 to 45.63 Macaronesian Laurel Forests).

EU Birds Directive - Council Directive on the conservation of wild birds (79/409/EEC)

Category: Annex I

Aim: To protect wild birds and their habitats, e.g. through the designation of Special Protection Areas (SPA). The Directive states that species listed in Annex I 'shall be the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution' and that 'Member States shall classify in particular, the most suitable territories in number and size as special protection areas for the conservation of these species, taking into account their protection requirements in the geographical sea and land area where this Directive applies'.

Bern Convention - Convention on the Conservation of European Wildlife and Natural Habitats

Category: Appendix II

Aim: To maintain populations of wild flora and fauna with particular emphasis on endangered and vulnerable species, including migratory species. Each Contracting Party shall take appropriate and necessary legislative and administrative measures to ensure the special protection of the wild fauna species specified in Appendix II.

CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora

Category: Appendix I

Aim: Appendix I lists species that are the most endangered among CITES-listed animals and plants. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial, for instance for scientific research. In these exceptional cases, trade may take place provided it is authorized by the granting of both an import permit and an export permit (or re-export certificate).

Table 2. Conservation listings and legal status of the Azores bullfinch

Global status ¹	European status ²	SPEC category ²	ETS ³	EU Bird Directive Annex ⁴	Bern Convention Annex ⁵	Bonn Convention Annex ⁶	CITES
CR	CR	SPEC 1	EN	Annex I	Annex II	n/a	Annex I

¹ IUCN 2008. 2008 IUCN Red List of Threatened Species. Categories: EX = Extinct; EW = Extinct in the Wild; CR = Critically endangered; EN = Endangered; VU = Vulnerable; LR = Lower Risk; CD = conservation dependent; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; NE = Not Evaluated.

² BirdLife International (2004a) *Birds in Europe: population estimates, trends and conservation status*. Second edition. Wageningen, The Netherlands: BirdLife International. (BirdLife Conservation Series No. 12). Same categories as above.

³ BirdLife International (2004b) *Birds in the European Union: a status assessment*. Wageningen, The Netherlands: BirdLife International. Same categories as above.

⁴The species shall be subjected to special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution.

⁵ Give special attention to the protection of areas that are of importance (Article 4) and ensure the special protection of the species (Article 6).

⁶ Animals for which agreements need to be made for the conservation and management of these species.

National policies, legislation

The species is protected under Portuguese law. Pico da Vara/Ribeira do Guilherme has been designated as a Special Protected Area, and this was enlarged from 2,000 ha to 6,067 ha in 2005, including all the range known from the data available until 2003 (beginning of the LIFE Priolo project).

Pico da Vara/Ribeira do Guilherme SPA is included in the *Parque Natural de Ilha de São Miguel* (Decreto Legislativo Regional n.º 19/2008/A, from 8th June), the new regional framework for protected areas. Along with the SPA, the active raised bog area of Planalto dos Graminhais and the hydrological basin of Furnas Lake, two contiguous areas to the SPA which recently have assumed greater importance for the Azores bullfinch population, have been included in the *Parque Natural de Ilha de São Miguel*. Specific management of this area, now named *Reserva Natural do Pico da Vara*, is under the responsibility of the Secretaria Regional do Ambiente e do Mar.

- Management plan of the Pico da Vara/Ribeira do Guilherme SPA
- Natura 2000 Management Plan for the Azores Region
- Pico da Vara/Ribeira do Guilherme SPA has been included in the *Parque Natural de Ilha de São Miguel* (Decreto Legislativo Regional n.º 19/2008/A, from 8th June) the new regional framework for protected areas

Ongoing activities for conservation of the species

A SPA management plan was created and implemented along with the LIFE Priolo project (2005 – 2010) and will be revised and incorporated in the future São Miguel Natural Park management plan.

- The IBA was increased to 6067 ha thus encompassing most of the world population
- 2003-2008 LIFE Priolo project “Recovery of Azores bullfinch’s habitat in the Special Protection Area of Pico da Vara/Ribeira do Guilherme” (LIFE NAT/P/000013)
- 2009-2012 LIFE Laurissilva Sustentável project “Recovery, conservation and sustainable management of priority habitats at Serra da Tronqueira/Planalto dos Graminhais” (LIFE07 NAT/P/000630)
- Species Guardian (SPEA) funding by the 2007, 2008 e 2009 British Birdwatching Fair (Species Guardian: SPEA; Species Champion: BIRDWATCH magazine).
- Species Guardian (SPEA) 2008 funding by LUSH
- Disney Worldwide Conservation Fund awarded RSPB appliance for the Priolo Atlas 2008 entitled “Final countdown: Priolo world census” project.

4 - FRAMEWORK FOR ACTION

Aim

To remove the Azores bullfinch *Pyrrhula murina* from the IUCN Red List of threatened species.

Objectives

To increase and maintain the population of Azores bullfinch *Pyrrhula murina* on the Island of San Miguel to at least 1,000 breeding pairs within the next 10 years.

Results

- Result 1: Legal and management measures in place to restore and maintain sufficient area of breeding habitat in favourable condition.
- Result 2: A long term monitoring programme for the species implemented and relevant research completed.
- Result 3: Visitors and local public on the Azores recognizing the value of the native forest and the Azores bullfinch.

Actions

Table 3 includes all the results and actions agreed by the stakeholders on the Island of San Miguel.

Table 3. Actions corresponding to the results and ranked according to their importance, following from the problem tree.

<i>Result</i>	<i>Action</i>	<i>Priority</i>	<i>Time scale</i>	<i>Organisations responsible</i>
<p>1.0 <i>Legal and management measures are in place to restore and maintain sufficient area of breeding habitat in favourable conditions.</i></p>	<p>1.1 Adopt regional legislation on invasive alien species Applicable to: PT</p>	Medium	Short	Regional governments
	<p>1.2 Develop and implement a management plan for the eastern area of the São Miguel Natural Park Applicable to: PT</p>	High	Short	Competent conservation authorities
	<p>1.3 Promote financial incentives for private landowners who control invasive alien vegetation. Applicable to: PT</p>	Medium	Long	Competent conservation authorities
	<p>1.4 Gradually convert degraded public areas into restored areas Applicable to: PT</p>	High	Long	Competent conservation authorities/NGO's
	<p>1.5 Restore an additional 120 ha of native laurel forest habitat to add to the current restored area. Applicable to: PT</p>	High	Short	LIFE+ Project Laurissilva Sustentável

<i>Result</i>	<i>Action</i>	<i>Priority</i>	<i>Time scale</i>	<i>Organisations responsible</i>
	1.6 Ensure government co-funding for promotion of the sustainable use of native forest and development of ecotourism Applicable to: PT	High	Medium	Competent conservation authorities
	1.7 Promote conversion of private land into native habitat Applicable to: PT	Medium	Long	Competent conservation authorities/NGO's
	1.8 Increase the capacity of the existing nurseries to produce native plant species. Applicable to: PT	Essential	Short	Competent conservation authorities/NGO's
	1.9 To ensure the maintenance of areas previously restored by controlling alien invasive species (<i>Hedychium gardneranum</i> , <i>Clethra arborea</i> , <i>Gunnera tinctoria</i> , etc) in new native forest areas Applicable to: PT	Essential	Ongoing	Competent conservation authorities/NGO's
	1.10 Reduce the impact of predators during the breeding season Applicable to: PT	Low	Long	Competent conservation authorities/NGO's

<i>Result</i>	<i>Action</i>	<i>Priority</i>	<i>Time scale</i>	<i>Organisations responsible</i>
<p>2.0 <i>A long term monitoring programme for the species is implemented and relevant research completed.</i></p>	<p>2.1 Monitor the population of Azores bullfinch through regular updates of the Priolo Atlas and through annual censuses. Applicable to: PT</p>	High	Long	SPEA
	<p>2.2 Improve breeding success monitoring and identify factors affecting it. Applicable to: PT</p>	High	Short	SPEA
	<p>2.3 Monitor results of invasive alien species eradication efforts and conversion of non-natural areas Applicable to: PT</p>	High	Short	SPEA
	<p>2.4 Conduct studies on the carrying capacity of native forest through Population Viability Analysis Applicable to: PT</p>	Low	Long	SPEA
<p>3.0 <i>The visitors and local public on the Azores recognize the value of the native forest and the Priolo.</i></p>	<p>3.1 Continue awareness efforts for promoting the Priolo, the native forest and the threat of invasive alien species to target audiences Applicable to: PT</p>	High	Long	Competent conservation authorities/NGO's

5 - REFERENCES

- Arosa, M., J.A. Ramos, T. Valkenburg, R. Ceia, H. Laborda, L.G. Quintanilla & R. Heleno (2009) Fern feeding ecology of the Azores bullfinch (*Pyrrhula murina*): the selection of fern species and the influence of nutritional composition in fern choice. *Ardeola* **56**: 71-84.
- Arosa, M, L.G. Quintanilla, J.A. Ramos, R. Ceia, H. Laborda. (2009b) Spore maturation and release of two evergreen Macaronesian ferns, *Cladonia macrocarpa* and *Woodwardia radicans*, along an altitudinal gradient. *American Fern Journal*. In press
- BirdLife International (2008) *Pyrrhula murina*. In: IUCN (2008) 2008 Red List of Threatened Species (www.iucnredlist.org). Accessed 12 May 2009.
- Ceia, R. (2008) *Monitorização da população de Priolo. Relatório da acção F6 do Projecto LIFE Priolo*. Sociedade Portuguesa para o Estudo das Aves, Lisboa.
- Ceia, R. (2009) *Azores bullfinch (Pyrrhula murina) annual monitoring programme* (unpublished report).
- Ceia, R., R. Heleno & J.A. Ramos (2009a) Summer abundance and ecological distribution of passerines in native and exotic forests in São Miguel, Azores. *Ardeola* **56**:25-39.
- Heleno, R.H., R.S. Ceia, J.A. Ramos & J. Memmott (2009) The effect of alien plants on insect abundance and biomass: a food web approach, *Conservation Biology* **23**(2): 410-419.
- Monticelli, D., R. Ceia, R. Heleno, H. Laborda, S. Timóteo, D. Jareño & J.A. Ramos (2009) High survival rate of a critically endangered species, the Azores bullfinch, as a contribution to recent population recovery. *Journal of Ornithology* (in revision)
- Ramos, J.A. (1994) The annual cycle of the Azores bullfinch, *Pyrrhula murina* (Aves: Passeriformes). *Arquipélago. Life and Marine Sciences* **12A**:101-109. Ponta Delgada. ISSN 0870-6851.
- Ramos, J. A. (1994) Fern frond feeding by the Azores bullfinch. *Journal of Avian Biology* **25**: 344-347.
- Ramos, J. A. (1995) The diet of the Azores bullfinch and floristic variation within its range. *Biological Conservation* **71**: 237-249.
- Ramos, J. A. (1996a) Introduction of exotic trees as a threat to the Azores bullfinch population. *Journal of Applied Ecology* **33**: 710-722.
- Ramos, J. A. (1996b) The influence of size, shape and phenolic content on the selection of winter foods by the Azores bullfinch. *Journal of Zoology London* **238**: 415-433.
- SPEA (2008) *Workshop científico: o Priolo e a Floresta de Laurissilva*. Sociedade Portuguesa para o Estudo das Aves, Lisboa.

SPEA (2009) *Recuperação do habitat do Priolo na ZPE Pico da Vara/Ribeira do Guilherme. LIFE 03NAT/P/000013. Relatório Final.* Sociedade Portuguesa para o Estudo das Aves, Lisboa (unpublished report).