

Notification 2006-116

Views and experiences for the in-depth review of work on invasive alien species

Portugal contribution to the EU-mixed submission

Provide views and experiences. Consult decisions VIII/27, VII/13, VI/23** and V/8), contain elements of relevance for Parties

1. Building awareness and support

Included in environmental education activities with young public in protected areas, the invasive alien species (IAS) issue is raised through local examples of invasion and control measures (see Table 1, Figure 1). An educative game on invasive alien species was developed to support field discovery activities and a leaflet was published.

The Portuguese representative of the Foundation for Environmental Education (FEE) - “Associação Bandeira Azul” (ABAE) (Blue Flag Association) — implements four educational programs which also address the IAS issue:

- Blue Flag Campaign – to conquer the flag local authorities have to implement at least 5 environmental activities. In what concerns IAS information was produced and activities were undertaken (<http://www.icn.pt/downloads/ICNBandeiraAzulBiodiv.pdf>).
- Eco-schools (<http://www.abae.pt/eco-escolas.php>) – the Portuguese guide for teachers involved in this program includes a chapter on biodiversity in which the main concepts about the IAS issue are presented. Also some suggestions for educational activities (e.g. removal of invasive plant species in schoolyards and replacement by native species) are included. Every year ABAE organises a seminar for teachers, where the IAS issue is raised by the Institute for the Conservation of Nature and Biodiversity (ICNB). As an output, several schools are developing projects to control alien species and to disseminate related information.
- Young Reporters for the Environment (<http://www.abae.pt/jra.php>) – the role of ICNB in this program is similar to the one above.
- ECOXXI (<http://www.abae.pt/eco21/eco21.php>) – the targets of this pilot program are the municipalities. This program evaluates the environmental performance using indicators. One of these indicators relates to alien species (fauna and flora).

Table 1 – Examples of the environmental education initiatives with the young public promoted by the ICNB in 2005 -2007.

Protected Areas	Target species
Reserva Natural da Serra da Malcata (RNSM)	Not identified
Parque Natural de Sintra-Cascais (PNSC)	<i>Carpobrotus edulis</i>
Parque Natural do Litoral Norte (PNLN)	<i>Carpobrotus edulis</i> <i>Acacia</i> spp.
Área de Paisagem Protegida da Serra do Açor (APPSA)	<i>Acacia dealbata</i>
Parque Natural do Vale do Guadiana (PNVG)	Freshwater fishes
Reserva Natural do Paul do Boquilobo (RNPB)	<i>Eichornia crassipes</i>

A joint team with researchers on Invasive Alien Species of Escola Superior Agrária de Coimbra (ESAC) and University of Coimbra (UC) is promoting several actions that aim to raise public awareness and environmental education, in the framework of the following projects:

A - Project Invader II – “Invasion processes, control and restoration of coastal ecosystems invaded by *Acacia longifolia*” (POCI/AMB/61387/2004) (2005-2008):

- Training staff to deal with exotic species (namely technicians in areas of conservation relevance, greenhouse workers, municipality gardeners) in essential aspects such as species identification, regulation and planning of early detection, prevention of new introductions and control methodologies;
- Publishing and maintenance of a webpage (www.uc.pt/invasoras), it includes the development of IAS profiles, adapted to Portugal, which are crucial to raise public awareness on these species;
- Development of a series of inquiries (targeting forestry associations, municipalities, greenhouse industries, conservation areas, research and teaching institutions) to evaluate the level of utilisation/keeping of exotic plant species and to evaluate the knowledge of the national law related to IAS.

B - Project Ciência Viva “Divulgação sobre Espécies de Plantas Invasoras em Portugal” (2006-127/107) (2007-2008) aiming to increase public awareness, through:

- Organisation of scientific field workshops involving control of IAS, lectures on biological invasion and scientific experiments;
- Large spectrum public awareness campaign using adequate aids: posters, leaflets, and an exotic plant species field guide, which are to be distributed in protected areas, schools and greenhouses.

C – Project ROBIN – Rhizosphere Organisms as Determinants of Biological Invasion by Exotic Plant Species (POCI/BIA-BDE/56941/2004) (2005-2008) comprises a general ‘raising public awareness’ task, in which research posters produced are put to public display.

The [Azores Islands] Regional Plan for the Eradication and Control of Flora Invasive Species in Sensitive Areas (PREFECIAS), which started in 2004, includes as one objective the advertising of the danger of invasive plants and the introduction of new alien species in the Azores archipelago.

Also in Azores, through the coordination of regional administration and under Faial Botanical Garden and Environmental Educational Centres plans for educational activities, several campaigns to control evasive species are organised and promoted with educational purposes aiming particularly at schools and NGOs, trying to actively engage people in the eradication actions:

- April 2006 – Control of *Hydrangea macrophylla* in the Caldeira Nature Reserve and Natura 2000 site in Faial Island;
- April 2006 – Control of *Arundo donax* in Monte da Guia Protected Landscape and Natura 2000 site in Faial Island;
- November 2006 – Control of *Carpobrothus edulis* in Pico Vineyard World Heritage Site.

On a different level, dissemination of information regarding the implementation of measures by the Regional Environment Directorate of Azores has taken place in scientific meetings:

- Pitta Groz, M., Bettencourt, M., Melo, J. & Almeida, M. (2006) Management of invasive alien species in the Azores Autonomous Region: challenges and opportunities;
- Bettencourt, M., Melo, J., Veríssimo, E. & Pimentel, P. “Regional plan of eradication and control of invasive alien species in sensible areas” no International Symposium Intractable Weeds & Plants Invaders 17 - 21 de July de 2006 – Ponta Delgada;
- Botelho, R. “Wild ginger (*Hedygium gardneranum*) an Indian-shot (*Canna indica*) eradication in Corvo Island – Azores western group” at the International Symposium Intractable Weeds & Plants Invaders 17 - 21 de July de 2006 – Ponta Delgada.

2. Collecting, managing and sharing information

2.1. Species inventories

An effort to update information on the introduced species is being developed by several institutions in their projects of research and monitoring. It comprises the elaboration of inventories and the evaluation of species invasive status:

- preliminary lists of coastal and marine alien species for the Portugal mainland and Azores;
- fresh-water and terrestrial plant species;
- fresh-water and terrestrial fauna species.

2.2. Research and monitoring

Marine and coastal species

Since 2006, the distribution and the abundance of *Sargassum muticum* in the Ria Formosa Protected Area (Algarve) is being evaluated. In the near future, the risks posed by the *Sargassum muticum* to the ecosystems, habitats or native species of this wetland will also be assessed and the removal essays using mechanical methods will be initiated.

The project INSPECT – “Introduced marine alien species in Portuguese estuaries and coastal areas: patterns of distribution and abundance, vectors and invading potential” is waiting for acceptance by the National Foundation for Science and Technology (FCT). It comprises 6 tasks, entitled as follows:

1. Literature review and data compilation
2. Taxonomic quality check
3. Invertebrate and macroalgae species
4. Plankton assemblages
5. Data integration and assessment of patterns of introduction of alien species
6. Dissemination of information and building awareness

Plant species

A - Project Invader II Invasion processes, control and restoration of coastal ecosystems invaded by *Acacia longifolia* (POCI/AMB/61387/2004) (2005-2008) aims to carry on studies on the processes underlying both the invasion and the recovery of the system. The specific objectives are:

- To evaluate long-term rehabilitation of invaded systems at floristic and soil level
- To evaluate seed persistence and spatial patterns of *A.longifolia* seed dispersal;
- To assess feedbacks between soil and *A.longifolia*;
- To study the genetic variation within *A.longifolia* populations, regarding the biological control agent acceptability.
- To develop methodologies to control *A.longifolia*, specifically biological control: this will be achieved through a series of tests to evaluate the safety and efficiency of *Trichilogaster acaciaelongifoliae* as a biocontrol agent of *A.longifolia*.

B - Project "Improvement of infrastructures and management of Habitats in the Protected Landscape Area of Serra do Açor" (POCI/BIA-BDE/56941/2004), focus on:

- Preliminary analyses of *A. dealbata* seed bank & primary dispersal;
- Monitoring of vegetation recovery after the removal of the invasive species;
- Impact evaluation at soil level, namely through analyses of soil chemical properties and microbial biomass.

C – Project ROBIN –Rhizosphere Organisms as Determinants of Biological Invasion by Exotic Plant Species (POCI/BIA-BDE/56941/2004) (2005-2008) focuses on the importance of belowground communities of rhizosphere organisms for the processes of invasion of RND SJ by *Acacia longifolia*, by comparing those communities and their impacts on the invasive and native plant species. Specifically, this project aims at:

- Surveying the rhizosphere of *A. longifolia* and *Ulex europaeus* for natural mutualistic (rhizobia and mycorrhiza) and antagonistic (plant-parasitic nematodes and pathogenic fungi) organisms and evaluating the differences in the rhizosphere community associated to the two plant species;
- Investigating the existence and outcome of soil feedback mechanisms to these plants, including in transplant experiments;
- Assessing the potential role of each group of organisms and their interactions in the invasion process of *A. longifolia* in controlled conditions.

The following recent papers results from research on plant species:

Aguiar, F.C., Ferreira, M.T., Albuquerque, A. & Moreira, I. *in press*. Alien and endemic flora at reference and non-reference sites in Mediterranean-type streams in Portugal. *Aquatic conservation: Marine and freshwater ecosystems*.

Aguiar, F.C., Ferreira, M.T. & Albuquerque, A. 2006. Patterns of exotic and native plant species richness and cover along a semi-arid Iberian river and across its floodplain. *Plant Ecology* 184, 189-202.

Aguiar, F.C., Ferreira, T., Albuquerque, A. & Bernez, I. 2005. Invasibility patterns of knotgrass (*Paspalum distichum*) in Portuguese Riparian Habitats. *Weed Technology* 19, 509-516.

Almeida, J.D. & Freitas, H. 2006. Exotic naturalized flora of continental Portugal – a reassessment. *Botanica Complutensis* 30, 117-130.

Trends in amphibian, reptile and bird species distribution

New atlas for amphibians and reptiles (Loureiro et al. *in press*) and birds (ICNB *in prep.*) are been prepared. Results for these comprehensive surveys facilitate a comparative analysis with the previous distribution maps, for determining the stability, decrease or increase of the following alien species distribution area:

- Amphibians and reptiles: *Trachemys scripta*, *Podarcis sicula*, *Xenopus laevis*

- Birds: *Lonchura malacca*, *Estrild astrild*, *Amandava amandava*, *Euplectes afer*, *Ploceus melanocephalus*, *Psittacula krameri* and *Acridotheres cristatellus*

Trends in mammal species

No comprehensive data exists for evaluating trends in mammal species. However, occasional information compiled from 1996 to 2006 (ICNB and Francisco Álvares) confirm that *Mustela vison* is expanded its distribution area (Figure 2). The species also seems locally abundant in some areas, namely in the Cávado estuary (Esposende): minks are being regularly observed since 2000, in daylight activities, foraging in the inland waters. The species reproduces there, and an offspring of 4 pups was found in June 2006 (Figure 3). One fur farm is still labouring in the Northwest of Portugal, which are potential focus for new escapes.

LIFE Priolo project

In the scope of LIFE Project “Restoration of the Azores bullfinch habitat in “Pico da Vara/Ribeira do Guilherme” SPA co-ordinated by SPEA (BirdLife Portugal), in partnership with regional government departments (Direcção Regional do Ambiente, Direcção Regional dos Recursos Florestais), local farmers, municipality of Nordeste, Azores University, IMAR – Coimbra University and RSPB (BirdLife UK), research on control methods and monitoring of the expansion of flora invasive species (*Clethra arborea*, *Hedychium gardnerarum*, *Pittosporum undulatum*, *Gunnera tinctoria*) is taking place since October 2003.

2.3. Regional exchange of information

In the framework of the Project DAISIE (Delivering Alien Invasive Species Inventories for Europe) there is a collaboration between the Portuguese team (ESAC) and the Spanish team (CREAF) providing data of IAS (plant species only) present in Portugal; specifically information regarding: taxonomy, habitat, species status, species distribution and introduction pathways.

In the scope of project INTERREG IIIB (2000-2006) ATLÂNTICO, the software ATLANTIS Tierra 2.0 initially developed by the Canaries Regional Government in 1998, was adapted to other regions, in order to compile a geographical data-base with all available information regarding recorded biodiversity in the Macaronesian Region (archipelagos of Azores, Madeira, Canaries and Cape Verde).

3. Strengthening national policy, legal and institutional frameworks

Legal framework

The national legislation on invasive alien species is being reviewed and revised.

An interdisciplinary team is preparing changes in the procedures more in accordance with the “European Strategy of Invasive Alien Species” (Council of Europe) and the “Guiding principles for prevention, introduction and mitigation of alien species that threaten ecosystems, habitats or species” (CBD, decision VI/23) . Updated new appendices with species lists are been prepared.

A proposal of Regional Decree to implement the regulation on the introduction of alien species in the Azores Autonomous Region, regarding all taxonomic groups, in the scope of the European Strategy on Invasive Alien Species under the Bern Convention, is complete at technical level and will now follow an extensive consultation process among relevant authorities and institutions before being sent for approval and publication at the Azores Regional Assembly.

Strategies and action plans

In February 2007, a National Plan for the control of the water-hyacinth *Eichornia crassipes* was sent for possible adoption to the Environment Secretary of State.

The Azores Regional Government has published a Regional Plan for the Eradication and Control of Flora Invasive Species in Sensitive Areas (Resolution nº 110/2004, 29th July). The plan is being implemented since 2004 and foresees the eradication and control of 16 species of flora invasive species in sensitive areas in every islands of the Azores archipelago (*Pittosporum undulatum*, *Hedychium gardnerarum*, *Hydrangea macrophylla*, *Arundo donax*, *Gunnera tinctoria*, *Clethra arborea*, *Carpobrothus edulis*, *Lantana camara*, *Ailanthus altissima*, *Polygonum capitatum*, *Drosanthemum floribundum*, *Acacia melenoxylon*, *Ulex europaeus*, *Ipomoea indica*, *Rubus ulmifolius*, *Pteridium aquilinum*).

4. Regional co-operation and responsibility

No relevant actions are been taken.

5. Prevention

Intentional introduction

Along 2005 and 2006, the ICNB and the Forest Authority received requests to the intentional introduction of one bacteria species (*Ralstonia solanacearum*) and 3 plant species (*Vetiveria zizanioides*, *Erigeron karvinskianus* and *Arundo donax*). An aquaculture with *Oreochromis spp.* was also proposed.

Table 2 show more information about these requests and the decisions taken.

Table 2 – List of requests to the intentional introduction analysed in 2005-2006

Species	Group	Purpose	Decision taken
<i>Ralstonia solanacearum</i>	Bacteria	Mechanical and chemical cleaning of <i>Solanum dulcamara</i>	Allowed only for mechanical cleaning
<i>Vetiveria zizanioides</i>	Plant Graminae Poaceae	Strengthening infrastructures	Denied
<i>Erigeron karvinskianus</i>	Plant Compositae	Ornamental	Denied
<i>Arundo donax</i>	Plant Graminae Poaceae	Bioenergy	Denied
<i>Oreochromis spp.</i>	Fish Perciformes Cichlidae	Aquaculture	Denied

Unintentional introductions

The porcupine *Histrix cristata* was detected in the south of Portugal (Alentejo), probably escaped from a pet shop or a zoological garden.

7. Mitigation of impacts

Control and eradication

Control of invasive plant specie in Berlenga island

Conducted by ICNB staff and volunteers on the Berlengas Nature Reserve, two control projects to curb invasion by alien plant species were developed on Berlenga island (78 ha). This protected area is an oceanic archipelago with its surrounding waters and is relevant to nature conservation purposes mainly as a breeding site for seabirds, as habitat for two local reptile populations and also due to its native plants, specially *Armeria berlengensis*, *Herniaria berlengiana* and *Pulicaria microcephala*, but also as habitat for local forms of *Echium rosulatum*, *Angelica pachycarpa* and *Scrophularia sublyrata*.

1. In 2001, a small patch with *Oxalis pes-caprea* was detected around housing on Berlenga island. This species was new to the flora of the archipelago and its arrival is to be feared because of well recorded invasive behaviour on the adjacent mainland areas. In 2002 and 2003, all plants found within the “invasion hotspot” were systematically removed. The subsurface soil was dug and carefully sieved for even the very small bulbs that are so efficient to help propagate this species. This area was then covered with dark plastic sheeting, to avoid

subsequent sprouting or germination. From 2004 to 2006, no plants of this species were observed in the area, but in February 2007 a few individuals were observed again, and these will be eliminated soon.

2. Following a few decades of uncontrolled expansion since it was first introduced to the island as a decorative species, up to 9 hectares of Berlenga were covered with *Carpobrotus edulis* in 2001. Systematic measures to control this invasive species were carried out from 2002 to 2005, coordinated by the local ICNB staff. The area occupied by this species has been reduced to 6 hectares and will be reduced even more in 2007 (Figure 4). No effort is being made towards complete eradication however, and all the management actions that are now under way aim to contain the species within a well-defined area around housing facilities on Berlenga and to avoid any further expansion of this species on the island.

Control of *Acacia dealbata*

The National Park of Peneda-Geres has been implementing control and eradication measures for *Acacia dealbata* since 1989. Several projects were performed over this time period, co-funding by INTERREG, LIFE and FEDER projects. The most used method was chemical control with the application of glifosate in individual stems after cutting the stems. For small individuals, the removal by physical methods have also been employed. However, the success of controlling this species has been only partial, and the best results occurred in small *Acacia* patches (< 1ha). Also, it has been difficult to find the long-term constant financial support that this kind of control measures requires.

In the last three years, in the framework of a project untitled "Improvement of infrastructures and management of habitats in the Protected Landscape Area of Serra do Açor" (POCI/BIA-BDE/56941/2004), the protected area developed the control of the invasion by the species *Acacia dealbata* in an area of approximately 12 hectares. The control actions that took place were: mechanic control of the acacia trees; application of a systemic herbicide on the stump; monitoring the regeneration of native vegetation and the regrowth of acacia after control; periodic control of acacia sprouts. All this action occurred in a partnership with the ESAC and the UC.

PREFECIAS

The implementation of the Regional Plan for the Eradication and Control of Flora Invasive Species in Sensitive Areas (PREFECIAS), already mentioned above, started in 2004 and will take place until the end of 2009. The plan consists of 4 steps (Inventory, Eradication, Recovery, Promotion and Monitoring) and the main goals are:

- To improve the conservation of natural habitats and priority species population;

- To minimize adverse impacts of invasive plants;
- To create an alien plants list indicating the invasive and potential invasive ones;
- To advertise to the danger of the invasive plants and the introduction of new alien species in the Azores archipelago.

During the **Inventory** target species (*Pittosporum undulatum*, *Hedychium gardneranum*, *Hydrangea macrophylla*, *Gunnera tinctoria* and *Carpobrothus edulis*) and sites for intervention were identified in every island of the Azores archipelago (see Table 3).

Table 3 – Inventory target species: extent and number of sites identified for intervention

ISLAND	EXTENT OF INTERVENTION (ha)	NUMBER OF SITES
SANTA MARIA	150	1
SÃO MIGUEL	80	8
TERCEIRA	130	9
SÃO JORGE	2	3
PICO	15	7
FAIAL	140	6
GRACIOSA	11	3
FLORES	197	10
CORVO	<1	2
TOTAL	723	49

Regarding eradication, recovery and monitoring, several actions were developed between 2004 and 2006:

Corvo Island

- In 2004, the total eradication of *Hedychium gardneranum* and *Canna indica* from the island was accomplished;
- In 2004, removal of 2000 plants of *Criptomeria japonica* in Natura 2000 site;
- In 2005 and 2006 monitoring and control when re-infestation occurred in intervention sites and local authority was involved contributing with staff and equipment;

Flores Island

- In 2005 control of *Hedychium gardneranum* in Natura 2000 site;
- In 2006 control of *Hedychium gardneranum*, *Pittosporum undulatum* e *Acacia melanoxylon* followed by re-introduction of *Juniperus brevifolia*, *Vaccinium cylindraceum*, *Laurus azorica*, *Angelica lignescens*, *Myrsine retusa*, *Erica azorica*, *Calluna vulgaris*, *Picconia azorica*, *Leontodon sp.* e *Tolpis azorica* in Natura 2000 site;

Pico Island

- In 2005 and 2006 experimental fields are being set up to test eradication methods for *Pittosporum undulatum* as well as a nursery to produce native plants in large scale;
- In 2005 control of *Pittosporum undulatum* and *Metrosidero excelsa* in a Natura 2000 site;
- In 2005 and 2006 monitoring and control when re-infestation occurred in intervention sites;
- In 2006, control of *Carpobrothus edulis* in Pico Vineyard World Heritage Site, accomplished in close cooperation between local authorities (city hall, technical school, NGO and environmental education centre).

São Miguel Island

- In 2005, near Lagoa Azul in Sete Cidades, 40 tons of *Eichornia crassipes* were collected and destroyed in a control action;

Santa Maria Island

- In 2005 eradication of *Ulex europaeus* e *Pittosporum undulatum* in Barreiro da Faneca Protected Landscape.

8. Restoration of native biodiversity

LIFE Priolo project

In the scope of LIFE Priolo Project “Restoration of the Azores bullfinch habitat in “Pico da Vara/Ribeira do Guilherme” SPA co-ordinated by SPEA (BirdLife Portugal), in partnership with regional government departments (Direcção Regional do Ambiente, Direcção Regional dos Recursos Florestais), local farmers, municipality of Nordeste, Azores University, IMAR – Coimbra University and RSPB (BirdLife UK), restoration of native biodiversity through the re-introduction of flora native species is taking place since October 2003:

- Annual production of nearby 50.000 plants in the nurseries at the Forest Services of Nordeste (*Erica azorica*, *Vaccinium cylindraceum*, *Juniperus brevifolia*, *Viburnum tinus ssp subcordatum*, *Frangula azorica*, *Prunus lusitanica ssp azorica* e *Picconia azorica*);
- Plantation of more than 30.000 native plants in the area of action of the LIFE Priolo Project;
- Nearby 10 Km. of open or recovered paths in all the area of action;
- Plantation of more than 2 hectares of traditional fruit species;
- More that 70 hectares have already been cleared from exotics in the main area of live of the Azores bullfinch through the eradication of exotic species and the plantation of native species.

PREFECIAS

In the scope of the Regional Plan for the Eradication and Control of Flora Invasive Species in Sensitive Areas, namely in the actions mentioned above, the Eradication actions are always

coupled with Recovery actions, and for those purposes infra-structures such as nurseries are being built in order to make large scale actions possible.

The Table 4 makes an assessment of the needs of native plans for the recovery actions that will follow the eradication actions, according to the interventions targeted during the Inventory, already presented above.

Table 4 - Assessment of the needs of native plans for the recovery actions

	Sta. Maria	S. Miguel	Terceira	Graciosa	S. Jorge	Pico	Faial	Flores	Corvo	Total
<i>Laurus azorica</i>	250	250	5000	250	250	250	250	250	250	7000
<i>Erica azorica</i>	250	250	5000	250	250	250	6000	250	250	12750
<i>Viburnum subcordatum</i>	250	250	250		250	10000	250	250	250	11750
<i>Myrica faya</i>	250	250	5000	250	250	250	6000	250	250	12750
<i>Picconia azorica</i>	250	250	250		250	250	1500	250	250	3250
<i>Juniperus brevifolia</i>	250	250	250		250	250	1000	1000	250	3500
<i>Ilex pazorica</i>	250	250	250		250	250	1500	1500	250	4500
<i>Frangula azorica</i>	250	250	250		250	250	250	250	250	2000
<i>Vaccinium cylindraceum</i>	250	250	250		250	250	250	500	250	250
<i>Prunus azorica</i>			250			250	250			750
TOTAL	2000	2250	16750	750	2250	12250	17250	4500	2250	58500

References

Loureiro, A., Carretero, M.A., Ferrand, N., Paulo, O. *in press*. Atlas dos Anfíbios e Répteis de Portugal. Instituto da Conservação da Natureza, Lisboa.

ICN (*in prep*). Novo Atlas das Aves Nidificantes Instituto da Conservação da Natureza, Lisboa.