

Chapter 27

Supplementary Material

Management of invasive Australian *Acacia* species in the Iberian Peninsula

Elizabete Marchante¹, Conceição M. Colaço², Iryna Skulska², Florian Ulm³, Luís González⁴, Liliana N. Duarte¹, Silvia Neves⁵, Catarina Gonçalves⁶, Sérgio Maggioli⁷, Jorge Dias⁸, Cristina Máguas³, Nuno Fernandes⁵, Luís Fernandes⁵, Hélia Marchante^{1,9}

¹ Centre for Functional Ecology, Department of Life Sciences, University of Coimbra, Coimbra, Portugal

² Centre for Applied Ecology Baeta Neves, CEABN-InBIO, School of Agriculture, University of Lisbon, Lisbon, Portugal

³ Faculdade de Ciências da Universidade de Lisboa, cE3c - Center for Ecology, Evolution and Environmental Changes | CHANGE - Global Change and Sustainability Institute, Lisbon, Portugal

⁴ Universidade de Vigo, Departamento de Biología Vexetal e Ciencia do Solo. Facultade de Biología. E36310 Vigo, Spain

⁵ Paisagem Protegida da Serra do Açor, Instituto da Conservação da Natureza e das Florestas (ICNF), Benfeita, Portugal

⁶ RAIZ, Forest and Paper Research Institute, Aveiro, Portugal

⁷ Navigator Forest Portugal, Setúbal, Portugal

⁸ Direção Regional da Conservação da Natureza e Florestas do Norte, ICNF, Braga, Portugal

⁹ Polytechnic Institute of Coimbra, Coimbra Agriculture School, Bencanta, Coimbra, Portugal

Supplementary Information 27.S1 - Systematic literature review performed on the management of invasive Australian *Acacia* species in the Iberia Peninsula.

The literature search was first conducted on ISI Web of Science (26/05/2022), using four sets of keywords, relating to: acacias (Acacia OR acacia* OR acácia OR wattle), invasive (alien OR invasive OR exotic OR weed OR invader OR invasor* OR infestante), management (control* OR management OR remov* OR gestão OR gestao OR manejo OR elimina* OR contain* OR eradicate*

OR erradica* OR monitor* OR prevent* OR restor* OR prioritiz*) and Iberia (Portugal OR Spain OR España OR Iberia OR “Iberian Peninsula” OR “Península Ibérica”). The same search was also run on SCOPUS and, in addition, Portuguese scientific journals not indexed on WoS or SCOPUS were explored, resulting in extra eight studies included.

The search yielded 169 publications. These were screened, reading the title and abstract, and 123 were excluded for not being relevant (e.g., studies that did not relate to any type of management, studies on the ecology or impacts of the species, studies outside the Iberian Peninsula, studies including non-Australian *Acacia* species, etc.). In the end, 54 publications were considered. For each, information was gathered on the publishing year, the country where the study was conducted, *Acacia* species, main theme, type of study and if the study was focused on wattles or included several species (Fig. 27.1 in the main text).

List of publications analysed:

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- Dinis, M., Vicente, J.R., César de Sá, N. *et al.* (2020) Can niche dynamics and distribution modeling predict the success of invasive species management using biocontrol? Insights from *Acacia longifolia* in Portugal. *Frontiers in Ecology and Evolution*, 8, 576667.
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Supplementary Information 27.S2 – Survey distributed to land managers (translated)

Management of invasive acacias in Europe

Introduction

This questionnaire is intended for **managers and/or responsible for areas where invasive acacias are present and where management or control measures are/ were carried out.**

Who are we and what is the purpose of this questionnaire?

We are researchers from several European research institutions (Departamento de Ciências da Vida da Universidade de Coimbra, Escola Superior Agrária do Instituto Politécnico de Coimbra, Faculdade de Ciências e Instituto Superior de Agronomia da Universidade de Lisboa, Universidade de Vigo, etc.) and we are doing a study which aims to better understand how invasive acacias have been managed and controlled in Europe.

The results of this questionnaire will be included in a chapter of a book to be published by CABI by the end of 2022, which will provide a comprehensive overview of knowledge on Australian acacias globally: Wattles - Australian *Acacia* species around the world, to be edited by David Richardson (Stellenbosch University, South Africa), Jaco Le Roux (Macquarie University, Australia) and Elizabete Marchante (University of Coimbra, Portugal). In this context, your contribution as a manager/responsible of area(s) where invasive acacias exist and where management or control measures are/were carried out is very important to analyse what has been done in Europe and propose measures for improvement.

Please answer according to what is carried out in the area you manage, thinking in particular of the period since 2000. If you manage more than one area, please answer thinking about the global of the areas. If you started working in the area after that date, please answer according to the information you have. If you do not have concrete data to answer some questions, please answer according to your perception.

The questionnaire takes about 10 minutes to complete. Please answer by 31 March.

The answers are anonymous and cannot be associated with the person answering. However, if you are interested in having access to the results of this questionnaire you can leave your e-mail address in the field for comments and when we have the results we can send them to you. Any questions can be sent to Elizabete Marchante, who coordinates this study emarchante@uc.pt

Thank you very much!

Section 1

In the area(s) you manage, do you manage or control any species of acacia? *

- Yes.
- No. The completion of the questionnaire ends here. Thank you very much for your time!

Section 2 - Management of invasive acacias in Europe

Characterisation of the area(s) of intervention where acacias occur

Help us understand what the area(s) you manage and where acacias occur are like. If you manage more than one area, please answer the questions below to cover the various areas.

District/Island/Province where the area you manage is located *

Portugal

- Aveiro
- Beja
- Braga
- Bragança
- Castelo Branco
- Coimbra
- Corvo
- Évora
- Faial
- Faro
- Flores
- Graciosa
- Guarda

Spain

- Albacete
- Alicante/Alacant
- Almería
- Araba/Álava
- Asturias
- Ávila
- Badajoz
- Balears, Illes
- Barcelona
- Bizkaia
- Burgos
- Cáceres
- Cádiz

- | | |
|--|--|
| <input type="radio"/> Leiria | <input type="radio"/> Cantabria |
| <input type="radio"/> Lisboa | <input type="radio"/> Castellón/Castelló |
| <input type="radio"/> Madeira | <input type="radio"/> Ciudad Real |
| <input type="radio"/> Pico | <input type="radio"/> Córdoba |
| <input type="radio"/> Portalegre | <input type="radio"/> Coruña, A |
| <input type="radio"/> Porto | <input type="radio"/> Cuenca |
| <input type="radio"/> Porto Santo | <input type="radio"/> Gipuzkoa |
| <input type="radio"/> Santa Maria | <input type="radio"/> Girona |
| <input type="radio"/> Santarém | <input type="radio"/> Granada |
| <input type="radio"/> São Jorge | <input type="radio"/> Guadalajara |
| <input type="radio"/> São Miguel | <input type="radio"/> Huelva |
| <input type="radio"/> Setúbal | <input type="radio"/> Huesca |
| <input type="radio"/> Terceira | <input type="radio"/> Jaén |
| <input type="radio"/> Viana do Castelo | <input type="radio"/> León |
| <input type="radio"/> Vila Real | <input type="radio"/> Lleida |
| <input type="radio"/> Viseu | <input type="radio"/> Lugo |
| <input type="radio"/> Todos | <input type="radio"/> Madrid |
| <input type="radio"/> Other: | <input type="radio"/> Málaga |
| | <input type="radio"/> Murcia |
| | <input type="radio"/> Navarra |
| | <input type="radio"/> Ourense |
| | <input type="radio"/> Palencia |
| | <input type="radio"/> Palmas, Las |
| | <input type="radio"/> Pontevedra |
| | <input type="radio"/> Rioja, La |
| | <input type="radio"/> Salamanca |
| | <input type="radio"/> Santa Cruz de Tenerife |
| | <input type="radio"/> Segovia |
| | <input type="radio"/> Sevilla |
| | <input type="radio"/> Soria |
| | <input type="radio"/> Tarragona |
| | <input type="radio"/> Teruel |
| | <input type="radio"/> Toledo |
| | <input type="radio"/> Valencia/València |
| | <input type="radio"/> Valladolid |
| | <input type="radio"/> Zamora |
| | <input type="radio"/> Zaragoza |
| | <input type="radio"/> Todos |
| | <input type="radio"/> Otros: |

How do you best define the area you manage? *

If you manage more than one area, please tick more than one option if justified.

- Protected area (*Área Classificada: Área Protegida (AP)*)
- Other conservation areas (*Área Classificada: Rede Natura ou outra (que não AP), etc.*)
- Private forest area
- Public forest area
- Common land (*Baldio*)
- Linear infrastructures
- Urban area
- Agricultural area
- Other:

What is the size of the area(s) you manage (approximate)? *

If you manage more than one area, please consider the total size of the areas.

- < 1 ha
- 1 to 10 ha
- 10 to 25 ha
- 25 to 50 ha
- 50 to 100 ha
- 100 to 250 ha
- 250 to 500 ha
- 500 to 750 ha
- > 750 ha
- Don't know
- Other:

Management of acacias

In this section we aim to understand how the management and control of invasive acacias is carried out in the area(s) we manage.

Which acacia species are present in the area(s) you manage? *

Please consider all species present, even if they are not subject to control. Select several options if necessary. (with photos)

- mimosa (*Acacia dealbata*)
- acácia-negra (*Acacia mearnsii*)
- austrália (*Acacia melanoxylon*)
- acácia-de-espigas (*Acacia longifolia*)
- acácia (*Acacia saligna*)
- acácia (*Acacia retinodes*)
- acácia (*Acacia pycnantha*)
- acácia (*Acacia cyclops*)
- Don't know
- Other:

Of the acacia(s) present in the area, which are or have been subject to control since 2000? *

Select multiple options if necessary. (with photos)

- mimosa (*Acacia dealbata*)
- acácia-negra (*Acacia mearnsii*)
- austrália (*Acacia melanoxylon*)
- acácia-de-espigas (*Acacia longifolia*)
- acácia (*Acacia saligna*)
- acácia (*Acacia retinodes*)
- acácia (*Acacia pycnantha*)
- acácia (*Acacia cyclops*)
- Don't know
- Other:

Do you recognise the invasive nature of acacia(s) in the area(s) you manage? *

- Yes, they multiply widely and spread in the territory, without human intervention, causing impacts at various levels.
- No, it is not clear. They were planted in the past and remain close to the initial planting areas.
- No
- Other:

What is the main reason(s) for controlling acacias in the area(s) you manage? *

Select multiple options if necessary.

- Threaten habitats and/or species with a conservation status or interest
- Damage agricultural or forestry production areas
- Invade linear infrastructures (or their margins) making it difficult to manage them
- Block irrigation areas
- Increase the risk of fire
- Decrease the recreational value of the area
- Damage anthropic activities
- They cause allergies
- Other:

What approximate percentage of the area you manage is occupied by acacia(s)? *

If you manage more than one area, consider the global of the whole managed area. If you do not know the exact value, please answer according to your perception.

- Acacias are sporadic in the managed area
- Acacias occupy less than 10% of managed area
- Acacias occupy from 10% to 25% of the managed area
- Acacias occupy 25% to 50% of the managed area
- Acacias occupy 50% to 75% of the managed area
- Acacias occupy more than 75% of the managed area
- Other:

Since when has acacias control been carried out in the area(s) you manage? *

If you do not have concrete data, please answer according to your perception.

- Started after 2020
- Started between 2015 and 2019
- Started between 2010 and 2014
- Began between 2005 and 2009
- Began between 2000 and 2004
- Began before 2000
- Other:

What methods are used in acacia control in the area(s) you manage? *

Select multiple options if necessary.

- Hand pulling
- Mechanical pulling
- Manual cut
- Mechanical cut
- Cut + herbicide application on stumps
- Cut + herbicide spraying on the shoots
- Debarking
- Injection of herbicide through blows or holes (on stems of live trees)
- Foliar application of herbicide (without cutting)
- Prescribed fire
- Biological control
- Grazing
- Don't know
- Other:

More broadly, what management measures are implemented in the area(s) you manage in relation to acacias? *

Answer according to what has been happening in the area you manage since 2000. Select multiple options if necessary.

- Monitoring. Including, for example, field work to detect and report new invasive species, including acacias, surveillance of already invaded sites, detection of new invaded sites, surveillance and monitoring of entry mechanisms, etc.
- Prioritisation. Including, for example, Risk Assessment, determination of priority management measures in relation to species and locations where measures should be implemented, etc.
- Prevention. Including, for example, measures for the prevention of introduction and dispersal of acacias (and other invasive species), such as public awareness activities, biosecurity measures focused on preventing machinery/tools/equipment/operations from introducing species into areas where they do not occur, etc.
- Eradication and Control. Including rapid eradication of newly introduced acacias and control of established populations through physical removal, chemical or biological control, etc.
- Environmental Recovery and Restoration. Measures to improve the environmental quality of sites and make re-invasion more difficult after acacia removal, e.g. through afforestation with native plants, soil rehabilitation, etc.
- Other:

How would you rate the level of success of the acacia control interventions carried out in the area(s) you manage? *

Please choose the option that best describes the current state of play. If you manage more than one area, please select the option that best describes the areas overall.

- Excellent success - acacia(s) have been "eradicated" from the managed area(s) (no more plants or propagules).
- Good success - the acacia(s) is(are) under control; it(they) continue(s) to exist in the area, but at low densities, without impacting on human activities or the conservation of local fauna and flora.
- Reasonable success - acacia(s) is(are) controlled allowing most human activities, but densities increase regularly requiring further control measures.
- Low success - despite implemented management measures, acacia(s) continue(s) to show high densities and promote significant negative impacts on anthropogenic activities and nature conservation.
- Unsuccessful - despite the management measures implemented, the current situation is worse than before the interventions.
- Other:

According to your perception, what has been the evolution of acacias in terms of occupied area since 2000 in the area(s) you manage? *

If you manage more than one area, please select the option that best describes the global of the areas. If you do not have concrete data, please answer according to your perception.

- Decrease, as a result of management measures
- Increase, due to insufficient management measures
- Increase, despite the management measures
- No change
- Don't know
- Other:

What type of funding has been used in acacia management? *

Select multiple options if necessary.

- National public funds
- Regional public funds
- Local public funds
- European funds
- Private funds
- Private donations
- Environmental Non-governmental organisation (ENGO) or similar
- Work contributions (volunteers)
- Don't know
- Other:

Since 2000, what financial resources have been used for acacia management in the area(s) you manage? *

If you manage more than one area, consider the global of the areas. If you do not have concrete data, please answer according to your perception.

- < 10,000€
- 10,001€ - 50,000€
- 50,001€ - 100,000€
- 100,001€ - 250,000€
- 250,001€ - 500,000€
- 500,001€ - 1,000,000€
- 1,000,001€ - 2,500,000€
- 2,500,001€ - 5,000,000€
- > 5,000,000€
- Don't know
- Other:

In general, what is the destination of acacia control waste in the area(s) you manage? *

Select multiple options if necessary.

- Sent to biomass power plants
- Left piled up on site
- Left on site (at least part of them burnt)
- Left on site (shredded)
- Sent for composting
- Sold as firewood
- Offered for firewood
- Other:

In the area(s) you manage do you organise initiatives where volunteers help control acacias? *

- Yes.
- No.

Comments:

Thank you very much for your contribution! Your reply has been noted.

Figures with responses to the survey not shown in the main text.

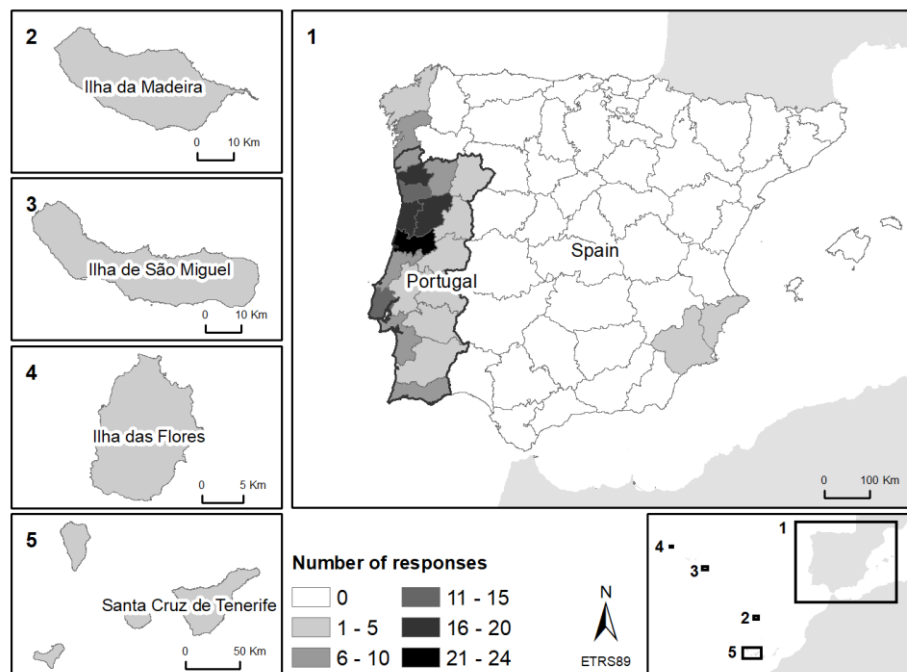


Fig. 27.S1. Number of responses from land managers to a survey on invasive wattle management according to the region of intervention.

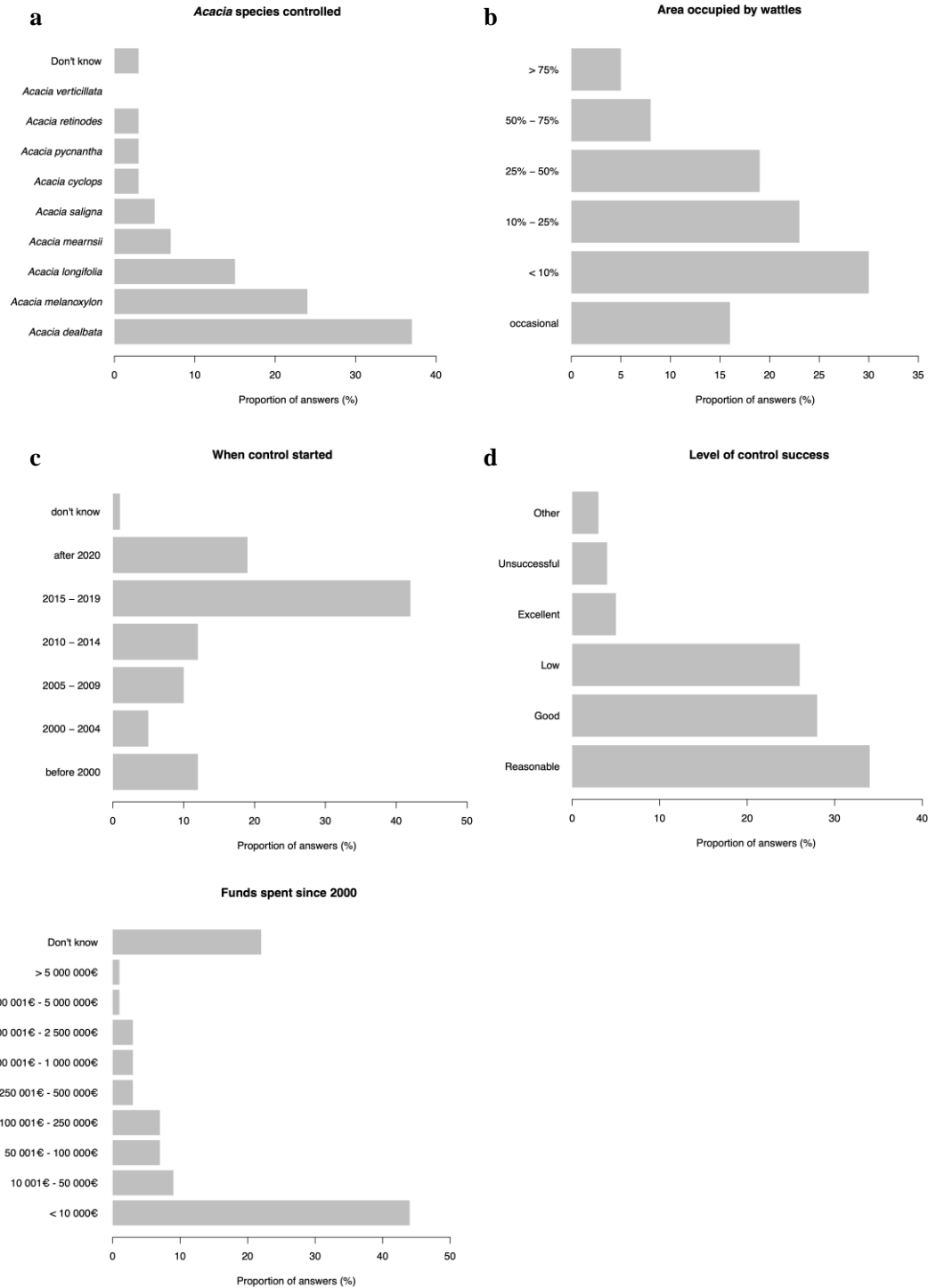


Fig. 27.S2. Responses from land managers to a survey on wattle management regarding: (a) *Acacia* species controlled, (b) percentage of area occupied by wattles, (c) time when management begun, (d) level of control achieved, and (e) funds spent since 2000. n = 144. Note: some chart captions (corresponding to response options) have been abbreviated for readability, please check the survey for full options in Supplementary Information 27.S2.