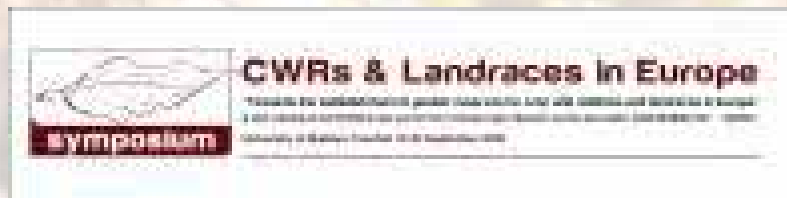


# Towards to the establishment of a genetic reserve for *Beta patula*

Pinheiro de Carvalho, M.A.A., Frese, L.  
Nóbrega, H., Freitas, G., Fontinha, S.



**ISOPlexis**  
Banco de Germoplasma





Project

„An integrated European in situ management work plan. Implementing genetic reserves and on farm concepts – AEGRO“  
AGRI GEN RES 057

Work package 06  
Crop case study: Beta and Patellifolia



## Objectives

Identification and selection of sites suitable for the establishment of genetic reserves for beet CWR.

To develop the guidelines for the establishment of genetic reserves and management plan for beet CWRs based on field visits and data obtained from the AEGRO case study.

## Application of the four steps methodology

**CWR In-Situ Strategy Helpdesk**

**A step-wise methodology for identifying CWR genetic reserve sites for a target crop gene pool**

**Key elements:**

- 1. Taxon delineation and selection of target taxa
- 2. Ecogeographic diversity analysis
- 3. Selection of target sites
- 4. Establishment of a genetic reserve

**References:**

- 1. FAO (2001) *World Crop Genetic Diversity*
- 2. FAO (2002) *World Crop Genetic Diversity: A Strategy for Conservation*
- 3. FAO (2003) *World Crop Genetic Diversity: A Strategy for Conservation*
- 4. FAO (2004) *World Crop Genetic Diversity: A Strategy for Conservation*
- 5. FAO (2005) *World Crop Genetic Diversity: A Strategy for Conservation*
- 6. FAO (2006) *World Crop Genetic Diversity: A Strategy for Conservation*
- 7. FAO (2007) *World Crop Genetic Diversity: A Strategy for Conservation*
- 8. FAO (2008) *World Crop Genetic Diversity: A Strategy for Conservation*
- 9. FAO (2009) *World Crop Genetic Diversity: A Strategy for Conservation*
- 10. FAO (2010) *World Crop Genetic Diversity: A Strategy for Conservation*

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**Taxon delineation and selection of target taxa: UMa and JKI**

**Ecogeographic diversity analysis**  
– climate, soil, census: UMa  
– genetic analysis: JKI

**Selection of target sites: UMa and JKI**

**Establishment of a genetic reserve: PNM**

## Taxonomy and gene pools

Primary gene pool	<p><b>Genus Beta L.</b> Section <i>Beta</i> <i>B. vulgaris</i> L.</p> <ul style="list-style-type: none"><li>• subsp. <i>vulgaris</i> (cultivated beets)<ul style="list-style-type: none"><li>• Leaf Beet Group</li><li>• Garden Beet Group</li><li>• Fodder Beet Group</li><li>• Sugar Beet Group</li></ul></li><li>• subsp. <i>maritima</i> (L.) Arcang.</li><li>• subsp. <i>adanensis</i> (Pamuk.) Ford-Lloyd &amp; Will.</li></ul> <p><i>B. macrocarpa</i> Guss. <i>B. patula</i> Ait.</p>
Secondary gene pool	<p>Section <i>Corollinae</i> Ulbrich <i>B. corolliflora</i> Zosimovich <i>B. macrorhiza</i> Steven <i>B. lomatogona</i> Fisch &amp; Meyer <i>B. intermedia</i> Bunge <i>B. trigyna</i> Wald. &amp; Kid.</p> <p>Section <i>Nanae</i> Ulbrich <i>B. nana</i> Boiss. &amp; Heldr.</p>
Tertiary gene pool	<p><b>Genus <i>Patellifolia</i></b> (Moq.) A.J.S cott, B.V. Ford-Lloyd &amp; J.T. Williams) <i>P. patellaris</i> (Moq.) A.J. Scott et al. <i>P. procumbens</i> (C.Sm.) A.J. Scott et al. <i>P. webbiana</i> (Moq.) A.J. Scott et al.</p>

*Beta patula* Aiton



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*Beta vulgaris* L. subsp. *maritima* (L.) Arcang



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## Survey of beet resources in Madeira

Four beet CWRs (Press, 1994, Borges et al. 2008)

Primary gene pool

- *Beta patula* (M,D)
- *Beta vulgaris* subsp. *maritima* (M,PS,D)

Tertiary gene pool

- *Patellifolia procumbens* (M,PS,D,S)
- *Patellifolia patellaris* (PS,S)

Two beet crops

- *Beta vulgaris* subsp. *vulgaris* Leaf Beet Group (M,PS)
- *Beta vulgaris* subsp. *vulgaris* Fodder Beet Group (M,PS)



**Early state of the art**

**The target species – *B. patula* – is an:**  
**Endemic species**  
**Biannual plant growing in dry coastal places**  
**Rare critically endangered, according to IUCN criteria (area assessment)**

**Status protection:**

**Natura 2000 Network sites**  
**ID (Partial Protected Area)**  
**IC (Full Protected Area)**

**Geographical distribution**

**Population growing at:**  
**Ilheu do Desembarcadouro**  
**Ilheu Chão**

Assessment of *Beta* and *Patellifolia* distribution.  
Field work on Ilheu do Desembarcadouro (ID), Ponta de São Lourenço



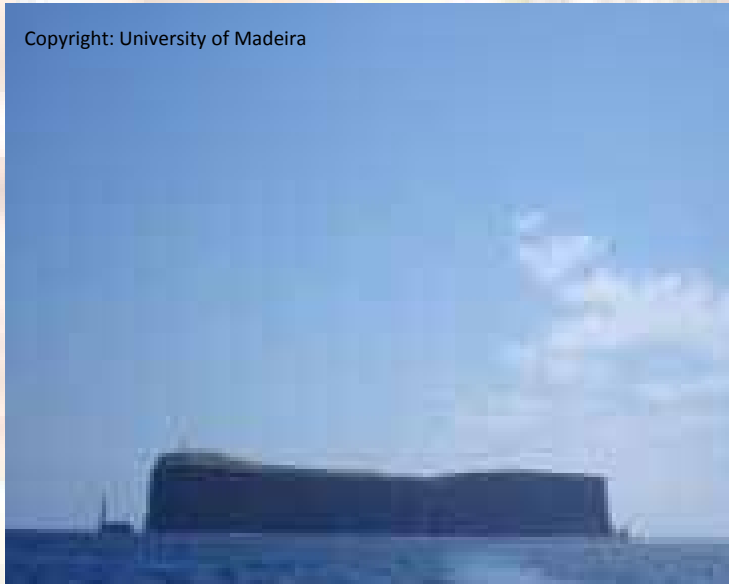
Set of field missions  
have been realized in:

- April to July 2008
- April to July 2009
- July 2010



# Assessment of *Beta* and *Patellifolia* distribution. Field work on Ilheu Chão (IC). Desertas Islands

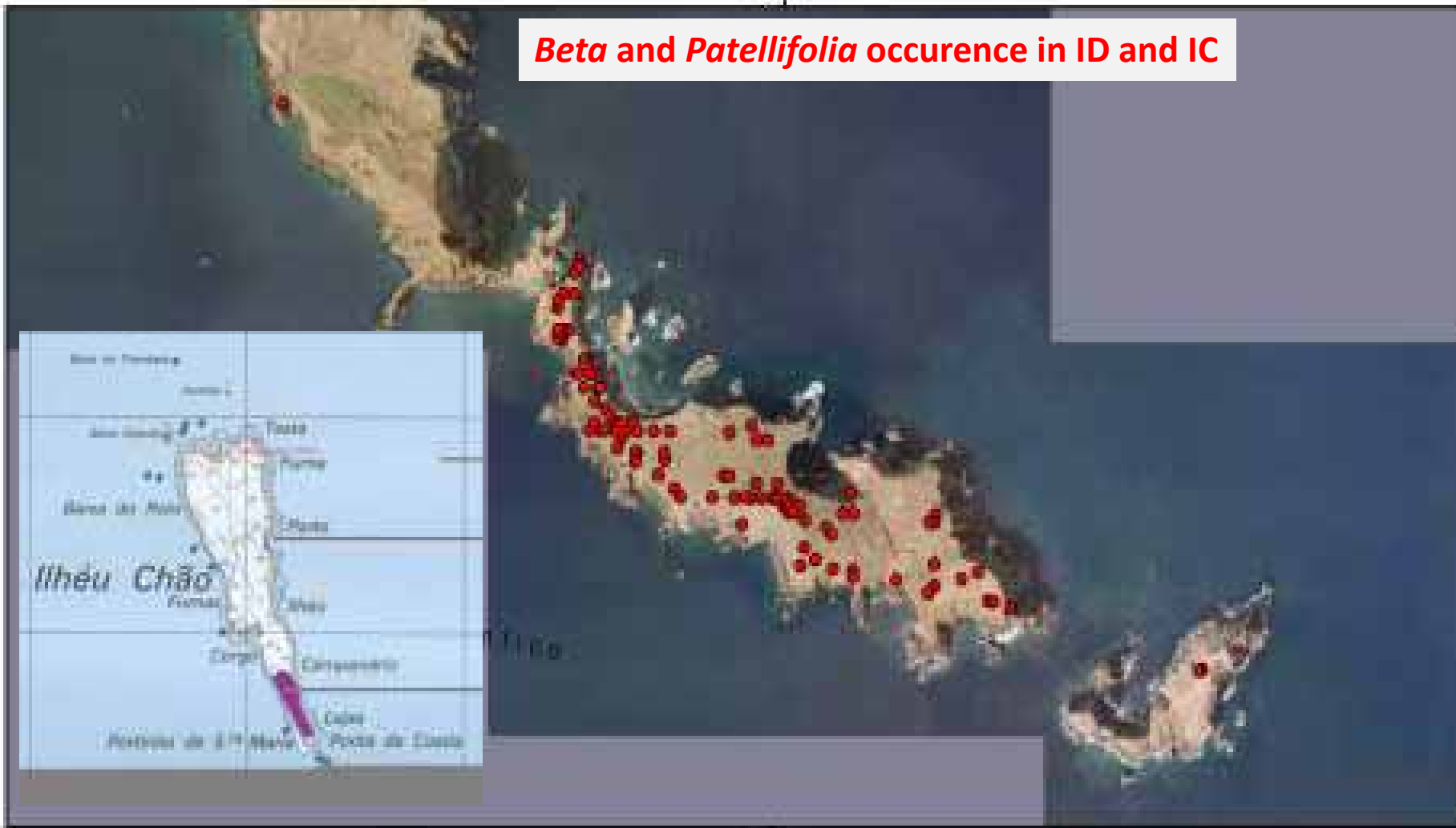
Copyright: University of Madeira



Set of field missions  
have been realized in:

- May/ June 2008
- May/ June 2009

**Beta and Patellifolia occurrence in ID and IC**



TÍTULO

# PROJECTO AEGRO

Localização das Amostras (Pormenor)

LEGENDA

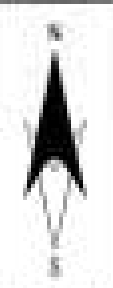
- |                   |                 |
|-------------------|-----------------|
| <b>Hipometria</b> | <b>Amostras</b> |
| 0 - 200 m         | ●               |
| 200 - 400 m       | ○               |
| 400 - 600 m       | □               |
| 600 - 800 m       |                 |
| 800 - 1.000 m     |                 |
| 1.000 - 1.200 m   |                 |
| 1.200 - 1.400 m   |                 |
| 1.400 - 1.600 m   |                 |
| 1.600 - 1.800 m   |                 |
| 1.800 - 2.000 m   |                 |

ESCALA

1:75.000  
Metros

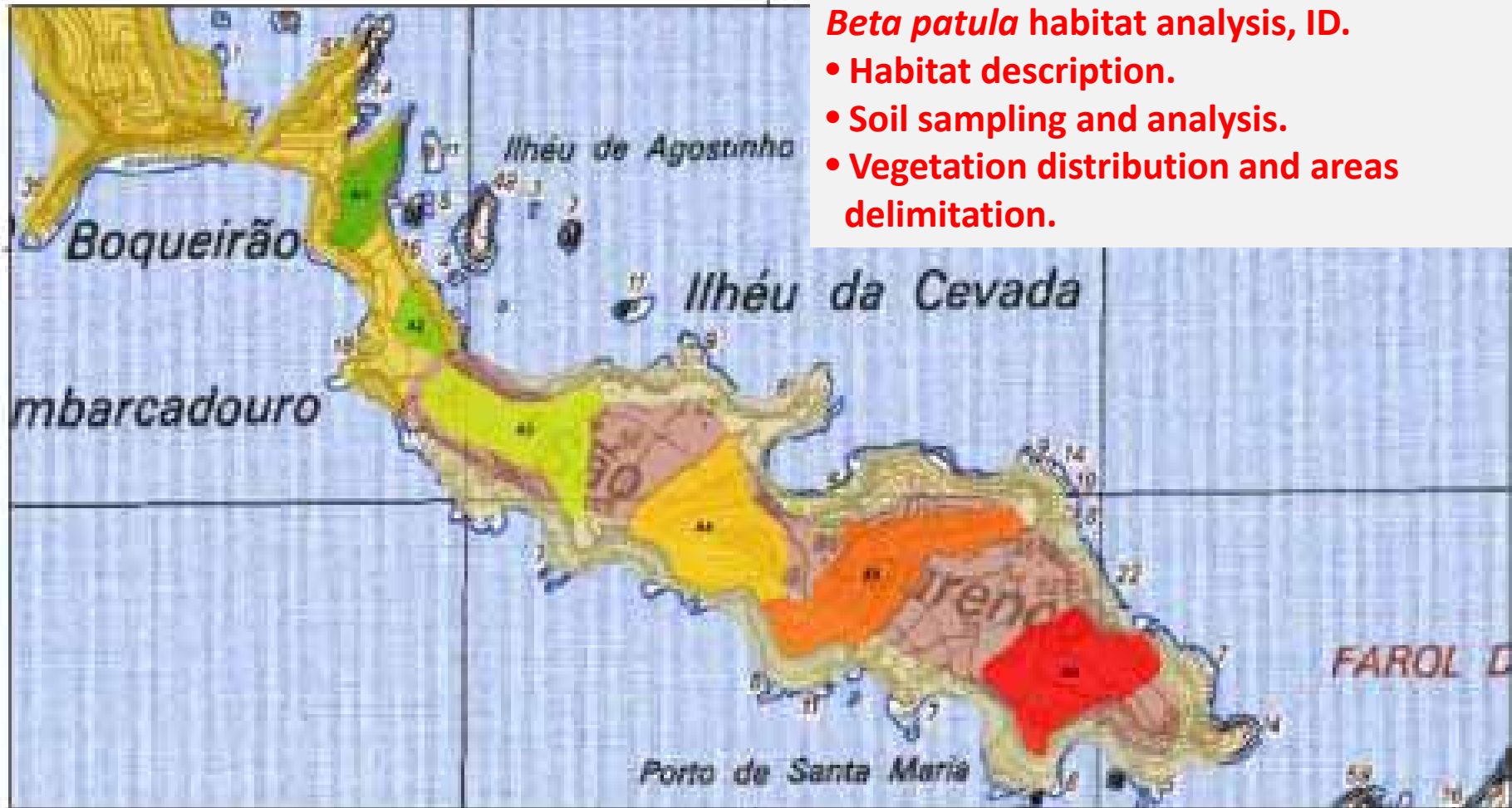
**INSTITUTO DE ESTUDIOS DE MONTANHA**  
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Responsável: Professor Doutor Miguel Ângelo P. Carvalho  
Cartógrafo: M<sup>o</sup>  
Folha Geológica - 0402



**Beta patula habitat analysis, ID.**

- Habitat description.
- Soil sampling and analysis.
- Vegetation distribution and areas delimitation.



**TITLE**

# AEGRO PROJECT

Agreement Number: SBT AGR/ICM RES 8192004  
Contract Number: AGR-008-008

## Soil Sample

**LEGEND**

Soil Sample	
31	31
32	32
33	33
34	34
35	35
36	36
37	37
Soils	
38	Terreno Cascaloso (TCu)
39	Terreno Alagado/Alto (TAa)
40	Terreno Riológico Escuro (TRa)

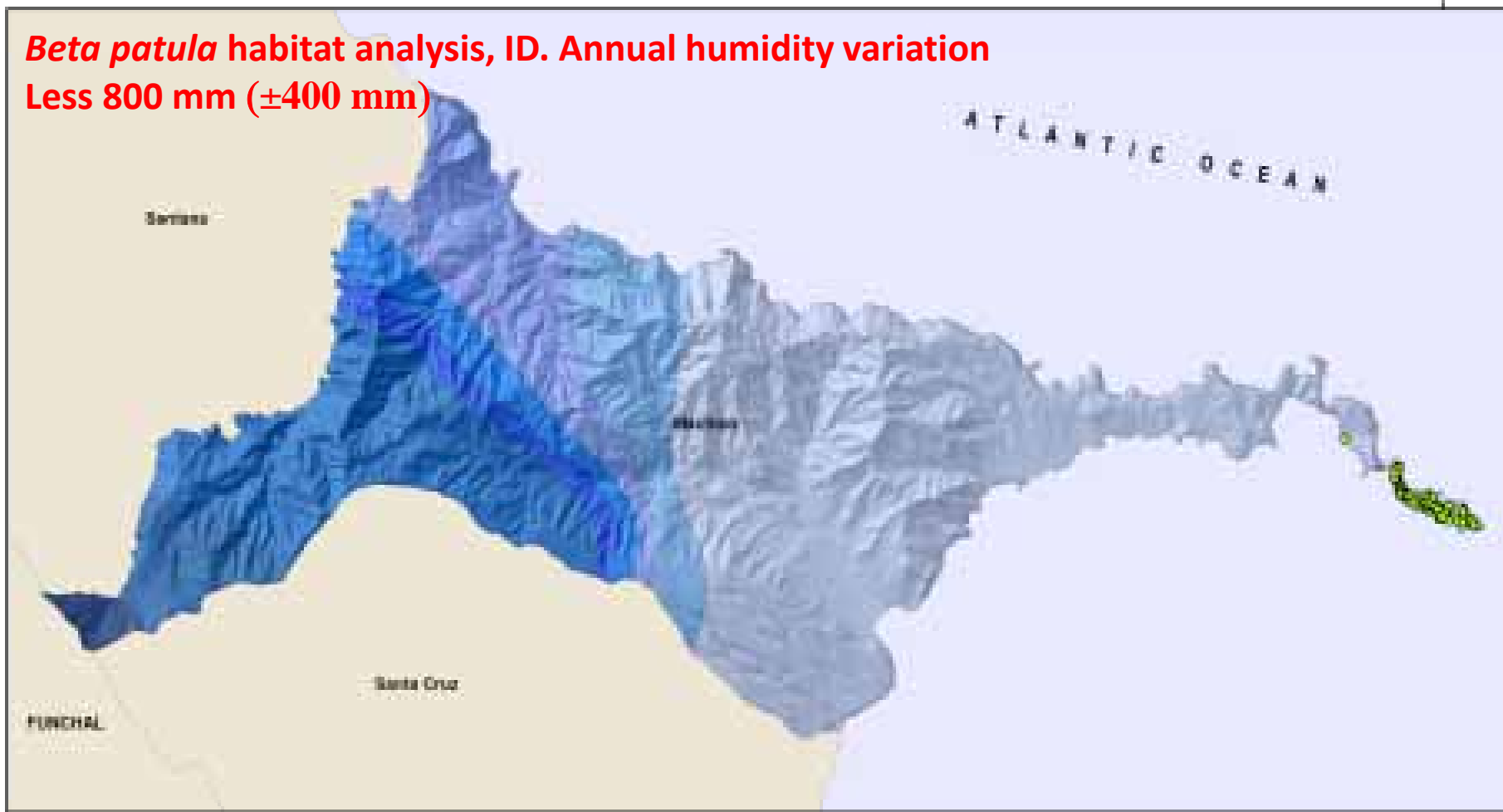
**MAP**



Departamento Centro de Estudos de Montanha  
Instituto de Ambiente  
Laboratório de Pedologia  
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Tel: +351 291 700 000  
Fax: +351 291 700 000



**Beta patula habitat analysis, ID. Annual humidity variation  
Less 800 mm ( $\pm 400$  mm)**



**TITILE**

**AEGRO  
PROJECT**

Agreement Number: SET AGR/IGDA/RES/STUC2014  
Contract Number: 6081/2008/2008

**Precipitation**

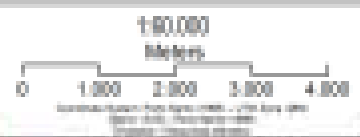
**LEGEND**

**Precipitation**  
Annual Average

Lightest Blue	< 800mm
Light Blue	800 e 1000mm
Medium Light Blue	1000 e 1200mm
Medium Blue	1200 e 1400mm
Dark Blue	1400 e 1600mm
Very Dark Blue	1600 e 2000mm
Darkest Blue	2000 e 2400mm
Darkest Blue	2400 e 2800mm

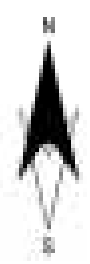
- Sample**  
■
- Municipality Boundaries**  
■

**ENTITLED TO: LEGEND**



Departamento Insular de Estatística do Arquipélago da Madeira  
Serviço de Estatística  
Comp. da Pólvora  
8000-000 Funchal - Madeira  
Tel: +351 291 700 000  
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Project Coordinator: Joana Regina Borges de Oliveira  
Borges



*Beta patula* habitat analysis.

Soil composition, comparison of ID areas sampled according to their plant coverture.

Occupation	Soil sampling area	Soil pH	Organic matter %	N ppm	P ppm	Ca meq /100g	K meq /100g	Na meq /100g	B ppm	Conductivity (mS/cm)
Eroded soil	ES1	7,7	0,8	150,0	343,0	27,0	3,8	1,7	4,1	69,0
	ES2	5,8	2,2	135,0	41,0	17,1	6,0	1,4	4,2	61,1
Alien species	AS1	6,0	6,0	145,0	1319,0	14,0	6,0	1,3	4,2	2,3
	AS2	6,6	2,1	140,0	398,0	10,4	6,5	1,0	4,2	2,3
Beta patula	BP1	5,6	4,1	155,0	234,0	12,1	7,5	1,9	4,2	3,6
	BP2	7,3	4,6	175,0	289,0	8,1	5,4	1,5	4,6	4,1
	BP3	7,4	3,0	10,0	453,0	11,8	0,9	1,4	4,1	7,0
	BP4	6,6	2,4	50,0	371,0	6,0	6,1	1,3	4,1	6,3

Tukey – Bonferroni tests shows statistical significant differences between ID Beta patula areas and IC soil sampling areas for phosphorus ( $P < 0.05$ ) and between ES areas against the other soil sampling areas for conductivity ( $P < 0.01$ ).



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### ***Beta patula* habitat description**

- Grassland on coastline.
- Relief, elevation 0 to 100 asl.
- Poor rocky soil.
- Annual mean temperatures: 18°C.
- Annual mean rainfall: less 800 mm
- Soil moisture: low, dry soil
- Stress factors: saline and/or hydric stress

**Beta and Patellifolia distribution in ID.**

**Beta patula growing area.**



**TITLE**

# AEGRO PROJECT

Agreement Number: OIT AGR GEN PES 8702084  
Contract Number: RDPN-008-8208

**Beta patula**

**LEGEND**

Covered Areas	Sample
Sp-A1	Sp-A1-1
Sp-A2	Sp-A1-2
Sp-A3	Sp-A2-1
Sp-A4	Sp-A2-2
Sp-A5	Sp-A3-1
Sp-A6	Sp-A3-2

1:10,000  
Meters

0 180 360 540 720

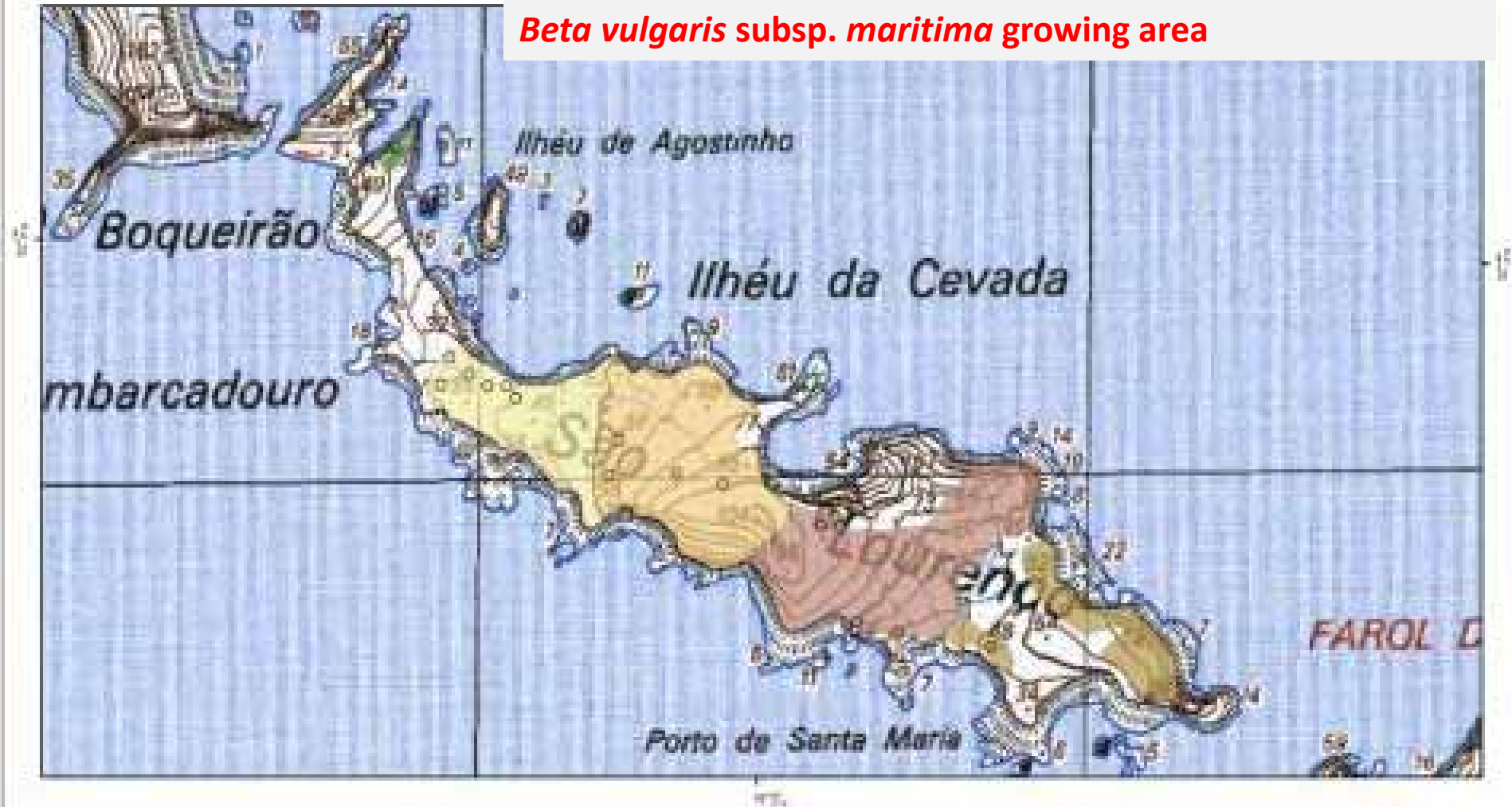
Department: Centro de Estudos de Recursos Genéticos e Melhoramento de Plantas  
Laboratório de Patógenos  
6000-348 Faro, Portugal  
Tel: +351 289 700 300  
Fax: +351 289 700 300

**N**

**S**

**Beta** and *Patellifolia* distribution in ID.

**Beta vulgaris subsp. maritima** growing area



**TITLE**

# AEGRO PROJECT

Agreement Number: DT AGR/LEA RES 87/0204  
Contract Number: 4291-028-008

*Beta vulgaris maritima*

**LEGEND**

Covered Areas	Sample
Bm-A1	Bm-D-1
Bm-A2	Bm-D-2
Bm-A3	Bm-D-3
Bm-A4	Bm-D-4
Bm-A5	Bm-D-5
Bm-A6	Bm-D-6
Bm-A7	Bm-D-7
Bm-A8	Bm-D-8

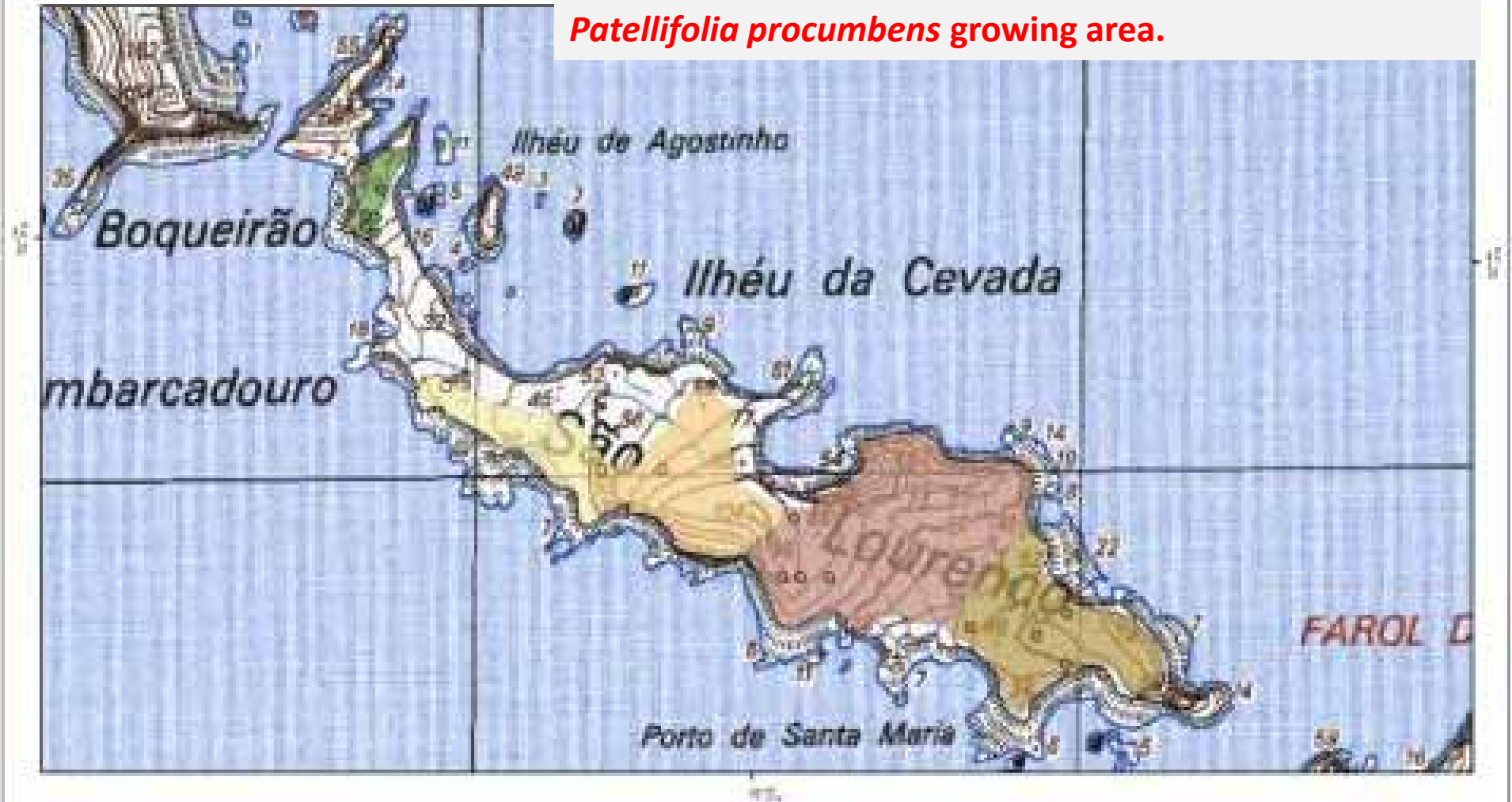
1:50,000  
Meters

0 100 200 300 400

Department: Centro de Estudos de Botânica  
Universidade de Madeira  
Laboratório de Fitosociologia  
8000-109 Funchal - Madeira  
Tel: +354 291 800 200  
Fax: +354 291 800 200

Project Coordinator: Susana Inácio Rodrigues  
BIOGEO: Susana Inácio Rodrigues, 2008

**Beta and *Patellifolia* distribution in ID.**  
***Patellifolia procumbens* growing area.**



**TITLE**

# AEGRO PROJECT

Agreement Number: SBT AGR/ICM RES. 87/02064  
 Contract Number: AGR-008-008

*Patellifolia procumbens*

**LEGEND**

Covered Areas	Sample
<span style="color: green;">■</span> Pp-01	<span style="color: green;">●</span> Pp-01
<span style="color: yellow;">■</span> Pp-02	<span style="color: yellow;">●</span> Pp-02
<span style="color: orange;">■</span> Pp-03	<span style="color: orange;">●</span> Pp-03
<span style="color: brown;">■</span> Pp-04	<span style="color: brown;">●</span> Pp-04
<span style="color: red;">■</span> Pp-05	<span style="color: red;">●</span> Pp-05

**SCALE**



Department: Centro de Estudos de Microorganismos  
 Instituto de Medicina  
 Universidade Federal de Pernambuco  
 Rua J. Soares de Sousa, 1000  
 CEP: 50670-900, Recife, PE  
 Tel: (51) 3241-1000

Project Coordinator: Susan Rojas-Ruiz  
 SBT/ICM, Universidade Federal de Pernambuco





## Summary of the analysis of the distribution of *Beta* and *Patellifolia* species

The study shows:

- Three of 4 beet CWRs in Madeira are present in the ID and IC;
- These CWRs share the same habitat and distribution areas;
- *P. procumbens* shows the widest and most uniform distribution;
- *B. patula* has the most fragmented distribution area;
- Five main spots *B. patula* have been delimited.
- Extrapolated area of occurrence of *B. patula* accounts for 89,154 sq meters.

**Target species, *B. patula***

**Plant census for baseline determination. Field work experimental design.**

- Two (2) linear transects along ID.
- Fifty (50) squares of 1 sq m area disposed linearly along the transects.
- Minimal distance between squares 40 to 50 m.
- Georeferencing of census squares and sampled plots



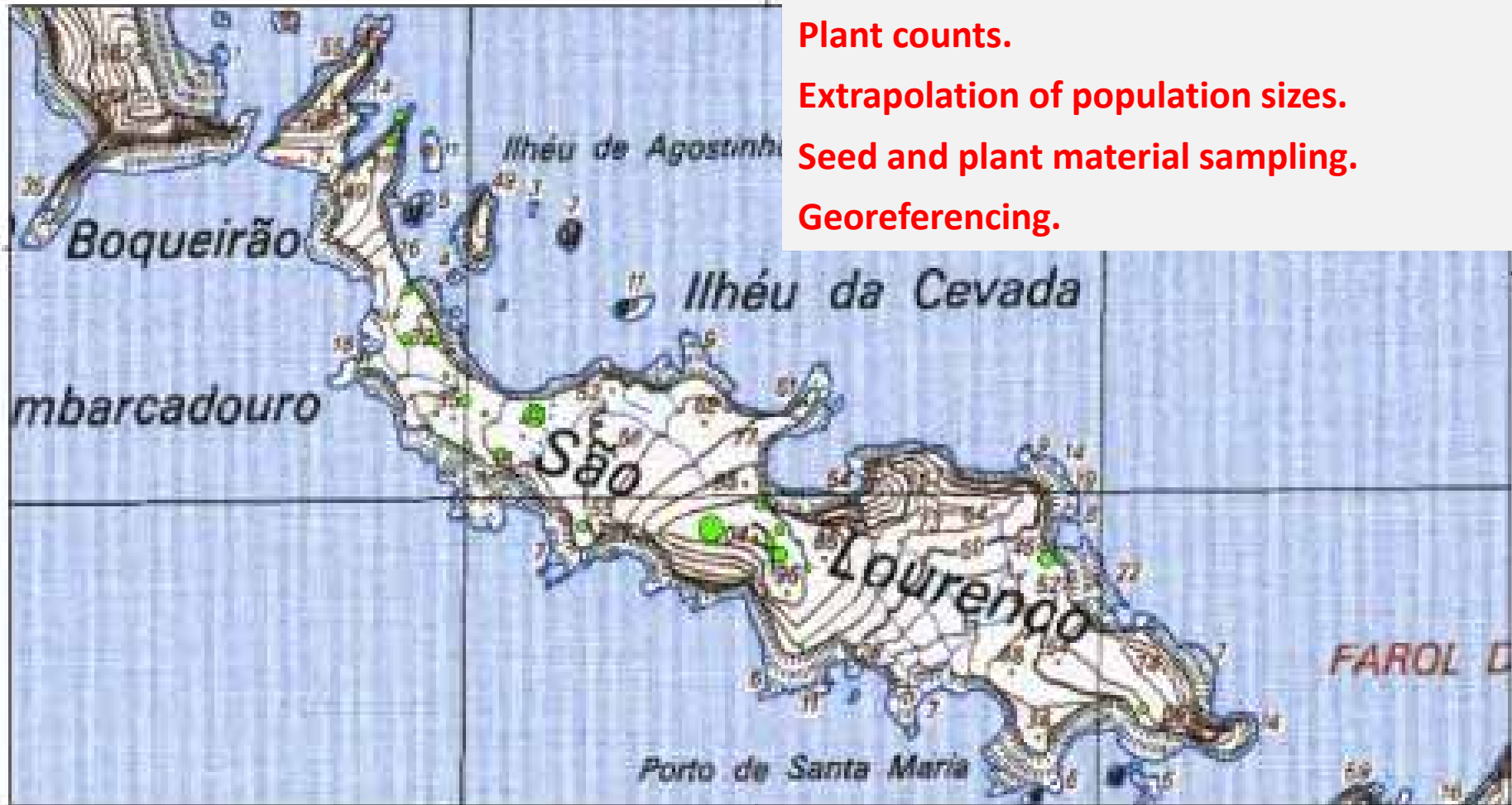
Beta patula census in ID.

Plant counts.

Extrapolation of population sizes.

Seed and plant material sampling.

Georeferencing.



TITLE

# AEGRO PROJECT

Agreement Number: INT AGRO GEN RES ETH/2004  
Contract Number: MFR-2004-028

*Beta patula*

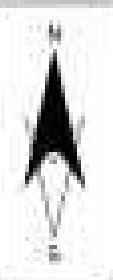
LEGEND

- Sample Individual Counting
- 1-2
  - 3-20
  - 21-50
  - 51-75
  - 76-100

1:6,000  
Meters

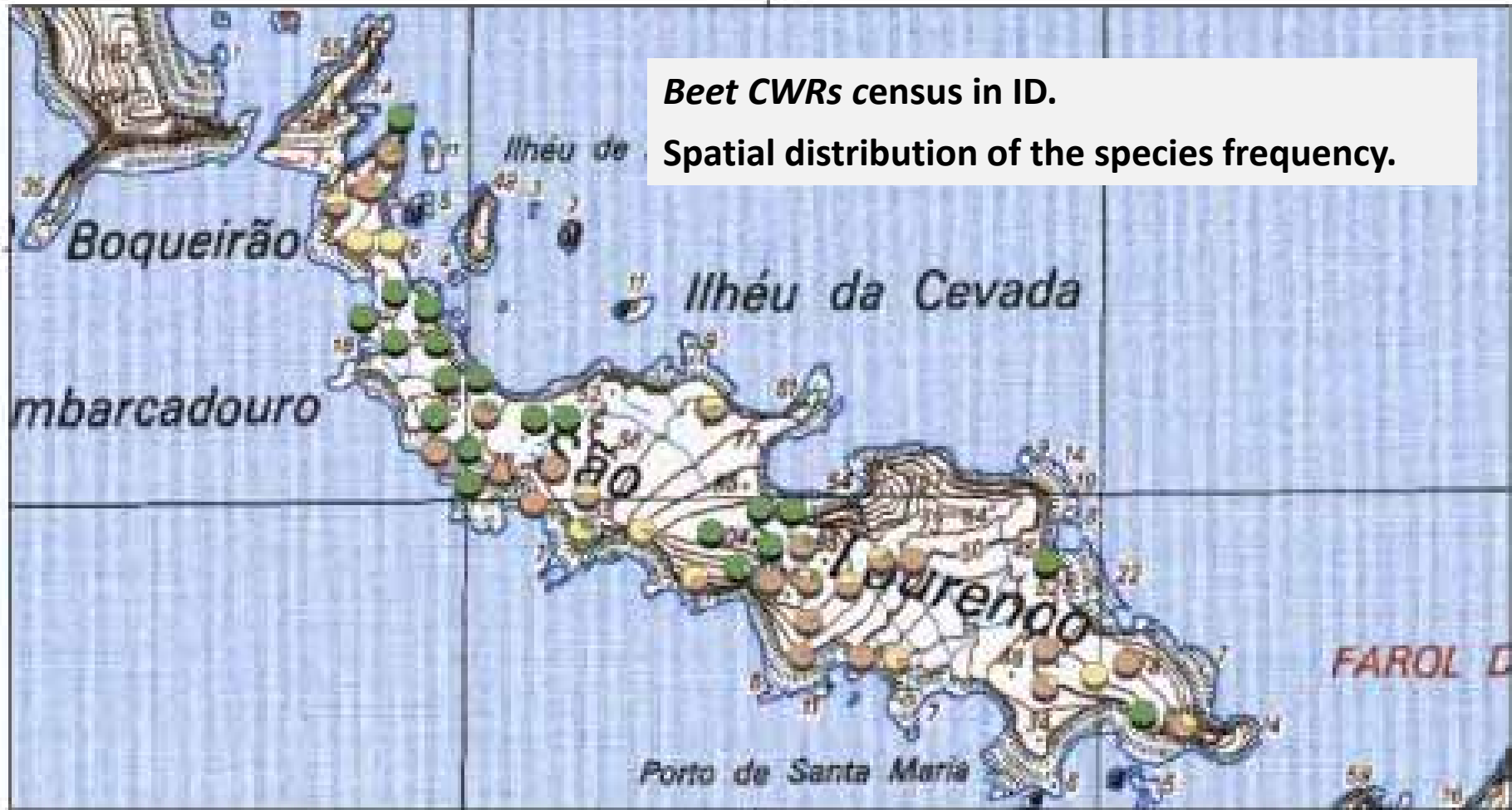
Department of Ecology and Environment  
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Campus de Pôrto de Pedras  
BR-116 Pôrto de Pedras - Pôrto de  
Pedras - RJ 22451-900, Brazil  
Tel: +55 (21) 251-7500  
Fax: +55 (21) 251-7500

Project Classification: Green House Project of Genetic  
Banking - Conservation of Biodiversity (CIB)



**Beet CWRs census in ID.**

**Spatial distribution of the species frequency.**



**TITLE**

# AEGRO PROJECT

Agreement Number: SBT AGR/ICM RES 87102064  
Contract Number: AGR/ICM 008-009

## Composite Samples

**LEGEND**

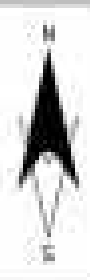
- Beetle CWRs*
- Plant CWRs*
- Marine CWRs*

**INTRODUCTION**



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Laboratório de Parasitologia  
RUA 288 Funchal - Portugal  
Tel: +351 291 700 288  
Fax: +351 291 700 288

Project Coordinator: Susana Regina Lopes-Ferreira  
BIOGEO: Universidade do Algarve, Faro, Portugal



## Summary of census data

The data show the following trends for *B. patula* population in ID:

- *B. patula* and *B. vulgaris* subsp. *maritima* grow sympatrically;
- Species patches show high percentage of mature plants producing seeds;
- The census data *B. patula* has used to extrapolate the species population in the ID, based on n° census squares, population area and expected percentage of occurrence.
- Our estimates shows that *B. patula* population comprises 14,000 to 27,000 individuals
- Field observations in times series from 2008 to 2010 have shown high dynamic changes of *B. patula* spots.
- 41% of initial squares do not show regeneration during the 2 years
- Seed banks have been detected in 66% of the controlled squares.

**Data will contribute to the elaboration of a National (P and G) and European recommendations and strategy for in situ conservation of CWR genetic resources.**

Conclusions for *B. patula* genetic reserve planning and implementation

- Madeira political status: **Autonomous Region of Portugal.**
- Environmental policies are ruled by **Regional Office for Environment and Natural Resources.**
- Entity in charge for environmental and resources policies implementation: **Natural of Park of Madeira (PNM).**
- PNM actually manages 10 protected areas, including Desertas and Ponta São Lourenço.
- Target areas for implementation of *B. patula* genetic reserve:
  - Ponta São Lourenço (Ilheu Desembarcadouro), already a Partial Protected Area, population I of *B. patula*.
  - Desertas (Ilheu Chão), already a Full Protected Area, *B. patula* population II.
- Legal Resolutions: nº1408/2000, JORAM nº85, 22 September 2000 (directive I: habitats; directive II: species, *B. patula* )

**Recommendations for *in situ* management and genetic reserve guidelines.**

**Action plan to support to *B. patula* genetic reserve implementation**

**Current status:** protected.

**Site safeguard and management:** currently exist

**Current research action:** Species distribution and population sizes established. Species demographic and genetic baseline, under way.

**Future research:** Monitoring of *B. patula* populations, during a larger time period. Evaluation of the importance of *B. patula* as PGRFA (see poster Schliephake et al.).

**Treats and factors of diversity loss or decline:** need to be assessed, but alien species and habitat degradation (acidification by seagulls) seems to be important factors

**Action plan, with objectives and targets:** need to be proposed?

**Communication of results:** to be planned with local authorities, including PNM

## Acknowledgements

We would like to thank the Parque Natural da Madeira (PNM), the Nature Wardens of PNM as well as the Portuguese Navy for the safety navigation to “Ilhéu Chão” and back to the Madeira Island. We would also like to thank DRIGOT for providing us with all the necessary maps.

This work is part of Workpage 6, case study *Beta*, of the EU project AGRI GENRES 057  
“An integrated European in situ management work plan: implementing genetic reserve and on farm concepts”

coordinated by the Julius Kühn Institute and co-funded by the  
EU Commission, DG AGRI within the framework of Council Regulation 870/2004.

Thank you for your attention

