Habitat mapping of the higher grounds of the Ria de Alvor, Algarve, Portugal

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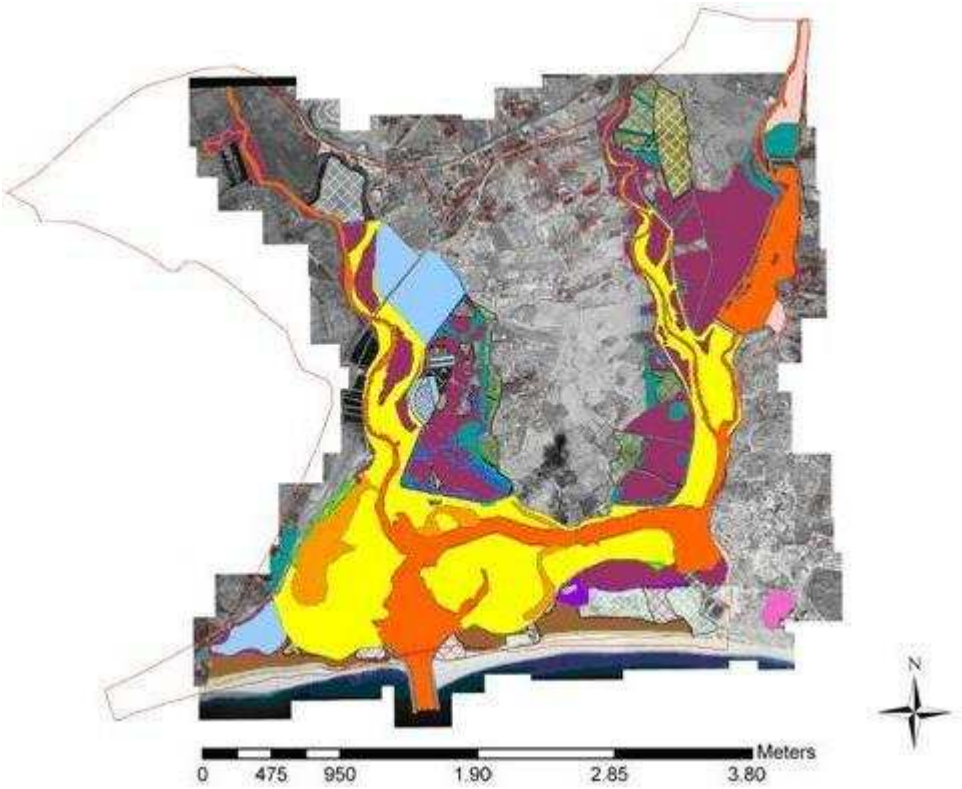
Introduction

The Ria de Alvor is a wetland system of 1,454 hectares big. It is situated at the western part of the Algarve, Portugal, in between the cities of Lagos and Portimão at 37º08'N and 008º37' W. The area is a Ramsar site and classified as a protected landscape area; a national ecological reserve (Ramsar 2005). The Ria de Alvor is an estuarine ecosystem with sand dunes, mudflats, salt-marshes and saline areas. The area is of high importance for among others the many migrating waders, resident birds and aquatic wildlife. The Ria de Alvor is also of great botanical value, for example *Linaria algarviana* and *Thymus camphorates* are present. Additionally, the area plays an important role in the flood control and the groundwater recharge (Wetlands 2005). Present areas of traditional farmland and semi-natural scrubland are included in the Natura 2000 site (A Rocha 2005).

The Ria de Alvor is a basis for numeral research projects, mainly carried out by 'A Rocha Portugal'. The availability of an accurate habitat map is of importance for a number of ongoing and future studies, and for the management planning of the area. Baker (2005) used a coded habitat map of the area, created by the Natura 2000 working group, to review the original Natura 2000 area map and to refine the distinctions made between the Natura 2000 habitat categories at Ria de Alvor. She created a more refined habitat map of the wetland areas of the Ria de Alvor (figure 1). A currently accurate map of the higher ground area was yet not available. Therefore, these areas were investigated to be able to create a habitat map for the whole area.



Legend

- RdAlvor_N2K
- 1110 - Sandbanks which are slightly covered by sea water all the time
- 1130 - Estuaries
- 1140 - Mudflats and sandflats not covered by sea water at low tide
- 1150 - Coastal Lagoons
- 1150 Dry - Coastal Lagoon (Area that should be flooded but currently dry)
- 1210 - Annual vegetation of drift lines
- 1310 - Salicornia and other annuals colonising mud and sand
- 1320 - Spartina swards (Spartinion maritimae)
- 1410 - Mediterranean salt meadows (Juncetalia maritimi)
- 1420 - Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi)
- 1430 - Halo-nitrophilous scrubs (Pegano-Salsoletea)
- 1510 - Mediterranean salt steppes (Limonietalia)
- 2110 - Embryonic shifting dunes
- 2120 - Shifting dunes along the shoreline with Ammophila arenaria (white dunes)
- 2130 - Fixed coastal dunes with herbaceous vegetation
- 2230 - Malcolmietalia dune grasslands
- 3170 - Mediterranean temporary ponds
- 6210 - Semi-natural dry grasslands
- 6420 - Mediterranean tall humid herb grasslands of the Molinio-Holoschoenion
- 92D0 - Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae)
- BS - Bare Soil
- DA - Disturbed Area (Ploughed, rubbish dumped etc.)
- DM - Dredged Material
- EX - Exotic Species Dominate
- MS - Mediterranean Scrub
- NM - Natural Material (cut grasses, turf, farm waste)
- PS - Pasture
- SW - Standing Water

Figure 1: habitat map of the wetland areas of the Ria de Alvor (Baker 2005)

2. Methodology

2.1 The study site

The research area was situated within the Ria de Alvor and included the higher ground areas. The site was about 264 hectares big and consists, in a geologically view, primarily of limestone, and red sand soils from the Pleistocene. The area mainly comprised of (recently) cultivated agricultural land, and land that had been fallow for several years and/ or used as pasture. Furthermore, irrigated agriculture and market gardens were present in the area. Scrubland and forestry were only present in a small percentage of the area.

2.2 Habitat mapping

The fieldwork period started early October 2005 and proceeded until November 2005. The basis for the habitat mapping of the area of Ria de Alvor forms the habitat map created by Baker (2005)(figure 1), which is a refined map based upon the existing Natura 2000 Habitat Map created by the Natura 2000 working group. The map was based upon an aerial photograph from the area,. The area was divided in land parcels with use of the photograph. The division was based upon clearly visible differences in habitat type or land use, and/or based upon the presence of fences, natural borders, roads and waterways. With the help of this map, the location of the different habitat types was recorded in the field using a Magellan 315 Global Positioning System device (GPS). Since the satellite image is dated at 19xx, changes in habitat, land use, and the presence of linear features were adjusted by taking GPS points in the field. The data was stored in ArcView GIS 8.3. The projected coordinate system UTM-WGS1984-29N was used to map the data.

Due to a high number of private grounds and fences in the area, the access was in a considerable part, mainly in the north-western area, restricted to the tracks. Therefore some of the borders between habitat types/ land use were based upon the aerial photograph.

2.3 The habitat classification

The habitat types were classified based upon EUNIS, European Nature Information System (EUNIS 2005), CORINE Biotopes Classification (CORINE 1991), and PROTAL, A preliminary classification of the defined ecological units in the Algarve region by CCDR (Comissão de Coordenação e Desenvolvimento Regional do Algarve). These classifications were used while it also incorporates agricultural, horticultural and domestic habitats, whereas the classification used by Baker, the Natura 2000 habitat types, does not. EUNIS, CORINE and as well PROTAL did not cover all the habitat types, therefore an adjusted classification has been used. Table 1 shows the used habitat classes. Table 2 shows the EUNIS, CORINE and PROTAL habitat types where the classification was partly based upon.

The habitat was divided into; 1) dry land agriculture, 2) irrigated agriculture, 3) forestry, 4) scrubland, , and 5) habitations and other built development. Linear features such as hedges, canals and roads were already defined.

1. Dry land agriculture; a considerable part of the area consisted of dry land agriculture. A division was made between:
    a. Arable or short-term fallow; habitat was classified as arable or short term fallow whenever the land was cultivated, ploughed and/or whenever the density of plant species such as *Dittrichia viscosa* and *Foeniculum vulgare* was still low (less than 20% coverage). The density of these species was used as an indicator between short and long term fallow.
    b. Long term fallow and/or pasture; habitat was classified as long term fallow and/or pasture, when the density of *Dittrichia viscosa* and *Foeniculum vulgare* was high (more than 20% coverage), and/ or whenever the land was unsuitable for cultivation caused by steepness and/ or the presence of rocks.
    c. Orchards of almond, fig and/or carobs; the habitat was classified as such if the density of either one or more of the species *Ceratonia siliqua*, *Ficus carica*, *Prunus dulcis* covered more than 40% of the area.
    d. Olive orchards; the habitat was classified as such if the major tree specie was *Olea europeae* (figure) and if it covered more than 40% of the area.
    e. Vineyards
2. Irrigated agriculture
    a. Market gardens; mainly consisted of small sized areas with irrigated crops such as cove, lettuce, pumpkin, peppers, etc.
    b. Citrus orchard; the habitat was classified as citrus orchard whenever citrus trees where the main species and if they covered more than 40% of the area
    c. Other irrigated orchard; for instance palm trees
3. Forestry
    a. Pine plantation; the habitat was classified as a pine plantation whenever the area that was covered consisted of more then 50% of *Pinus pinea* and/ or *Pinus pinaster*.
    b. Eucalyptus plantation; the habitat was classified as an eucalyptus plantation whenever the area that was covered consisted of more then 50% of *Eucalyptus cinerea.*
4. Scrubland; there are two types of scrubland present in the area
    a. Coastal matos; the coastal matos is based upon the ‘Thermo-Mediterranean shrub formations’ and ‘Western meso-Mediterranean calcicolous garrigues’ described by CORINE and ‘Thermo-Mediterranean scrub’ and ‘Western garrigues’ described by EUNIS (appendix 1). The main species found are: *Cistus* species (*C. salvifolius, C. albidus, C. monspeliensis, C. ladanifer, C. crispus*), *Genista Hirsuta, Pistacia lentiscus, Quercus coccifera* and *Thymus camphorates.*
    b. Limestone outcrop scrubland; the following species can be found among others on the Limestone outcrop scrubland: *Asparagus albus, Chamaerops humilis, Daphne gnidium, Pistacia lentiscus, Pyrus bourgeana, Rhamnus alaternus* and *Rhamnus lycioides.*

5. Habitations and other built development
    a. House and garden
    b. Town
    c. Village
    d. Farm buildings
    e. Industrial
    f. Wasteland
    g. Ruins

Habitat classes	***Code***	***Habitat types***
Dryland Agriculture	D1	Arable or short-term fallow
	D2	Long term fallow and pasture
	D3	Pasture with low density shrubs/trees
	D4	Orchard of almond, fig and/or carobs
	D5	Olive orchard
	D6	Vineyard
	D7	Naturalized abandoned orchard
Irrigated Agriculture	I1	Market gardens
	I2	Citrus orchard
	I3	Other irrigated orchard
Forestry	F1	Pine plantation
	F2	Eucalyptus plantation
Scrubland	S1	Coastal matos
	S2	Limestone outcrop scrubland
Habitations/Other Built Development	H1	House and garden
	H2	Town
	H3	Village
	H4	Farm buildings
	H5	Industrial
	H6	Wasteland
	H7	Ruins

Table 1: The habitat classification, partly based upon the European Nature Information System (EUNIS 2005) and CORINE Biotopes Classification (1991) (appendix 1).

Used habitat classification		*CORINE code and description*		*EUNIS code and description*		*PROTAL Ecological units*
	DRYLAND AGRICULTURE					
D1	Arable or short-term fallow	82,3	Extensive cultivation	I1.3	Arable land with unmixed crops grown by low-intensity agricultural methods	Arvenses de sequeiro e pastagens
		87,1	Fallow Fields	I1.52	Fallow un-inundated fields with annual weed communities	
				I1.51	Bare tilled land	
D2	Long term fallow and pasture	34,52		E1.3	Mediterranean xeric grassland	
			Southwestern Mediterranean perennial pastures	E1.32	Southwestern Mediterranean perennial pastures	
D3	Orchard of almond, fig and/or carobs	83,14	Almond groves			Pomares de sequeiro
D4	Olive orchard	83,11	Olive groves			
D5	Vineyard	83,21	Vineyards			
	IRRIGATED AGRICULTURE					
I1	Market gardens	82,12	Market gardens and horticulture	I1.22	Small-scale market gardens and horticulture, including allotments	
I2	Citrus orchard	83,16	Citrus orchards			
I3	Other irrigated orchard	83,15	Fruit orchards (Rosaceae)			
		83,18	Other high stem orchards			
	FORESTRY					
F1	Pine plantation	83,3112	European pine plantations	G3.73	Stone pine forests	Pinhais
				G3.72	Mesogean pine forests	
				G3.74	Aleppo pine forests	
F2	Eucalyptus plantation	83,322	Eucalyptus plantations			
	SCRUBLAND					
S1	Coastal matos	32,2	Thermo-Mediterranean shrub formations	F5.5	Thermo-Mediterranean scrub	Matos litorais calcários
		32,4	Western meso-Mediterranean calcicolous garrigues	F6.1	Western garrigues	Matos litorais calcários
S2	Limestone outcrop scrubland					
	HABITATIONS/ OTHER BUILT DEVELOPMENTS					
H1	House and garden			I2.21	Ornamental garden areas	
H2	Town	86,1	Towns			
H3	Village	86,2	Villages			
H4	Farm buildings	86,5	Greenhouses and other agricultural constructions			
H5	Industrial	86,43	Railroad switch yards and other open spaces			
H6	Wasteland	87,2	Ruderal communities			

Table 2: The used CORINE, EUNIS and PROTAL codes for the habitat classification

4 Results

The resulting habitat map, which includes both the higher and the lower ground areas, is shown in Figure 2.

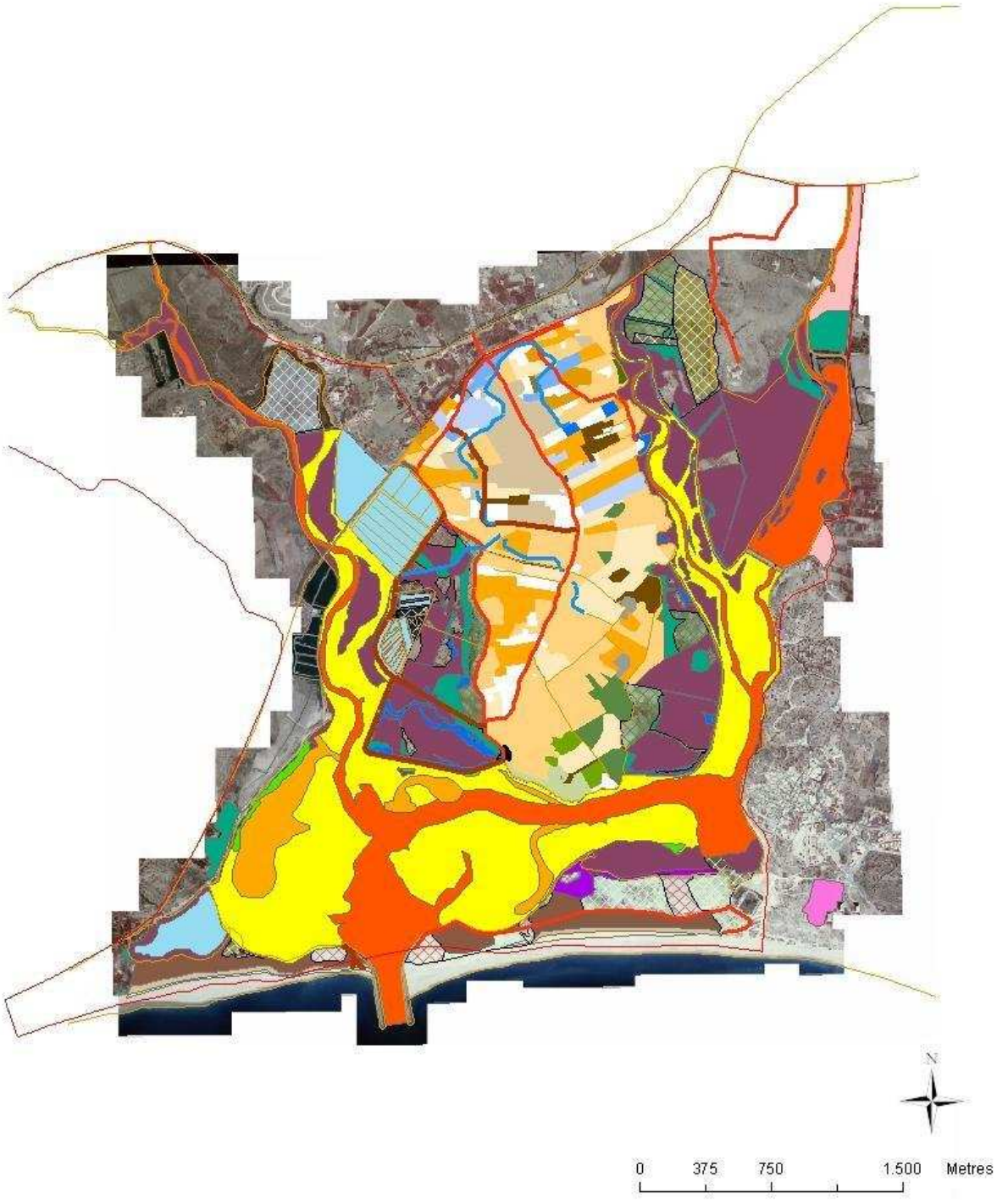


Figure 2: Habitat classification map of The Ria de Alvor

Table 3 and figure show the amount of coverage per habitat type, the total amount and in percentages. The most common land use type is long term fallow or pasture land (37%), followed by arable or short term fallow land (13%) and by orchards of almond, fig and or carobs (12%). Also low density mixed orchard on arable or short term fallow land is present in a high density (10%). Furthermore, about 9% of the area is consumed by houses and gardens.

Code	*Habitat*	*Total size (ha)*	*Percentage*
D1	Arable or short term fallow	33,05	12,53
D2	Long term fallow or pasture	97,31	36,89
D3	Orchard of almond, fig and or carobs	32,94	12,49
D4	Olive orchard	4,38	1,66
D5	Vineyard	0,48	0,18
D6	Old orchard, mixed trees and shrubs	8,08	3,06
D7	Low density mixed orchard on arable or short term fallow land	25,81	9,78
F1	Pine plantation	3,22	1,22
F2	Eucalyptus plantation	0,56	0,21
H1	House and garden	23,78	9,01
H4	Farm buildings	1,65	0,63
H5	Industrial	0,35	0,13
H6	Wasteland	1,02	0,39
H7	Ruins	0,41	0,16
I1	Market gardens	9,67	3,67
I2	Citrus orchard	6,08	2,31
I3	Other irrigated orchard	1,53	0,58
S1	Coastal matos	4,44	1,68
S2	Limestone outcrop	9,04	3,43
Total		*263,80*	*100,00*

Table 3: Total amount of coverage per habitat type in The Ria de Alvor in hectares and in percentages

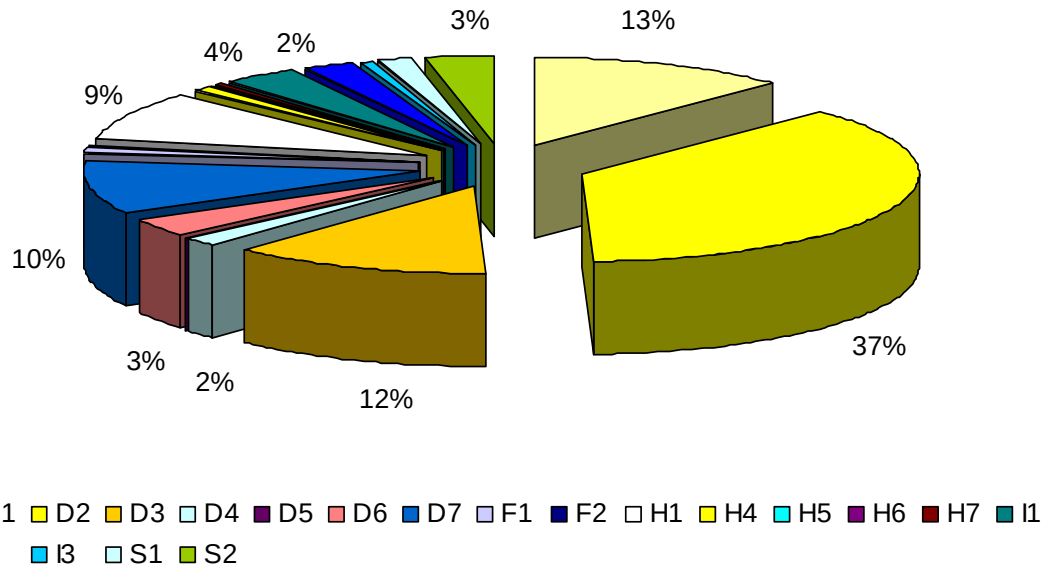


Figure 3: Pie chart of the total amount of coverage per habitat type in The Ria de Alvor in percentages. Only the percentages of the habitat types with of coverage ≥2 are given. D1 Arable or short term fallow, D2 Long term fallow or pasture, D3 Orchard of almond, fig and or carobs, D4 Olive orchard, D5 Vineyard, D6 Old orchard, mixed trees and shrubs, D7 Low density mixed orchard on arable or short term fallow land, F1 Pine plantation, F2 Eucalyptus plantation, H1 House and garden, H4 Farm buildings, H5 Industrial, H6 Wasteland, H7 ruins, I1 Market gardens, I2 Citrus orchard, I3 Other irrigated orchard, S1 Coastal matos, S2 Limestone outcrop

5 Discussion

When using this map as a reference, it must be noted that some of the borders in the north-western area might not be completely accurate. Due to a high number of private grounds and fences in this area, the access was restricted to the tracks. Therefore some of the borders between habitat types/ land use were based upon the aerial photograph. Furthermore, the division between D1 Arable or short-term fallow and D2 Long term fallow and pasture might be narrow. After the habitat classification and the heavy rains, areas classified as D1 arable or short term fallow, have been used as grazing fields. The land use of these areas are likely to be susceptible to the seasons.

A suggestion for further work is to classify the areas of the Ria the Alvor to the north of the railroad, and the area in the north-east, which is named Abicada, that is left unclassified.

References

Literature

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