

**CONSERVATION STATUS OF MEDITERRANEAN
TEMPORARY PONDS IN CAMPO MILITAR DE SANTA
MARGARIDA (RIBATEJO, PORTUGAL)**

A. Rosselló-Graell*, D. Draper & C. Tauleigne Gomes

Museu, Laboratório e Jardim Botânico da Universidade de Lisboa. R. Escola Politécnica,
58. 1250 - 102 Lisboa. Portugal. E-mail: arossel@fc.ul.pt

Rosselló-Graell, A., Draper, D. & Tauleigne Gomes, C. (2000).
Conservation status of mediterranean temporary ponds in
Campo Militar de Santa Margarida (Ribatejo, Portugal).
Portugaliae Acta Biol. **19**: 191-199.

An approach to the conservation status of Mediterranean
temporary ponds located at Campo Militar de Santa Margarida
(Ribatejo, Portugal) is presented. Two conservation indexes
were applied to this aquatic ecosystem in order to evaluate its
preservation status.

Preliminary results suggest that these freshwater habitats have
a relevant conservation value and a significant ecological
importance in the Iberian Peninsula.

Finally, main threats are pointed out and several management
measures are suggested.

This work also attempts to improve the knowledge of
Portuguese aquatic ecosystems and to contribute to its
management.

Key words: Mediterranean temporary ponds, aquatic eco-
systems, conservation indexes, military areas.

Rosselló-Graell, A., Draper, D. & Tauleigne Gomes, C. (2000).
Estado de conservação das lagoas temporárias mediterrâneas
localizadas no Campo Militar de Santa Margarida (Ribatejo,
Portugal). *Portugaliae Acta Biol.* **19**: 191-199.

É apresentada uma aproximação ao estado de conservação das
lagoas temporárias mediterrâneas localizadas no Campo Militar
de Santa Margarida (Ribatejo, Portugal). Foram aplicados dois
índices de conservação a este ecossistema aquático para avaliar
o seu estado de preservação.

* Work financed by a PRAXIS XXI grant BM/17918/98 of the Fundação para a Ciência e a Tecnologia.

Resultados preliminares sugerem que estes habitats de água doce têm um alto valor para a conservação e uma importância ecológica significativa na Península Ibérica.

Finalmente, as principais ameaças são apontadas assim como são sugeridas várias medidas de gestão.

Este trabalho tenta também melhorar o conhecimento sobre estes ecossistemas aquáticos portugueses e contribuir para a sua gestão.

Palavras chave: Lagoas temporárias mediterrâneas, ecossistemas aquáticos, índices de conservação, áreas militares.

INTRODUCTION

Wetlands are considered one of the most threatened habitats in the European Union. They are receding and degrading at an alarming rate, mainly during the twentieth century (COMMISSION OF THE EUROPEAN COMMUNITIES, 1995; COSTA *et al.*, 1996). Anthropogenic activities, mainly drainage and eutrophication, are the causes for the extreme situation of these ecosystems.

Thus, the Habitats 92/43/CEE Directive includes Mediterranean temporary ponds (3170* code) in Annex II as a priority habitat. Priority habitats are those in danger of disappearance and whose natural range falls mainly within the territory of the European Union (COMMISSION OF THE EUROPEAN COMMUNITIES, 1996).

In this work the conservation status of Mediterranean temporary ponds system was evaluated. It is located in a military perimeter, Campo Militar de Santa Margarida (Ribatejo, Portugal), 130 km northeast of Lisbon, south of the Tagus River ($8^{\circ} 15' W$, $39^{\circ} 20' N$) (Fig. 1), with an area about 62 km^2 . The area is a military training camp but other activities like grazing and hunting also take place.

This camp is located in a Pliocene sedimentary plateau with 179-200 m of altitude and a smooth orography. The wetlands studied form a net of ca. 20 endorreic ponds and pools spread throughout the plateau over 25 km^2 . Their dimensions are variable, mainly from 150 m to 350 m of maximum length with an area about $0.1 - 0.9 \text{ km}^2$.

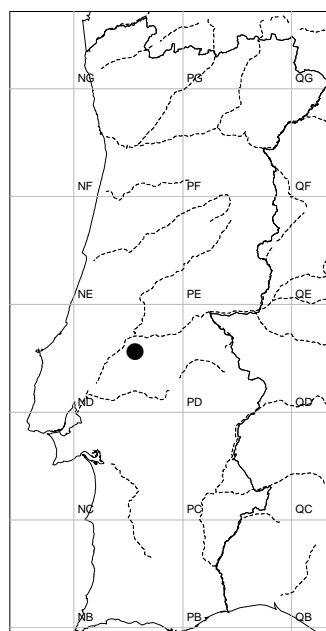


Figure 1. Location of Campo Militar de Santa Margarida (Ribatejo, Portugal). Main rivers are shown.

The water level differs during the year from completely dry to 20-40 cm at the peak of flooding with higher fluctuations depending on seasonal rainfall variation.

Hydrology is probably the most important determinant for the establishment and maintenance of specific types of wetlands and wetlands processes (MITSCH & GOSSELINK, 1986). Thus, hydroperiod is one of the most important characteristics of Mediterranean temporary ponds because the duration of the flooding period determines the variation in floristic composition around the year.

The study area has a Mediterranean climate with a pronounced dry season during the summer, when the ponds and pools become completely dry, in contrast to a mild autumn and winter with a changeable rainfall. The annual precipitation is 828 mm and the mean annual temperature of 15.6 °C (INMG, 1991). Figure 2 shows the climatic diagram of Tancos, the nearest meteorological station.

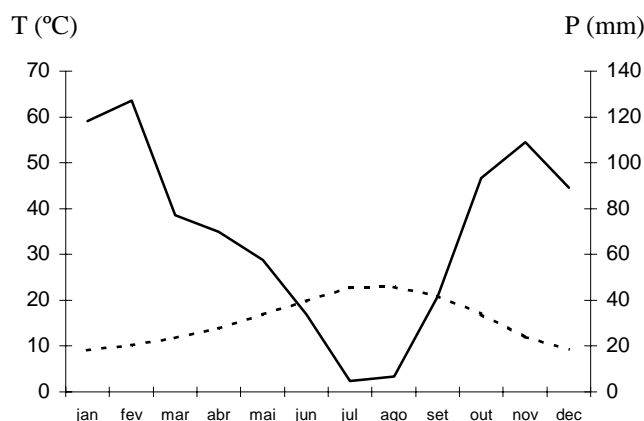


Figure 2. Climatic diagram of Tancos (8° 22'W, 39° 29'N). T = mean annual temperature (discontinuous line), P = annual precipitation (continuous line).

The ponds and pools form multiple patches within a homogeneous area with dominant formations of *Quercus suber* L. and Mediterranean shrubs (DRAPER *et al.*, in press). These wetlands are characterised by a strong transition from terrestrial to freshwater habitats without a boundary of riparian species. The flora presents a relative plant species homogeneity between ponds, principally composed of Mediterranean short-lived therophytic and geophytic species. Their main environmental values are the succession of plant communities along the year as a response to the flooding level and the occurrence of *Isoetes velatum* A. Braun subsp. *velatum*, *I. setaceum* Lam. and *Littorella uniflora* (L.) Ascherson.

Few studies on aquatic ecosystems have been carried out in Portugal (SERRA, 1995), even less focused on Mediterranean temporary ponds. Recently, PINTO-

GOMES *et al.* (1999) studied Mediterranean temporary ponds in the Algarve Barrocal (Portugal), under a phytosociological point of view. In Spain there are several works on freshwater ecosystems either with descriptive, phytosociological or conservation purposes. We can refer as examples ALVAREZ-COBELAS, *et al.* (2001), CIRUJANO, (1995), FERNÁNDEZ-ALÁEZ, *et al.* (1986), MOLINA (1996), ROBLEDANO *et al.* (1987) and VELAYOS, *et al.* (1989).

Traditionally the evaluation of wetlands is based on aquatic birds richness. This situation carries the risk of under evaluating wetlands of biodiversity interest in other biological groups. In order to fill this gap, some authors proposed criteria to determine the preservation status of wetlands focused on floristic parameters. In that sense, CIRUJANO *et al.* (1992) created a standard method to evaluate aquatic *taxa* and wetlands based on an exhaustive collection of data concerning aquatic vegetation. This index was developed and applied in Spain and Balearic Islands and was never applied to Portuguese aquatic habitats. FERREIRA (1994) proposed another index to qualify the conservation value of Portuguese freshwater ecosystems based on macrophytic vegetation, modified by FERREIRA *et al.* (in press).

The aim of the present study is to determine the conservation status of the Mediterranean temporary ponds and pools at Campo Militar de Santa Margarida using these two indexes.

METHODS

The study area was visited in 1996 and 1997, collecting data regarding vegetation and floristic species in the framework of the European Community Project of "Natural Habitats Cartography" (DRAPER *et al.*, in press). During 1998 and 1999 several ponds were studied to determine the dynamic of its floristic composition and its relation with environmental parameters. The ponds were visited each month during one year collecting data related to composition, coverage and distribution of species. The field works allowed to obtain a complete list of aquatic species of the study area as well as coverage and habitat characteristics.

The *taxa* were identified using CASTROVIEJO, S. *et al.* (1986; 1993; 1997), COMELLES, (1985), COUTINHO (1939), FRANCO (1971), FRANCO & ROCHA (1994, 1998), MEDINA & SEQUEIRA (1999), PRADA (1983), TUTIN *et al.* (1964-1980) and VASCONCELLOS (1970).

Following CIRUJANO *et al.* (1992), all the ponds and pools evaluated were considered as one unit due to their geographical proximity.

These authors determined the value of aquatic species, Plant Evaluation Index (I_T), according to their importance in Spain, Balearic Islands and Europe and to their threat category. In this work we assumed for the plants that occur in Portugal these I_T values. The mentioned authors calculated also the Diversity

Index (I_D) of wetlands, based on the number of aquatic *taxa* (Table 1), as well as the Floristic Index (I_F) using the expression:

$$I_F = \Sigma I_T / \text{number of hydrophytic species}$$

Table 1. Classification of the Diversity.

I_D value	Aquatic plants / site
2	1 – 2
4	3 – 5
6	6 – 11
8	10 – 20
10	>20

Finally, the Wetlands Evaluation Index (I_H) proposed by CIRUJANO *et al.* (1992) is obtained through the following relation:

$$I_H = (I_F + I_D) / 2$$

I_H values vary from 1 to 10 and classify wetlands as follow:

- $5.5 < I_H \leq 6.5 \Rightarrow$ Important National Wetland
- $I_H > 6.5 \Rightarrow$ Important European Wetland

The Macrophytic Conservation Index (**MCI**), proposed by FERREIRA (1994) and modified by FERREIRA *et al.* (in press), is based on macrophytic vegetation. This index is calculated by the expression:

$$MCI = (P1+P2+P3+P4+P5) / 4$$

- P1 = Floristic richness
- P2 = Woody riparian plant coverage
- P3 = Emerging *taxa* coverage
- P4 = Strictly aquatic plant coverage
- P5 = Number of species with protection status

The range of values for each of these parameters is presented in Table 2.

Table 2. Values for Macrophytic Conservation Index variables.

Number of species	P1	Coverage (%)	P2	P3	P4	Species with protection status	P5
<10	1	≥ 80	1	1	1	0	0
10-19	1	50-79	2	2	2	1	1
20-29	2	30-49	3	3	4	2	2
30-39	3	10-29	4	4	3	3	3
≥ 40	4	<10	1	1	1	>3	4

MCI results, from 1 to 5, indicate the conservation status of freshwater ecosystems and a higher value corresponds to a better well preserved site.

RESULTS

The *taxa* reported for the study area, considered to calculate Wetlands Evaluation Index, as well as their correspondent Plant Evaluation Index value (I_T) are:

HYDROPHYTIC SPECIES (n = 8)	I_T
<i>Callitriche stagnalis</i> Scop.	3.3
<i>Isoetes setaceum</i> Lam.	6.6
<i>Isoetes histrix</i> Bory	7.3
<i>Isoetes velatum</i> A. Braun subsp. <i>velatum</i>	4.6
<i>Myriophyllum alterniflorum</i> DC.	2.6
<i>Potamogeton natans</i> L.	2.6
<i>Ranunculus peltatus</i> Schrank subsp. <i>peltatus</i>	2
<i>Ranunculus tripartitus</i> DC.	6.6
$\Sigma I_T =$	35.6

The following results were obtained by the application of Wetlands Evaluation Index (I_H):

$I_F = 4.45$; $I_D = 8$ (aquatic plants / site = 16) and $I_H = 6.22$.

According to this result, the ponds and pools system of Campo Militar de Santa Margarida can be considered as an important peninsular wetland.

The **MCI** result of the evaluated wetlands was 2.75. The value for each parameter of this index were; **P1**= 1, **P2**= 1, **P3**= 4, **P4**= 3, **P5**= 2.

DISCUSSION

The indexes applied allow comparison of the conservation status between the ponds and pools of Campo Militar de Santa Margarida and other wetlands of the Iberian Peninsula and Balearic Islands.

The freshwater ecosystem studied is classified as “important national wetlands” according to the Wetlands Evaluation Index. CIRUJANO *et al.* (1992) evaluated ca. 450 wetlands and 62 (13.7 %) were also important national wetlands.

Macrophytic Conservation Index was applied by FERREIRA (1994) to evaluate some permanent Portuguese ponds, “Lagoa da Vela” and “Lagoa das Braças” (Beira Litoral), and the values obtained were 4.38 and 4.63 respectively.

Macrophytic Conservation Index includes a parameter regarding the woody riparian plant coverage (P2). Nevertheless, there are no riparian woody formations surrounding the ponds studied, for that reason this parameter always achieves the minimum value (1) and that situation could under evaluate this wetland conservation value.

The Macrophytic Conservation Index was created to classify rivers or permanent ponds, where woody riparian vegetation has an important role. Some adaptations should be necessary in order to improve its fitness on temporary Mediterranean ponds.

There is no Red Data Book regarding vascular flora in Portugal. This fact does not allow the accurate evaluation of the importance of species in Portugal nor their threatened category. Thus, on one hand parameters estimated for Spanish wetlands like the Plant Evaluation Index (I_T), were used in the application of Wetlands Evaluation Index in the study area. On the other hand, the number of species with protection status (P5) of Macrophytic Conservation Index was based on bibliographic references or on herbaria evidences.

The Red Data Book for vascular flora in Portugal will be a useful tool to assist in evaluating preservation of wetlands.

It is important to point out that this work is a first approach to the conservation status of Mediterranean temporary ponds at Campo Militar de Santa Margarida and a better knowledge and understanding of this aquatic system could modify the present results.

CONCLUSIONS

There is a lack of a standard methodological framework to evaluate wetlands in Portugal.

The temporary ponds and pools system at Campo Militar de Santa Margarida can be considered as an important wetland with a relevant conservation value as well as an important site for the preservation of Mediterranean temporary freshwater habitats in the Iberian Peninsula.

The presence of this freshwater system within the military perimeter permitted a good conservation of these priority habitats.

ACKNOWLEDGEMENTS

The authors would like to thank the Authorities at Campo Militar de Santa Margarida for their helpful cooperation.

REFERENCES

- ALVAREZ-COBELAS, M., CIRUJANO, S. & SÁNCHEZ-CARRILLO, S. 2001. Hydrological and botanical man-made changes in the Spanish wetland of Las Tablas de Daimiel. *Biological Conservation*, 97: 89-98.
- CASTROVIEJO, S., LAÍNIZ, M., LÓPEZ GONZÁLEZ, G., MONTSERRAT, P., MUÑOZ GARMENDIA, F., PAIVA J. & VILLAR, L. (eds.). 1986. *Flora Iberica*. Vol. 1. C.S.I.C. Real Jardín Botánico de Madrid. Madrid.
- CASTROVIEJO, S., AEDO, C., CIRUJANO, S., LAÍNIZ, M., MONTSERRAT, P., MORALES, R., MUÑOZ GARMENDIA, F., NAVARRO, C., PAIVA J. & SORIANO, C. (eds.). 1993. *Flora Iberica*. Vol. 3. C.S.I.C. Real Jardín Botánico de Madrid. Madrid.

- CASTROVIEJO, S., AEDO, C., BENEDÍ, C., LAÍNIZ, M., MUÑOZ GARMENDIA, F., NIETO FELINER, G. & PAIVA J. (eds.). 1986. Flora Iberica. Vol. 8. C.S.I.C. Real Jardín Botánico de Madrid. Madrid.
- CIRUJANO, S., VELAYOS, M., CASTILLA, F. & GIL, M. 1992. Criterios botánicos para la valoración de las lagunas y humedales españoles (Península Ibérica y Islas Baleares). ICONA. C.S.I.C. Madrid.
- CIRUJANO, S. (1995). Flora y vegetación de las lagunas y humedales de la provincia de Cuenca. Junta de Comunidades de Castilla-La Mancha. C.S.I.C. Real Jardín Botánico de Madrid. Madrid.
- COMELLES, M. 1985. Clave de identificación de las especies de carófitos de la Península Ibérica. Asociación Española de Limnología. Barcelona.
- COMMISSION OF THE EUROPEAN COMMUNITIES, 1995. Utilização Racional e Conservação de Zonas Húmidas. Comunicação da Comissão ao Conselho e ao Parlamento Europeu. COM(95) 189 final. Bruxelas.
- COMMISSION OF THE EUROPEAN COMMUNITIES, 1996. Interpretation Manual of European Union Habitats. Luxembourg.
- COSTA, L. T., FARINHA, J. C., HECKER, N. & TOMÁS VIVES, P. 1996. Mediterranean Wetland Inventory: A Reference Manual. MedWet / Instituto da Conservação da Natureza / Wetlands International Publication, Volume I.
- COUTINHO, A.X. PEREIRA, 1939. Flora de Portugal (Plantas Vasculares) disposta em chaves dicotómicas. 2ª Ed., Bertrand Ltd. Lisboa.
- DRAPER, D., ROSSELLÓ-GRAELL, A., TAULEIGNE GOMES, C., ARAÚJO RODRIGUES, R., MALTEZ MOURO, S., CAMEJO RODRIGUES, J., PEREIRA, J. & CATARINO, F. (in press) Ponds system of "Santa Margarida" Area (Portugal). In: Proceedings of XVI Jornadas de Fitosociología. Almería (Spain).
- FERNÁNDEZ-ALÁEZ, M., LUIS CALABUIG, E. & FERNÁNDEZ-ALÁEZ, M. C. 1986. Estudio sobre la vegetación macrofítica en tres lagunas del sureste de la provincia de León. Limnética, 2: 41-49.
- FERREIRA, M.T., 1994. Criação de um índice de avaliação do valor conservacionista de locais dulciaquícolas com base em características habitacionais e macrófitos aquáticos. 4ª Conferência Nacional do Ambiente, 71-75.
- FERREIRA, M.T., AGUIAR, R.F. & MOREIRA, I.S. (in press) Macrófitos fluviais da bacia do Sado. Padrões espaciais e factores ambientais determinantes. In: Nunes Correia, F., Saraiva, M. G., Moreira I. S. (Eds.). Conservação, valorização e gestão ambiental de sistemas fluviais.
- FRANCO, J.A., 1971. Nova Flora de Portugal (Continente e Açores). Escolar Editora. Lisboa.
- INMG, 1991. O Clima de Portugal. 2 (XLIX), 2ª região. Instituto Nacional de Meteorologia e Geofísica. Lisboa.
- MEDINA, L. & SEQUEIRA, M., 1999. *Hippuris vulgaris* (Hippuridaceae) en Portugal. Anales Jard. Bot. Madrid. 57(1), 160-161.
- MITSCHEW, W.T. & GOSSELINK, J. G. 1986. Wetlands. Van Nostrand Reinhold Company, New York.
- MOLINA, J. A. 1996. Sobre la vegetación de los humedales de la Península Ibérica (1. Phragmiti-Magnocaricetea). Lazaroa, 16: 27-88.
- PINTO-GOMES, C. J., GARCÍA FUENTES, A., ALMEIDA LEITE, A. M., CARDOSO GONÇALVES, P. C. 1999. Charcos temporários mediterrânicos do Barrocal Algarvio: diversidade e conservação. Quercetea, 1: 53-64.

- PRADA, C., 1983. El género *Isoetes* L. en la Península Ibérica. Acta Bot. Malacitana. 8: 73-100.
- ROBLEDANO, F., CALVO, J. F., ESTEVE, M. A., PALAZÓN, J. A., RAMÍREZ, L. & MAS, J. 1987. Tipología, conservación y gestión de las zonas húmedas del sureste español. Limnetica, 3(2): 311-320.
- SERRA, M.G., 1995. A flora e vegetação das zonas ribeirinhas. Contribuição para o seu conhecimento. In: Instituto da Conservação da Natureza, Ecossistemas ribeirinhos. Comunicações. Congresso Nacional de Conservação da Natureza. Lisboa.
- TUTIN, T.G., HEYWOOD, V.H., BURGESS, N.A., MOORE, D.H., VALENTINE, S.M., WALTERS, S.M., WEBB, D.A. (Eds.), 1964-1980. Flora Europaea. 1-5. Cambridge University Press. Cambridge.
- VASCONCELLOS, J., 1970. Plantas (Angiospérmicas) aquáticas, anfíbias e ribeirinhas.
- VELAYOS, M., CARRASCO, M. A., CIRUJANO, S. 1989. Las lagunas del Campo de Calatrava (Ciudad Real). Botánica Complutensis, 14: 9-50.