CONTRIBUTION OF STANDING WATERS TO REGIONAL AQUATIC BIODIVERSITY: THE CASE OF WATER BEETLES IN SOUTH-EAST OF SPAIN

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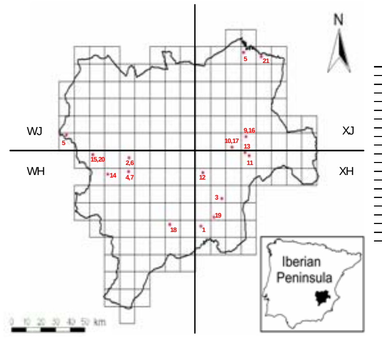
INTRODUCTION

South-east of the Iberian Peninsula and, particularly, the province of Albacete is a recognised area of high aquatic biodiversity being water beetles one of the most known faunal groups contributing to this biodiversity (Millán *et al.* 2001a y b; 2002). Standing waters are diverse in this region including small water body types: fresh, saline, temporary, permanent, karstic, endorheic and artificial. Despite this habitat diversity, no attempt has been done in order to analyse the contribution of those standing waters to regional biodiversity. In this study we identified which of the 218 species recorded in the regional check-list were found in standing waters, which species were exclusive of them (not occurring in running waters following Ribera *et al.* (2003), and which habitats showed the highest conservation value. Finally, we highlight the most threatened species and the main impacts disturbing these habitats.

Habitat types

A. Rice-fields
B. Karstic lagoons
C. Pools-ponds
D. Endorheic lagoons
E. Artificial ponds-irrigation pools
F. Continental salt-pans

STUDY AREA: Province of Albacete (Spain).



	Site	HT	Altitude	Size	Depth	Conductivity mín/máx (µS/cm)	Temporality
1	Arrozales en Casas del Río	1	450	Large	Shallow	n.d.	Yes
2	Laguna de Ojos de Villaverde	2	900	Large	Deep	470/470	No
3	Laguna grande de Alboraj	2	600	Medium	Deep	3430/3430	No
4	Laguna del Arquillo	2	1000	Large	Deep	469/749	No
5	Lagunas de Ruidera	2	840	Large	Deep	700/800	No
6	Poza en Ojos de Villaverde	3	900	Small	Shallow	510/510	No
7	Charca en el Arquillo	3	1000	Small	Shallow	469/49	No
8	Toyo en Tabaqueros	3	580	Small	Shallow	n.d.	Yes
9	Laguna del Salobralejo	4	940	Large	Shallow	26/11000	Yes
10	Laguna de Pétrola	4	860	Large	Shallow	2100/86200	Yes
11	Lagunas de Corral Rubio	4	870	Medium	Shallow	8/19000	Yes
12	Laguna de Ontalafia	4	840	Large	Shallow	954/9540	No
13	Laguna del Saladar	4	870	Large	Shallow	43000/100000	Yes
14	Laguna de la Sanguijuela	4	1024	Medium	Shallow	1/700	Yes
15	Laguna de Pinilla	4	960	Large	Shallow	24600/70000	Yes
16	Balsa en Salobralejo	5	940	Small	Shallow	1,5/1400	No
17	Charca en Pétrola	5	860	Small	Shallow	2100/86200	Yes
18	Balsa en Elche de la Sierra	5	650	Small	Shallow	n.d.	Yes
19	Laguna de los Patos	5	500	Medium	Deep	2620/2620	No
20	Salinas de Pinilla	6	960	Medium	Shallow	100000/110000	Yes
21	Salinas en Casas de Ves	6	571	Small	Shallow	100000/110000	No

RESULTS

Species list

	1	2	3	4	5	6	H
Agabus biguttatus		x					0
Agabus bipustulatus		x	x		x		1
Agabus brunneus			x				0
Agabus conspersus		x	x	x	x		2
Agabus didymus		x	x	x	x		0
Agabus nebulosus		x	x		x		2
Agabus paludosus		x	x				0
Agabus ramblae			x				0
Anacaena bipustulata		x	x				1
Anacaena limbata				x	x		1
Anacaena lutescens			x				1
Aulacohthebius exaratus			x				1
Aulonogyrus striatus	x						0
Berosus affinis			x	x	x		1
Berosus guttalis			x	x			2
Berosus hispanicus	x			x	x		1
Berosus signaticollis			x				2
Bidessus pumilus		x	x				2
Chaetarthria seminulum seminulum [c]			x				2
Colymbetes fuscus		x	x	x	x		2
Coelostoma hispanicum					x		1
Cybister lateralimarginalis			x	x	x		2
Dryops algiricus			x	x			2
Dryops gracilis	x	x	x	x	x		0
Dytiscus circumflexus			x	x	x		2
Dytiscus marginalis			x				1
Dytiscus semisulcatus			x				1
Enochrus bicolor		x	x	x	x	x	2
Enochrus fuscipennis			x	x			2
Enochrus halophilus		x	x	x	x		2
Enochrus politus		x	x	x			0
Enochrus salomonis					x		0
Eretes griseus	x						2
Graphoderus cinereus a			x				2
Graptodytes aequalis			x				2
Graptodytes castilianusa [b]					x		1
Graptodytes flavipes			x				1
Gyrinus caspius			x				2
Gyrinus dejeani			x	x			1
Gyrinus suffriani [a]		x					2
Gyrinus urinator		x	x				1
Haliplus andalusicus			x				2
Haliplus guttatus			x				2
Haliplus lineatocollis		x	x		x		1
Haliplus mucronatus		x					1
Haliplus obliquus		x					2
Hydrobius fuscipes			x	x	x		2
Hydrochus grandicollis			x				0
Hydrochus ibericusa [b]			x				0
Hydrochus smaragdineus			x				1
Hydrochara flavipes	x		x		x		2
Hydraena atrata [b]			x				1
Hydraena rufipennis					x		0
Helochares lividus	x	x	x	x	x		1
Helophorus alternans		x	x		x		2
Helophorus brevipalpis		x	x	x	x		1
Helophorus fulgidicollis				x	x		2
Helophorus longitarsis				x	x		2
Helophorus maritimus gr.			x	x	x		1
Helophorus nubilus		x	x				1
Helophorus seidlitzii [b]		x	x	x			1
Herophydrus musicus		x		x	x		1
Hydrophilus pistaceus			x				2
Hygrobia hermanni			x				2
Hydaticus leander	x	x			x		2
Hydaticus seminiger [a]		x	x				2
Hydroporus decipiens			x				1
Hydroporus discretus			x	x			0
Hydroporus limbatus				x			2
Hydroporus lucasi			x	x			1
Hydroporus nigrita			x				2
Hydroporus normandi [b]		x	x	x	x		0

Habtitat type: 1 Rice-fields, 2 Karstic lagoons, 3 Pools-ponds, 4 Endorheic lagoons, 5 Artificial ponds-irrigation pools, 6 Continental salt-pans; H (Habitat): 0 running; 1 running and stagnant; 2 stagnant; a (threatened species following Abellán *et al*. 2005); b (Iberian endemic species following following Sánchez-Fernández *et al*. 2008); c (species under revision).

Number of species, threatened species, endemic species and kind of impacts in each habitat type

HT	Richness	Vulnerability	Endemisms	Impacts
1	11	0	0	I, A, O
2	58	3	4	I, A, O
3	91	3	4	A
4	51	4	6	I, A
5	54	0	2	I, A
6	4	2	2	I

HT (Habtitat type): 1 Rice-fields, 2 Karstic lagoons, 3 Pools-ponds, 4 Endorheic lagoons, 5 Artificial ponds-irrigation pools, 6 Continental salt-pans; Richness: number of species; Vulnerability: number of threatened species following Abellán *et al*. 2005; Endemisms: number of Iberian endemic species following Sánchez-Fernández *et al*. 2008; Impacts: I Infraestructures, A Agriculture, O Others.

ANOSIM analysis similiraties among each habitat type

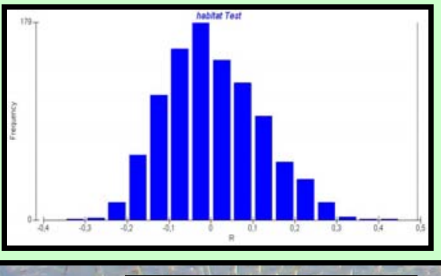
ANOSIM (ANALYSIS OF SIMILARITIES)

Sample statistic (Global R): 0,492
Significance level of sample statistic: 0,1% (p<0,001)
Number of permutations: 999

ANOSIM: Pairwise Tests

Groups	R Statistic	Significance level (%)
Rice-fields, Karstic lagoons	0,583	20
Rice-fields, Pools-ponds	0,556	25
Rice-fields, Endorreic lagoons	0,66	12,5
Rice-fields, Artificial ponds-irrigation pools	-0,25	80
Rice-fields, Continental salt-pans	1	33,3
Karstic lagoons, Pools-ponds	0	48,6
Karstic lagoons, Endorreic lagoons	0,548	0,6
Karstic lagoons, Artificial ponds-irrigation pools	-0,135	74,3
Karstic lagoons, Continental salt-pans	0,964	6,7
Pools-ponds, Endorreic lagoons	0,738	0,8
Pools-ponds, Artificial ponds-irrigation pools	0,389	8,6
Pools-ponds, Continental salt-pans	1	10
Endorreic lagoons, Artificial ponds-irrigation pools	-0,026	53,3
Endorreic lagoons, Continental salt-pans	0,935	2,8
Artificial ponds-irrigation pools, Continental salt-pans	1	6,7

significative differences between habitat types



SIMPER analysis showing similarities among sites in each habitat type

SIMPER ANALYSIS	Average similarity (%)
Group Rice-fields	less than 2 samples
Group Karstic lagoons	19,33
Group Pools-ponds	23,56
Group Endorreic lagoons	27,98
Group Artificial ponds-irrigation pools	21,21
Group Continental salt-pans	67,66

SIMPER analysis showing indicator species in each habitat type

SIMPER ANALYSIS	Species contributing (>9%)
Group Karstic lagoons	
Laccophilus hyalinus	20,11
Helochares lividus	10,23
Laccophilus minutus	9,66
Group Pools-ponds	
Agabus bipustulatus	9,99
Group Endorreic lagoons	
Ochthebius marinus	24,38
Hygrotus pallidulus	15,21
Enochrus bicolor	12,13
Laccophilus minutus	9,62
Group Artificial ponds-irrigation pools	
Hydroglyphus geminus	17,28
Laccophilus minutus	15,37
Ochthebius marinus	12,9
Helochares lividus	11,36
Group Continental salt-pans	
Ochthebius notabilis	100

CONCLUSIONS

Our results showed that standing water bodies hold the 57.3 % (125 species) of the regional species pool (province of Albacete), 54 of them typical of standing waters.

ANOSIM analysis showed differences among habitat types. Endorheic lagoons presented the most unique community of aquatic water beetles. SIMPER analysis showed the indicator species of each habitat type: *Laccophilus hyalinus* in Karstic lagoons, *Agabus bipustulatus* in Pools-ponds, *Ochthebius marinus* in Endorheic lagoons, *Hydroglypus geminus* in Artificial ponds-irrigation pools, and *Ochthebius notabilis* in Continental salt-pans.

Almost all the habitat types were impacted, mainly due to agriculture (clearing land for crops, water extraction for irrigation, non-point source pollution, etc.) and infraestructures (related with channelisations, drainage and other human developments). Other impacts such as recreational use and tourism, exotic species, grazing and other human disturbances were less important, occurring only in two habitat types .

Pools-ponds habitat type contributed with the highest richness (72.8 %, 91 species), and saline water bodies, principally endorheic lagoons habitat type, contributed with the most singular and threatened species: *Nebrioporus baeticus, Ochthebius tudmirensis* and *Ochthebius irenae,* three Iberian endemisms. Other rare and threatened species were *Gyrinus suffriani, Hydaticus seminiger* and *Graphoderus cinereus,* all of them found in pools-ponds habitat type.

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