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Some data on ecology and distribution of the European pond turtle in the Valencia Region (Eastern Spain)

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Abstract: According to regional endangered species act *Emys orbicularis* is listed as "vulnerable" so action plans in order to preserve populations must be developed. In this context present survey was carried out along all known populations in Valencia region. European pond turtle was found in 11 localities. Typical habitat are irrigation canals or drainage ditches, located in coastal marshes, with no submersed aquatic vegetation, but surrounded with reeds; silty clay substrate, good water quality and high transparency. Total European pond turtles captured were 296 (176 new marked and 120 recaptures) with eel fyke nets. Female's average size was larger than males (124.4 vs. 119.1 cm) and so was weight (338.1 vs. 270.1 g). Overall sex ratio is 1:1.4 and percentage of juveniles was 6.8%. Juveniles were only found in five of the 11 sampled localities. Population estimates were computed with CAPTURE software when number of recaptures made it possible. Otherwise tentatively comparison with preceding year with Chapman's and Lincoln-Petersen estimators were used. Estimated abundances range form 4 to 702 individuals, but most populations (n = 8) stand under 80 individuals.
Key words: biometry, *Emys orbicularis*, population estimates, Valencia Region.

Resumen: Datos sobre la ecología y distribución del galápago europeo en Valencia (este de España). – El Catálogo Valenciano de Especies Amenazadas incluye a *Emys orbicularis* en la categoría de "vulnerable", lo que hace necesaria la redacción de un Plan de Acción para conservar sus poblaciones. En este contexto, el presente trabajo se ha llevado a cabo en 11 de las poblaciones conocidas de la especie en la Comunidad Valenciana. El hábitat típico está formado por canales de riego o de drenaje ubicados en marjales costeros, con escasa vegetación subacuática y rodeados por carrizo, de sustrato arcilloso, buena calidad del agua y elevada transparencia. Mediante redes de captura para anguilas modificadas se colectaron 296 galápagos (176 nuevas capturas y 120 recapturas). Las hembras han resultado ser mayores que los machos (124.4 vs. 119.1 cm) y más pesadas (338.1 vs. 270.1 g). El sex ratio global es de 1:1.4, con un porcentaje de juveniles del 6.8%. Los juveniles sólo se han capturado en cinco de las 11 localidades muestreadas. Cuando el número de capturas y recapturas lo permitió, la estima poblacional fue llevada a cabo mediante el software CAPTURE. El rango de abundancias estimadas fue de 4 a 702 individuos, aunque para la mayoría de las poblaciones (n = 8) fue inferior a 80 ejemplares.
Palabras clave: biometría, Comunidad Valenciana, *Emys orbicularis*, estima poblacional.

Introduction

In most of its wide distribution area *Emys orbicularis* (L., 1758) is an endangered species. So is in Valencia Region where European pond turtle has been listed as "Vulnerable" in the regional endangered species act (Decreto 32/2004 del Consell de la Generalitat Valenciana). Previous studies have been made to determine distribution (Sancho & Lacomba, 2000); and conservation plans developed (Lacomba & Sancho, 2000, 2004). Thus once distribution is known, local abundances and population structure are the next step in order to make an adequate management.

MATERIAL & METHODS

Study Area

Sampled areas cover all sites (except Marjal de Castellón, Burriana and Moncofa (Fig. 1) where *E. orbicularis* has been recorded in the Valencia Region, wich comprises three provinces (from north to south) Castellón, Valencia and Alicante; European Pond Turtles inhabit only the two first. Almost all areas where the species is present (Table 1) have a more or less degree of legal protection, from international: Sites of Community Importance (EC Directive 92/43/ECC), Special Protection Areas (EC Directive 79/409/ECC) to regional: Natural Park (Regional Act 11/94), Wetland (Regional Wetland Catalogue 10/09/02).

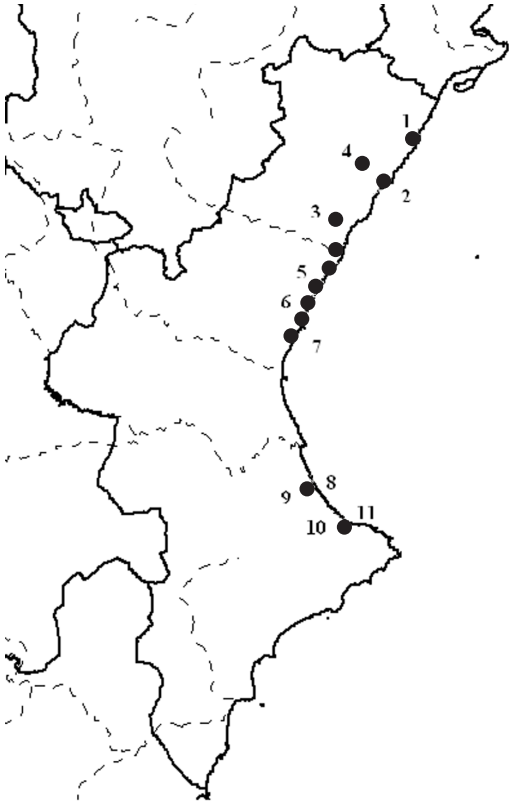


FIGURE 1. Distribution of *Emys orbicularis* in Valencia Region. White dots are localities not included in this survey. 1: Peñíscola, 2: "Prat" of Cabanes-Torreblanca, 3: La Pobla Tornesa, 4: Vilanova d´Alcolea, 5: Marshland of Nules-Burriana, 6: Marshland and "Estanys d´Almenara", 7: Marshland "del's Moros", 8: Outlet of the river Xeraco, 9: Marshland "La Safor", 10: Marshland Pego-Oliva and 11: Outlet of the river Racons.

FIGURA 1. Distribución de *Emys orbicularis* en la Comunidad Valenciana. Los círculos blancos corresponden a localidades no incluidas en este estudio. 1: Peñíscola, 2: Prat de Cabanes-Torreblanca, 3: La Pobla Tornesa, 4: Vilanova d'Alcolea, 5: Marjal de Nules-Burriana, 6: Marjals i Estanys d'Almenara, 7: Marjal del's Moros, 8: Desembocadura río Xeraco, 9: Marjal de la Safor, 10: Marjal Pego-Oliva and 11: Desembocadura río Racons.

Sampling Period

Survey comprised six months in which terrapins have higher activity; started on April 2004 and ended on October 2004.

Captures

Turtles were caught by means of unbaited submersed traps. Traps consist on slightly modified eel fyke nets where animals swim trough a series of net funnels that make it nearly impossible to escape. Top of the trap was raised above water-line to avoid endanger of turtles drowning.

Biometry

Animals were sexed, measured (carapace and plastron length and width, seams of abdominal scutes) weighted and marked. Measurements were taken with a precision (0.01 mm) digital calliper and weights with an electronic balance to the nearest 1 g.

Each individual was marked with a pattern of unique shell notches on marginal scutes for further identification. All captures were photographed.

Abiotic parameters

Some easy to measure parameters were recorded to define habitat requirements. Temperature, both air and water, were registered with a digital thermometer with 0.1º C precision. Transparency was measured with

TABLE 1. Some characteristics of sampling sites. Legal protection: SCI (Site of Community Importance), SPA (Special Protection Area), NP (Natural Park), Wt (Wetland), Nt (Not Protected). Substrate: Bd (boulders), Cb (cobbles), Gr (gravel), Sd (sand), Si (silt), Cl (clay).

TABLA 1. Algunas características de las localidades muestreadas. Protección legal: SCI (Lugar de Importancia Comunitaria), SPA (Area de Especial Protección), NP (Parque Natural), Wt (Humedal Protegido), Nt (Sin protección). Substrato: Bd (cantos rodados), Cb (guijarros), Gr (grava), Sd (arena), Si (cieno), Cl (arcilla).

Locality	Protection	Main substrate type	Sediment depth (cm)	Water velocity (m/s)	Habitat type
Peñíscola	SCI, Wt	Si-Cl	21	0-1	Canals, Ditches
Vilanova d'Alcolea	Nt	Bd, Si	5	0	Pools
Prat de Cabanes	SCI, SPA, NP, Wt	Si-Cl	27	0	Canals
La Pobla Tornesa	Nt	Bd-Cb	0	0-2	Pools
Marjal de Nules-Burriana	SCI, Wt	Si-Cl, Sd	26	0	Canals
Marjals i Estanys d'Almenara	SCI, Wt	Si	15	0-2	Ditches
Marjal del Moros	SCI, SPA, Wt	Si-Cl	30	0	Ponds
Desembocadura río Xeraco	Wt	Si-Cl	16	0	Ponds
Marjal de la Safor	SCI, Wt	Gr, Cl	6	0	Canals, Ditches, Ponds
Marjal de Pego-Oliva	SCI, SPA, NP, Wt	Sd-Si	32	0-4	Canals, Ditches
Desembocadura río Racons	Wt	Si	12	0	Ponds

Secchi disk to the nearest centimetre. Sediment samples were collected with a perspex corer that allows determine visually main particle size. Substrate type was defined according to Wentworth scale (BUCHANAN, 1984). Water velocity was measured to the nearest m/s with a mechanical flow meter (General Oceanics model 2030).

Population estimates

Abundances were calculated according to closed population capture-recapture methods with CAPTURE software (REXSTAD & BURNHAM, 1991). When number of recaptures was to low for software analysis a tentative comparison with preceding year by Chapman's and Lincoln-Petersen estimators were used.

RESULTS & DISCUSSION

Habitat characteristics

Habitat types. – Habitat distribution in Valencian Community is similar to those reported in Hungary (PUKY *et al.*, 2004): *E. orbicularis* is primarily lowland species present in standing or slow running waters (Table 1). However mountain populations are also recorded up to approximately 300 m a.s.l.

Of the 11 localities where the presence of European pond turtle has been detected we can separate two groups: 1) In coastal marshlands: draining ditches and irrigation canals (n = 7) and wetlands related within areas of river mouth (n = 2); 2) Pools in typical Mediterranean creeks with intermittent flows, were in the dry season water remains only in some pools (n = 2). These are similar to those described by CHEYLAN & POITEVIN (1998) in France.

Water quality is fairly good, slightly eutrophic, in most of sampled localities. Non-point source pollution is mainly due to agriculture activity. Only in two localities ("Marjal de la Safor" and "Pobla Tornesa") European pond turtle was detected in wastewaters near sewage treatment plants. Similar situation has been described by MAZANEVA & ORLOVA (2004) in Daghestan.

Sediment and water velocity. – Sediment texture is generally silty clay typical of still water bodies with scarce or none flow. Were velocity was detected sediments have bigger diameter, mainly sandy loam (Table 1).

Water velocity was null or imperceptible during almost sapling period among all sampling stations. Eventually some areas presented a substantial rise in current speed, related with agricultural activities ("Marjal de Pego-Oliva") or drainage after heavy rains ("Marjals i Estanys d'Almenara", "Peñíscola").

Vegetation. – Contrary to other places e.g. Lithuania (MEESKE, 2000), Albania (HAXHIU & BUSKIRK, 2000), northwest Germany (PODLOUCKY, 1998), central France (SERVAN, 1998), central Italy (ROVERO, 1995); in our study area the presence of *E. orbicularis* is only associated with submersed aquatic vegetation in some limited areas of three localities ("Marjal de Nules", "Marjal de la Safor", "Marjal de Pego-Oliva"). Typical water bodies are devoid of submerged plants, or these are present in isolated patches. Reeds (mainly *Phragmites sp.*) are present in all localities surrounding water table often forming a dense barrier. Abundant shoreline vegetation is also common in other countries, like Italy (FICETOLA *et al*., 2004).

Population characteristics

Biometry. – A total of 296 European pond turtles were captured along the study, 176 were individual captured for the first time and 120 were recaptures.

Mean size, measured as carapace length, was larger in females (124.4 mm) than in males (119.1 mm) (Table 2). Weight averaged 338.1 g in females, a value significantly larger than males with an average weight of 270.1 g. Juveniles average weight was 78.1 g. These data are similar to those obtained in Central Italy (♂♂ 114 mm, 233 g; ♀♀ 120 mm, 316 g) (ROVERO, 1995). But clearly smaller than other Spanish and European populations: Hungary (♂♂ 135 mm, ♀♀ 152 mm), Germany (♂♂ 159 mm; ♀♀173 mm) and Poland (♂♂ 165 mm; ♀♀175 mm) (FARKAS *et al.*, 1998); south-western Spain (♂♂ 139 mm, 427 g; ♀♀ 142 mm, 526 g) (KELLER *et al*., 1998); north-western Spain (♂♂ 136 mm, 408 g; ♀♀ 123 mm, 352 g) (AYRES & CORDERO, 2001); Turkey (♂♂ 124 mm, 336 g; ♀♀ 146 mm, 565 g) (AUER & TASKAVAK, 2004); Switzerland (♂♂ 134 mm, 344 g; ♀♀ 149 mm, 558 g) (MOSIMANN & CADI, 2004).

Juvenile percentage. – We considered as juveniles those individuals with age under 4/5 years (plastral growth rings) and with mean carapace length 73.51 mm (n = 20) and never exceeded 100 mm. Until this age, even some times older, sex determination was not possible. These data agree with north-western Spanish populations (80 mm, AYRES & CORDERO, 2001).

Juveniles, as described above, were only detected in 5 localities (Table 2). Percentage

TABLE 2. Carapace length (mm) and turtle weight (g) statistics of *E. orbicularis*.
TABLA 2. Estadísticos del tamaño (mm) y peso (g) de *E. orbicularis*.

		Carapace length	Turtle weight
Sex	N	Mean ± SD (range)	Mean ± SD (range)
Females	161	124.391 ± 16.319 (80.7 - 156)	338.119 ± 116.829 (84 - 631)
Males	113	119.153 ± 11.167 (89.9 - 158.4	270.106 ± 64.992 (114 - 428)
Juvenile	20	73.510 ± 17.649 (28.6 - 95.7)	78.150 ± 42.326 (5 - 142)
Indeterminate	2	100.600 ± 2.828 (98.6 - 102.6)	256.000 ± 39.598 (228 - 284)

of juveniles over total population ranged from 20% in "Peñíscola" to 7.1% in "Marjal dels Moros". The most similar results (15-31% juveniles) were obtained by SERVAN (1998) in central France.

Sex ratio. – Total number of females captured (161) was higher than males (113). Overall sex ratio was 1 male:1.4 females. This ratio is similar to those obtained in Switzerland 1:1.47 (MOSIMANN & CADI, 2004). Major disproportion occurred in "Marjal de Pego-Oliva" were 19 females and only 2 males were recorded; here ratio between sexes was 1:9.50. On the other hand in "Marjal dels Moros" the amount of males slightly exceeded females in a ratio of 1:0.69. Similar were the cases of "Marjal de Nules-Burriana" and "Marjal i Estanys d'Almenara" (Table 3).

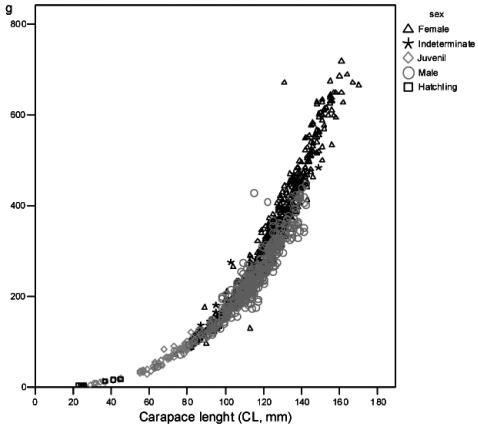
Reproduction. – Captured females were palpated for presence of shelled eggs. A total of 18 gravid females were detected in 7 of the 11 localities were *E. orbicularis* was present. Major presence of females with eggs was in "Desembocadura río Xeraco", with 7 individuals. In "Marjal i Estanys d'Almenara", and "Marjal de Pego-Oliva" three gravid females in each locality were detected; two in "Marjal dels Moros". And finally only one female carrying eggs was located in "Peñíscola", "Marjal de la Safor" and "desembocadura rio Racons".

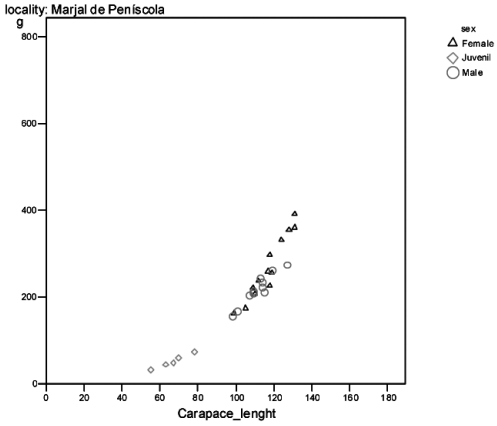
The earliest date where gravid female were detected was May 31st in "Marjal dels Moros"; and the latest was September 23rd in "desembocadura río Racons". The latter date must not be considered exceptional; in mid September also an *E. orbicularis* nest (only a few days old) was detected in Marjal dels Moros.

Abundance. – Population estimates were calculated through two ways: 1) Abundance was calculated with the adequate capture probability model selection (RESTAD & BURNHAM, 1991). Model selection and abundance estimates were computed with CAPTURE software (WHITE *et al*., 1978). Due to assume closure only data of the year 2004 were used; 2) In some localities the number of recaptures didn't suffice for CAPTURE calculations so tentatively population estimates were made through comparison with year 2003 data using Petersen-Lincoln estimator and Chapman's modification (WHITE *et al*., 1982).

TABLE 3. Sex ratio of *E. orbicularis* for each locality. M: male. F: female. ¿?: indeterminate. J: juvenile.
TABLA 3. Sex ratio de *E. orbicularis* en cada localidad. M: macho. F: hembra. ¿?: indeterminado. J: juvenil.

Locality	M	F	¿?	J	Total	Sex ratio	% males
Peñíscola	9	11	0	4	24	1:1,22	45.00
Prat de Cabanes-Torreblanca	13	12	0	0	25	1:0,92	52.00
La Pobla Tornesa	2	2	0	0	4	1:1	50.00
Vilanova d'Alcolea	7	21	0	3	31	1:3	25.00
Marjal de Nules-Burriana	6	2	0	0	8	1:0,33	75.00
Marjals i Estanys d'Almenara	15	8	0	0	23	1:0,53	65.22
Marjal del Moros	33	23	1	4	61	1:0,69	58.93
Desembocadura río Xeraco	18	41	0	8	67	1:2,27	30.51
Marjal de la Safor	3	7	0	1	11	1:2,33	30.00
Marjal Pego-Oliva	2	19	1	0	22	1:9,5	9.52
Desembocadura río Racons	5	15	0	0	20	1:3	25.00
TOTAL	113	161	2	20	296	1:1,4	41.24


g
sex
Female
Indeterminate
Juvenil
Male
Hatchling
Carapace lenght (CL, mm)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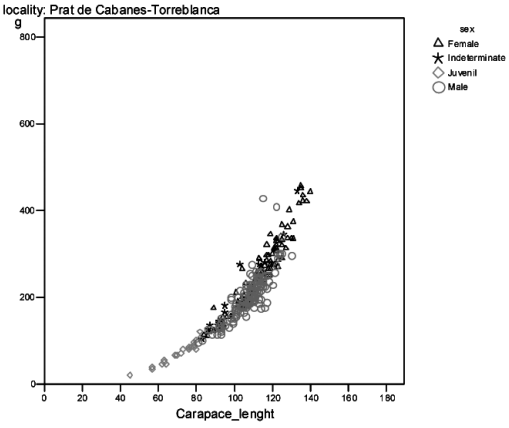
sex
Female
Juvenil
Male
Carapace_lenght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sex
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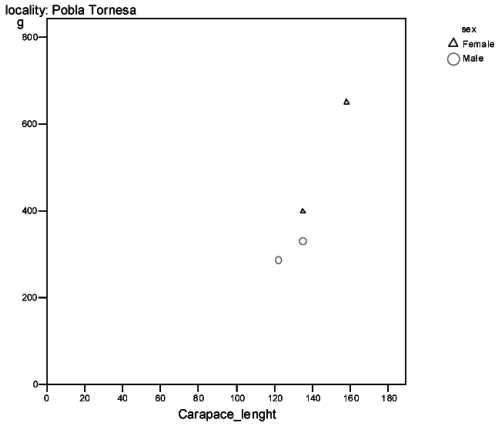
Juvenil
Male
Carapace_lenght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sex
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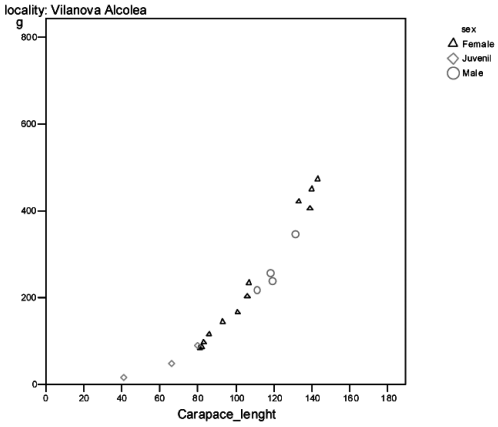
Male
Carapace_lenght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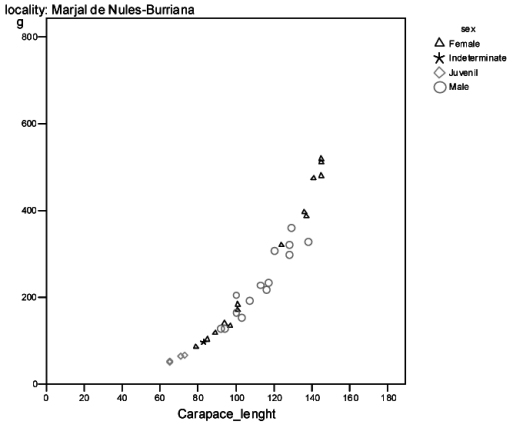
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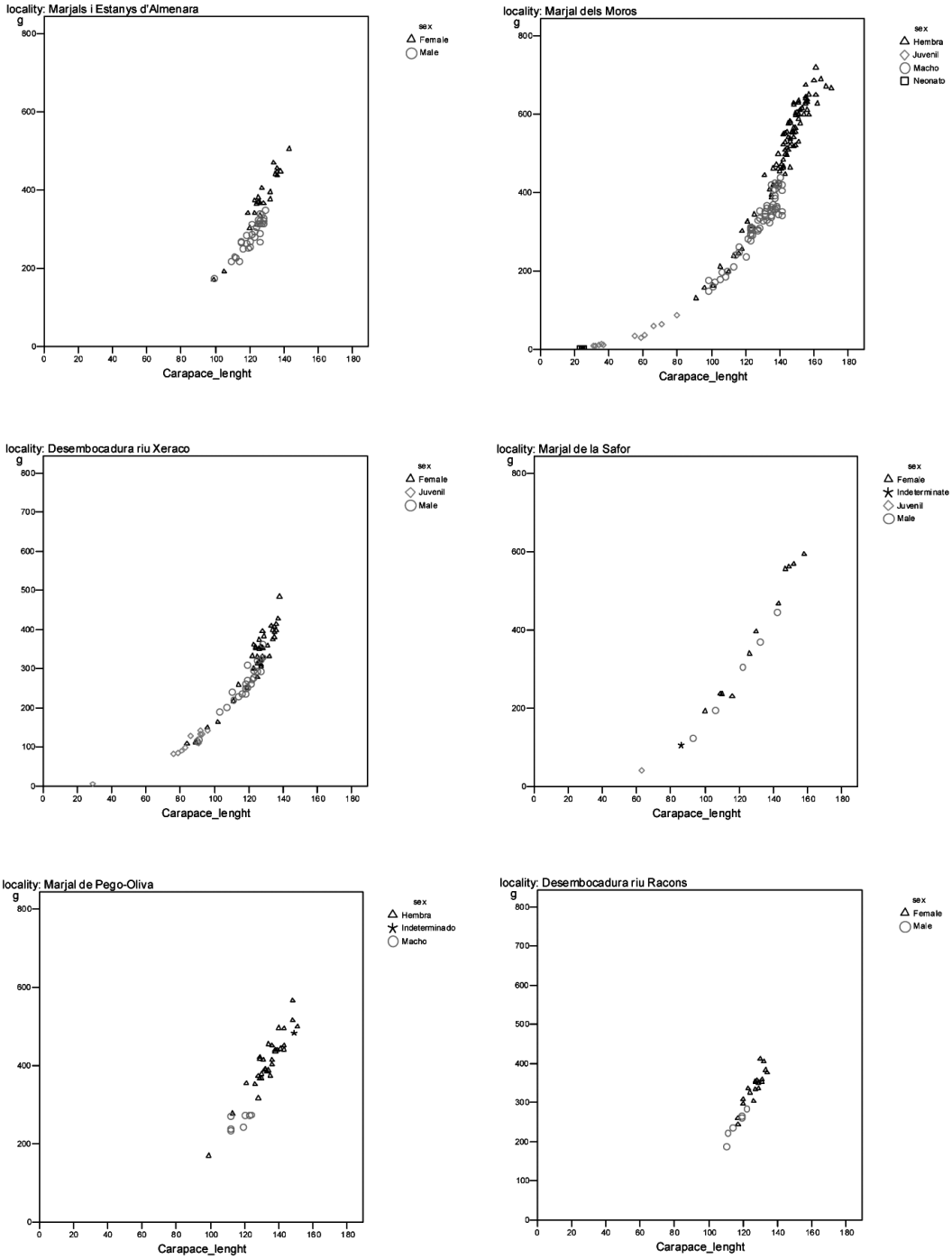

FIGURE 3. Relationship between carapace length and weight of total turtles captured (first graphic) and on each locality.

FIGURA 3. Relación entre la longitud del espaldar y el peso en el total de ejemplares capturados (primer gráfico) y en cada localidad considerada.

Estimated abundance ranges from only four individual in "Pobla Tornesa", to over 700 in "Prat de Cabanes-Torreblanca", but most populations (n = 8) stand under 80 individuals (Table 4). The fact that some estimates computed with CAPTURE agree with those obtained between years with Chapman's equation is confusing because both methods assume closed populations; this could be acceptable for short sampling periods, but not for periods over a year. An explanation for these values could be that these populations ("Marjal dels Moros", "desembocadura río Xeraco" and "desembocadura río Racons") meet closure no only in the sense mentioned by MOSIMANN & CADI (2004) but also as a sort of stability where birth/immigration and death/emigration is negligible through long time periods.

TABLE 4. Population estimates for each locality. n_{04}: Individuals marked in 2004. n_{tot}: total marked individuals (2003 & 2004). $\check{N}_{p\text{-}l}$: population estimate with Petersen-Lincoln estimator. $\check{N}_c$: population estimate with Chapman estimator. $\check{N}_{04}$: population estimate with 2004 data. n.r.: No recaptures. n.d.: No previous data. C.I.: confidence interval.
TABLA 4. Estimas poblacionales en cada localidad. n_{04}: Individuos marcados en 2004. n_{tot}: Total de indivuiduos marcados (2003 y 2004). $\check{N}_{p\text{-}l}$: Población estimada de acuerdo a Petersen-Lincoln. $\check{N}_c$: Población estimada de acuerdo a Chapman. $\check{N}_{04}$: Población estimada con los datos del año 2004. n.r.: No recapturados. n.d.: Sin datos previos. C.I.: Intervalo de confianza.

Locality	n_{04}	n_{tot}	$\check{N}_{p\text{-}l}$	$\check{N}_c$	$\check{N}_{04}$ (C. I.)
Peñíscola	21	29	s.r.	s.r.	186 (58-772)
Prat de Cabanes-Torreblanca	24	77	1325	702	n.r.
La Pobla Tornesa	4	n.d.	–	–	n.r.
Vilanova d'Alcolea	18	n.d.	–	–	29 (21-59)
Marjal de Nules-Burriana	6	26	80	63	s.r.
Marjals i Estanys d'Almenara	9	31	39	39	41 (29-53)
Marjal del Moros	25	62	74	75	124 (83-213)
Desembocadura río Xeraco	31	60	82	82	78 (62-94)
Marjal de la Safor	10	17	77	48	n.r.
Marjal Pego-Oliva	18	33	150	112	69 (35-103)
Desembocadura río Racons	10	21	32	32	30 (19-71)

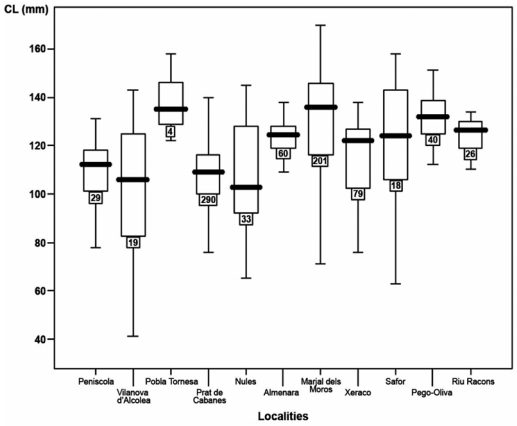

FIGURE 2. Carapace length and number of cases on each locality.

FIGURA 2. Longitud del espaldar y número de casos en cada localidad.

The lack of data about distribution within surveyed localities and the probably high sedentarity make us be cautious extrapolating abundance data to densities.

Population Structure. – Not all populations have a balanced structure as shown in the Figs. 2, 3. At some localities as "desembocadura río Racons" (minimum CL = 110 mm; N = 26), "marjal Pego-Oliva" (minimum CL = 99 mm; N = 40) and "marjal I Estanys d'Almenara" (minimum CL = 99 mm; N = 60) most of the individuals are large, with only few median and small sizes.

Also at "Marjal dels Moros" individuals under 100 mm (N = 201) are scarce and most of the females are of big size.

On the other hand, at "Marjal de Peñíscola" (N = 29), "Prat de Cabanes" (N = 290), "Marjal de Nules-Burriana" (N = 33) and "desembocadura río Xeraco" (N = 79) all age classes are well represented. And so in "Vilanova d'Alcolea" (N = 19) and "Marjal de la Safor" (N = 18), despite only few captures were made. In one of the two only known populations located at streams, "Pobla Tornesa" (N = 4), the low number of individuals captured make us expect low survival probability in a relatively medium period of time.

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