

Data on a relict population of *Emys orbicularis* from Burriana (Castellón, Eastern Spain)

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Abstract: During the years of 2003 and 2004 some recently discovered population of European Pond Turtle from a locality in the province of Castellón (Hort de Miralles, Burriana) was monitorized. The site is placed on a relictic marshland reduced today to a short net of draining channels (with permanent freatic waters) surrounded by culture land. The water extent of the mentioned assemblage of channels used by the European pond turtle population reaches 6325 m². A survey of this population was done, capturing the turtles with fish traps in 17 sampling points and giving a result of 184 captured and 102 recaptured animals. The mean carapace length is 118.98 mm for the females and 115.13 mm for the males and the mean weight is 309 g for the females and 244 g for the males. The sex ratio is 1:1.81 favouring the females and the assemblage holds individuals belonging to any class of size thus showing a healthy population structure (in spite of an evident isolation); a total of 532 individuals has been estimated (in an interval of 471-613). Movements of the marked individuals between the different channels are also reported, as well as information about the plankton and macroinvertebrates present in the area.

Keywords: *Emys orbicularis*, habitat, population structure.

Resumen: Datos sobre una población relictica de *Emys orbicularis* en Burriana (Castellón, este de España). – Durante los años 2003 y 2004 se estudió una población de *Emys orbicularis* ubicada en el paraje denominado Hort de Miralles, el término municipal de Burriana (Castellón, este de España). Se trata de un antiguo marjal residual constituido por canales rodeados por campos de cultivo. La superficie de agua ocupada por la población de galápagos es de unos 6325 m². Se realizaron muestreos instalando artes de pesca (nasas) en 17 estaciones y se realizaron un total de 184 capturas y 102 recapturas. El tamaño medio del espaldar de los individuos capturados fue de 118.98 mm para las hembras, y 115.13 mm para los machos y el peso de 309 g en el caso de las hembras y 244 g en el de los machos. El sex ratio es de 1:1.81 en favor de las hembras. La población incluye individuos de todos los tamaños, por lo que se encuentra bien estructurada, estimándosele un tamaño poblacional de 532 individuos (intervalo 471-613). Se incluyen datos sobre los movimientos realizados entre los canales, así como información sobre el fitoplancton, zooplancton y los macroinvertebrados presentes en el área.

Palabras clave: *Emys orbicularis*, hábitat, estructura poblacional.

MATERIAL & METHODS

Study area

Study site is located at 3 km northeast of the city of Burriana, Castellón on East coast of Spain (3° 58' 30" N, 0° 40' 38" E; 3-5 m a.s.l.) (see Fig. 1). This area is widely cultivated with orange trees and vegetables and has a vast

frame of ditches and canals that evidence the transformation of the former wetland (Fig. 2). Due to this highly modified environment, habitat doesn't favour the species, so we presume it's an isolated subpopulation with no possibility of contact with other nearby populations located 7 km south ("marjal de Nules") and 10 km north ("marjal de Castellón").



FIGURE 1. Situation of study area. Grey dots indicates *E. orbicularis* populations in Valencian Community. Arrows indicates the population objects of this study.

FIGURA 1. Ubicación del área de estudio. Los puntos grises indican las poblaciones de la especie en la Comunidad Valenciana. La flecha indica la población objeto de estudio.



FIGURE 2. View of one canal on study area.

FIGURA 2. Vista de uno de los canales del área de estudio.

Captures

Survey was taken in the months when terrapins have a higher activity (between May and July) through the years 2003 and 2004.

Turtles were caught by means of unbaited submersed traps. Traps consist on slightly modified eel fyke nets where animals swim through 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 g. Each individual was marked with a pattern of unique shell notches on marginal scutes for further identification. All captures were photographed.

Biotic and abiotic parameters

Zooplankton samples were taken with a 30 μm mesh net and a 200 μm mesh net was used to capture of macroinvertebrates. Conductivity was measured with a Hanna HI 8333 conductivity meter. Physical and Chemical parameters were measured at the laboratory with PEE/LSPV, NH_3 , chlorophyll and metal methods.

Population estimates

Abundances were calculated according to closed population capture-recapture methods with Noremark software applying Joint Hypergeometric Maximum Likelihood Estimator (JHE) method (WHITE, 1996).

RESULTS

Habitat characterization

Vegetation. – The area is a wetland with a high degree of saturation due to both the

natural geomorphologic evolution of coastal wetlands and the anthropic land transformation as agriculture. Canals are between 0.35 and 2.10 m depth; Shoreline vegetation is scarce and deteriorated composed mainly by *Phragmites* sp., *Iris pseudacorus*, *Scirpus* sp. and *Typha* sp.

Water quality. – Nutrient values obtained were low and nitrate values are probably due to percolation of fertilizers used in agriculture. Water is oligotrophic due to Chlorophyll values according to OECD classification. Conductivity, in these still waters, fluctuates according to precipitation and evaporation; during sampling period values were high, corresponding to mesohaline waters (Table 1).

Water colour varies from greenish, due to phytoplankton, in eutrophic canals to orange-yellow due to both humic acid and dinoflagellates observed among collected phytoplankton.

Zooplankton. – The lack of adult of cladocerans and copepods, those due to their size highly contribute in biomass, makes that total zooplankton biomass remains low. Zooplankton found in the area is mainly semiplanktonic or periphytic, despite there is

TABLE 1. Physichal and chemical characteristics of water.

TABLA 1. Características físico-químicas del agua.

| Variable | Value |
|---|------------|
| Conductivity ($\mu\text{S}/\text{cm}$) | 3690-6890 |
| Chlorophyll ($\mu\text{g}/\text{l}$) | <0.01-5.6 |
| Suspended matter (mg/l) | 30-36 |
| Amonia (mg/l NH ₄) | <0.35-0.38 |
| Nitrates (mg/l NO ₃) | <10-10 |
| Phosphorus (mg/l P) | <0.1 |
| Chlorides (mg/l Cl) | 929-1932 |

no submersed vegetation; this is explained by the short size of the canals that makes littoral zones larger, in proportion with their total volume. High densities of dinoflagellates were found in some of the samples, mainly in those with higher eutrophication (Table 2).

Macroinvertebrates. – Macroinvertebrate community is dominated by different groups of insect larvae, characteristic of still waters. Among crustaceans *Procambarus clarkii* is very common. The few gastropods found are of the genera *Physella*, their number could be higher in benthos. Some bryozoans have been found; and a grate number of stratoblasts, designated for resistance and propagation. Highest proportion of individuals is of chironomids, with a 76%; of these 55% are

TABLE 2. Quantitative composition of zooplankton.

TABLA 2. Composición cuantitativa del zooplancton.

| Taxon | Density (ind/l) | Biomass ($\mu\text{g}/\text{l}$) |
|---|-----------------|------------------------------------|
| Bdelloidea | 60.8 | 7.6 |
| <i>Brachionus calyciflorus f. typica</i> | 48.4 | 12.1 |
| <i>Brachionus calyciflorus f. anuraeiformis</i> | 0.2 | 0.06 |
| <i>Brachionus urceolaris</i> | 20 | 5 |
| <i>Brachionus plicatilis</i> | 0.4 | 0.14 |
| <i>Testudinella patina</i> | 1.2 | 0.06 |
| <i>Notholca accuminata</i> | 0.4 | 0.06 |
| nauplii | 91.2 | 9.6 |
| copepodites | 4.2 | 1.97 |
| Total | 226.8 | 36.57 |
| Diversity (bits) | 1.9 | |

Orthoclaadiinae and have a great importance as trophic resource. Among predators we found small micro-turbellarian (*Macrostomus* and *Gyratrix*) and coleopterans (*Laccophilus* sp. and *Helochares* sp. larvae) (Table 3).

Vertebrates. – Over sampling period, including data obtained in 2003, a total of 587 individual, of eight species, were captured. European pond turtle (*Emys orbicularis*) was the most common species with 286 captures (73.90% of total), following was the eel (*Anguilla anguilla*) with 73 captured individuals (18.86%), mullets (Mugilidae) with 12 individuals (3.10%) and red-eared slider (*Trachemys scripta elegans*) (eight individuals, 2.07%). The rest of the species didn't reach 1% of total captures (Table 4).

***Emys orbicularis* population characteristics**

Range. – Total length of canals inhabited by European pond turtle in the study area is 1483.36 m, and total water surface is about

TABLE 3. Macro-invertebrates in the shoreline.

TABLA 3. Macroinvertebrados de las orillas.

| Taxon | % |
|--|---------------|
| sF. Chironominae | 21 |
| sF. Orthoclaadiinae | 55 |
| <i>Corynoneura</i> | 1 |
| <i>Nais elinguis</i> | 4 |
| Oligocheta sd. (Enchitraedidae ¿?) | 3 |
| F. Ditiscidae <i>Laccophilus</i> sp. | 4 |
| F. Hidroptilidae <i>Helochares</i> sp. | 3 |
| <i>Physella acuta</i> | 1 |
| F. Naucoridae | 1 |
| <i>Mesovelia</i> sp. | 1 |
| F. Baetidae | 1 |
| <i>Ischnura elegans</i> | 1 |
| <i>Gyratrix</i> sp. | 1 |
| <i>Macrostoma</i> sp. | 1 |
| Mites | 1 |
| Briozoa | 3 |
| Briozoa statoblast | Very abundant |
| <i>Procambarus clarkii</i> | Very abundant |
| Colembola | 9 |

TABLE 4. Total number and proportion of vertebrates captured.

TABLA 4. Número total y porcentaje de vertebrados capturados.

| | N | % |
|----------------------------------|-----|--------|
| Mugilidae | 12 | 3.10 |
| <i>Anguilla anguilla</i> | 73 | 18.86 |
| <i>Rana perezi</i> | 1 | 0.26 |
| <i>Emys orbicularis</i> | 286 | 73.90 |
| <i>Trachemys scripta elegans</i> | 8 | 2.07 |
| <i>Natrix maura</i> | 3 | 0.78 |
| <i>Tachybaptus ruficollis</i> | 3 | 0.78 |
| <i>Gallinula chloropus</i> | 1 | 0.26 |
| Total | 387 | 100.00 |

6325.03 m². Canal length range from 27.20 to 179.30 m, with a mean width of 5.03 m (range 3.80-6.70 m) and a mean depth of 1.55 m (range 1.10-2.10 m).

Captures. – A total of 17 sampling stations were set, with a total sampling effort of 290 days/trap. Traps were checked 64 times, thus reviews were made with a 4.53 days per trap periodicity. A total of 124 *E. orbicularis* were caught along year 2003 and 162 in 2004. Of the total of 286 captures 102 are recaptured individuals.

Biometry. – Females have an average length (measured as straight carapace length) of 119.36 mm; for males this value is 115.11 mm. Weight is 307 g for females while males just reach 250 g. Hatchlings (considering individuals from years 2003 and 2004) have an average length of 41.00 mm and 15.00 g weight (see Tables 5, 6 and Fig. 3).

Sex ratio. – Males were the 35.60% of the adult individuals captured; global sex ratio is 1:1.81. This proportion is an indicator of the good situation of the population, with a higher number of females (Table 7).

Asymmetry of carapace. – Of the total of 184 individuals captured, 57 of them had some kind of asymmetry on carapace scutes, this is a 30.98% of the total. Asymmetry has

TABLE 5. Carapace length (mm) statistics.

TABLA 5. Estadísticos de la longitud del espaldar (mm).

| | N | Minimum | Maximum | Mean | SD |
|---------------|-----|---------|---------|--------|-------|
| Female | 105 | 74.00 | 156.00 | 119.36 | 18.34 |
| Male | 57 | 64.00 | 142.00 | 116.10 | 14.88 |
| Juvenil | 16 | 44.00 | 101.00 | 75.06 | 13.78 |
| Indeterminate | 2 | 92.00 | 121.00 | 106.50 | 20.50 |
| Hatchling | 3 | 37.00 | 45.00 | 41.00 | 4.00 |

TABLE 6. Turtle weight (g) statistics.

TABLA 6. Estadísticos del peso (g).

| | N | Minimum | Maximum | Mean | SD |
|---------------|-----|---------|---------|--------|--------|
| Female | 105 | 71.00 | 670.00 | 307.23 | 127.90 |
| Male | 56 | 46.00 | 424.00 | 249.98 | 80.84 |
| Juvenil | 16 | 18.00 | 178.00 | 83.50 | 37.72 |
| Indeterminate | 2 | 122.00 | 256.00 | 189.00 | 94.75 |
| Hatchling | 3 | 12.00 | 17.00 | 15.00 | 2.64 |

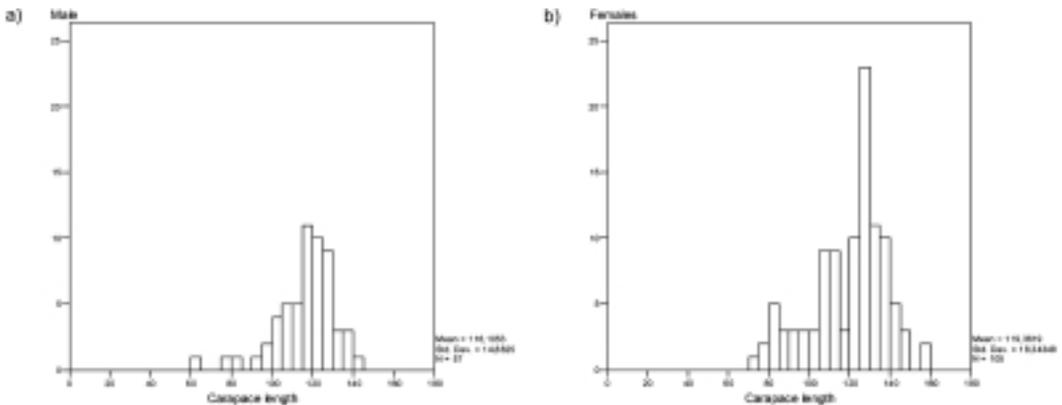


FIGURE 3. Distribution of size classes of Carapace length of males (a) and females (b)

FIGURA 3. Distribución de tamaños (longitud espaldar) en machos (a) y hembras (b).

been divided in four classes: One extra scute, few extra scutes, asymmetric scutes or seams and small scutes (Table 8).

Colour variation. – Plastron colour variability is very high, from individuals with totally dark plastron to those with only a few black dots (Fig 4).

Population estimate. – Total surface sampled was 3330.27 m², the 52% of the total surface with presence of terrapins (6325.03 m²). With these data population estimate (with 95% confidence interval) was 280 individuals (c.i. 248-323) in sampled area. Extrapolating this result to the total

TABLE 7. Sex ratio in study area.

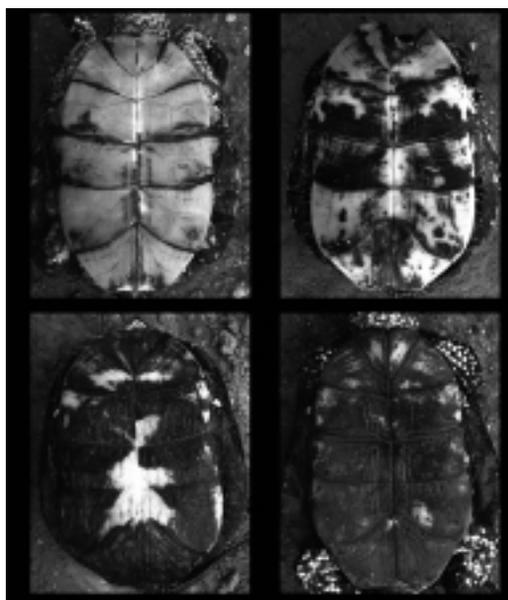
TABLA 7. Sex ratio en el área de estudio.

| | N | % |
|---------------|-----|-------|
| Female | 105 | 57.1 |
| Male | 58 | 31.5 |
| Juvenil | 16 | 8.7 |
| Indeterminate | 2 | 1.1 |
| Hatchling | 3 | 1.6 |
| Total | 184 | 100.0 |

TABLE 8. Typology of asymmetry, number of cases (N) and proportion.

TABLA 8. Número de casos (N) de asimetría por tipologías y porcentaje.

| Class of asymmetry | N | % |
|-----------------------------|-----|-------|
| Without asymmetry | 127 | 69.02 |
| One extra scute | 35 | 19.02 |
| Few extra scute | 11 | 5.98 |
| Assymmetric scutes or seams | 9 | 4.89 |
| Small scutes | 2 | 1.09 |
| Total | 184 | 100 |

FIGURE 4. Ventral view of some individuals of *Emys orbicularis* shown variability of design.FIGURA 4. Vista ventral de diferentes ejemplares de *E. orbicularis* mostrando la variación en el diseño.

surface of canals considered suitable for European pond turtles (6325.03 m²) total number of individuals in the area is 532 (c.i. 471-613).

That means the presence of 31'7-41'3 individuals per 100 m of canal (or 744'6-969'2 ind./ha). This is a much higher density than the obtained at the other populations (BADMAEVA *et al.*, 1985; TERTYCHNIKOV & VYSOTIN, 1987; MAZZOTTI, 1995;; DEVAUX & BLEY, 1996; MAZANAIEVA & ORLOVA, 2002).

Displacement. – Some recaptures have allowed detecting some movements of terrapins among different canals. Maximum distance between two recaptures ranged 260 m.

DISCUSIÓN

Water quality

Low nutrient rates have been obtained and waters may be considered as oligotrophic, as well as mesohaline due to the marine water intrusion. Rainfall and irrigation income may vary these values. Macroinvertebrates and zooplankton diversity is limited after the submerged vegetation scarcity and the verticality of the banks.

Population structure

Macroinvertebrates and zooplankton diversity is limited after the submerged vegetation scarcity and the verticality of the banks (KELLER & ANDREU, 2002).

The high density and equilibrated population structure may be due to the progressive surrounding marsh reduction, to the absence of disturbance in the area and to the scarce water pollution.

Occupied area

Some 1.483'86 m of canal occupied by the european pond turtle have been found, what represents a water extensión of 6325.03

m². The protection of the turtle population has to deal not only with the occupied area but with a bigger extension to allow short migrations. (CADI, 2003).

Considering a strip of 50 m beside the occupied canals (needed for the breeding and wintering movements) results a minimum extension of 115.136 m².

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