# First observation of *Triops* (Crustacea: Branchiopoda: Notostraca) in the Natural Park of the Serra d'Irta (Peníscola, el Baix Maestrat).

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First record of the tadpole shrimp *Triops* sp. in the Natural Park of the serra d'Irta (Peníscola, el Baix Maestrat).
*Key words: Notostraca, Triops, living fossil, temporary pond, biodiversity conservation, serra d'Irta, Peníscola, Iberian Peninsula.*

**Primera observació de *Triops* (Crustacea: Branchiopoda: Notostraca) al Parc Natural de la Serra d'Irta (Peníscola, el Baix Maestrat).**
Es documenta per primera vegada la presència de *Triops* sp. (família Triopidae) al Parc Natural de la serra d'Irta (Peníscola, el Baix Maestrat).
*Mots clau: Notostraca, Triops, fòssil vivent, ambients aquàtics temporanis, conservació de la biodivesitat, serra d'Irta, Peníscola, península ibèrica.*

## Introduction

The order Notostraca, branquiòpodes crustaceans consists of a large current distribution in North America, Eurasia, Africa and Australia, perhaps this is because of its old origin (Ombretta et al., 2005). The genus *Triops* Schrank 1803 has been quoted from the Triassic (Guthörl, 1934; Trusheim, 1938; Tröger et al., 1984; Wallossek, 1993; Kelber, 1998, 1999) or the late Permian (Gand et al., 1997). For most authors *Triops cancriformis* (Bosc, 1801), is a true living fossil existing for more than 200 million years (Cesari et al., 2004; Gall & Grauvogel-Stamm , 2005; Mantovani et al. 2008), and currently survives from this time in indistinguishable forms (Cesari et al. 2004). For Kelber (1999) it is the oldest living animal species on the planet. Its extraordinary survival is even more surprising taking into account the habitats it has occupyied such as the temporary pools, ponds and rice fields (Cesari et al., 2004), so ephemeral, fragile, isolated and unstable.

Their reproductive system is extremely complex. Being cited as bisexual (gametogénesis), and also parthenogenetic and hermaphroditic, but is not yet fully understood (Ombretta et al., 2005) although many researchers are concerned with genetic studies to reveal these and other issues such as variability (Cesari et al., 2004; Ombretta et al., 2005; Mantovani et al., 2008; Zierold et al., 2009). In the Iberian Peninsula it has a bisexual reproduction (Machado et al., 1999; Boix et al., 2002; Zierold et al. 2007) while in Northern Europe there is asexual, hermaphroditism and parthenogenesis.

*Triops* has never been documented until now in the Natural Park of the Serra d'Irta or in the Baix Maestrat. The records are from Ulldecona (Boix, 2002), Ares del Maestre (Zierold et al. 2007) and the Ebro Delta (Alonso, 1986) (fig. 2), and would be a minimum distance of 36 Kms from this site. To the south more recordings have been quoted so far: Vilanova d'Alcolea (Margalef, 1953), but the reference is more than 50 years ago, as is el Puig (Pardo, 1932) and the rice fields of the Albufera (Bolivar 1926). Recently, however, it has been found in the Devesa de l'Albufera of Valencia (Boix, 2002). Its presence in the rice fields, which at one time was so intense to the point of being considered a scourge (Alonso, 1986), has been greatly affected by the use of pesticides. Even more effect has been made by the replacement of the organochlorine organophosphates (Boix, 2002). *Triops cancriformis* is protected in Catalonia since 1994 (Boix, 2002, 11.23.1994 Order, Law 12/2006 of 27/07/2006).

The taxonomy of the genus *Triops* in the Iberian Peninsula has become rather complicated in recent years, as an article revealed that instead of three subspecies of T. *cancriformis* are two true species (*Triops cancriformis* and *Triops mauritanicus*: Korn et al., 2006 ).

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**Figure 1** | Location of the Basseta (Peníscola, el Baix Maestrat)

**Figura 1** | Localització de la Basseta, (Peníscola, el Baix Maestrat)

They investigated the philogenetic relationships among the three previous recognized subspecies of the *T. cancriformis* using mitochondrial DNA. Moreover, in a subsequent study, for the same researchers, the lineage *mauritanicus* is divided in 6 different species (Korn et al., 2010). However, the separation in many species of *T. mauritanicus* lineage, has raised doubts to other specialists (Vanschoenwinkel et al., 2012).

## Material and methods

### Study site

The observations were made by the sea in a temporary pool that is located near the town of Peníscola (fig. 1), within the Natural Park of the Serra d' Irta and the Natural Marine Reserve of Serra d'Irta, created by Decree 108/2002. Between the southern part of Peníscola and the northern part of Alcossebre (Alcalà de Xivert) there is still about 12 Km of shoreline which is a rare example of a relatively well preserved coast, in intensely anthropised part of the Valencian coast.

The temporary pool is about 200 $m^2$ in size and is subrectangular (fig. 1), it measures 25.4 x 8.5 m and is shallow, less than a meter in depth. The pool, is a mere 33 meters from the water line (fig. 1 and 6G), which separates a dirt road and a narrow line of natural vegetation (fig. 1 and 3 top) comprising of *Chamaerops humilis* L., *Pistacea lentiscus* L. and *Olea europaea* L., with a height between 1,5 and 3 m (fig. 6E) offering protection against salt droplets. There is the same vegetation around the pool (fig. 3 top and 6C), within which there is, no vegetation. To the west, abuts a parcel of land that was worked early in 2013, although it has since then grown.

The pool contains rainwater. The rainfall in the area is typically Mediterranean, moderate and has highly variable distribution and seasonality. As no data are available, an indication is given over a period of 42 years (1955-1997) recorded at the station of the Sant Jordi del Maestrat, located 24 Km away and 12 Km from the coastline (table 1). The maximum annual rainfall months are concentrated in autumn (October, September, December and November) and account for 71% of the sample. In a similar percentage (69%), these same months also had the highest daily precipitation throughout the year. During these periods of rainfall the pool can be filled. However, the months with minimal rainfall are recorded in winter (December and January in particular) and in July, which are expected to be the concentrated periods of drying of the pool.

The study area coincides with the isotherm surface water of the Sea of 13 - 25°C, the month of February being the coldest (Brasseur et al., 1996; Bianchi, 2007). Data agrees with recent measurements of surface water of the Columbretes made by Kersting & Linares (2012) during the period from 1991 to 2010, which gave an average of 13,16°C to 26,19°C from February to August, the latter being the warmest month. The pool is located in a small plain between the sea and the Serra d'Irta. The orientation is NE-SW, and extends parallel to the coast and adjacent to it. At some points it goes into the sea, as for example, a little further north, in the area of cliffs where


**Figure 2** | Points closest to where Basseta cited *Triops cancriformis*.

**Figura 2** | Punts més pròxims a la Basseta on s'ha citat *Triops cancriformis*.

the tower of Badum is located, so does the last branch to the north-east, which is a rocky island on which the town of Peníscola is situated. The maximum altitude of the Serra d'Irta is 572 m which is the highest point of the Campanilles, 4 kms from the Basseta. The eastern side of the area is drained by steep ravines which drain directly into the sea.

Currently the pool is concreted, but we think that its existence predates this recent work, because the name is old and also was generated simply from the common diminutive of the name, which points to its uniqueness: there are no other pools in the area which are spcifically named. Moreover, among the recorded names in the area is a "cove Basseta" a "beach Basseta" a "plain Basseta" and a "way of Basseta." All these indicate an ancient existence of the pool. Secondly the Basseta owes its origin to the geological conditions: the existence of outcrops of yellow marl of the Cretaceous period, which are those that provide waterproofing and allows the collection of water supplied by rain, which if it fills will flood onto nearby land. The age of these very clayey loams according to IGME (1973) is inaccurate, the Berriasian-Barremian. The Cretaceous layers in the environment near the sea, are usually covered by Quaternary conglomerates which are reddish and porous, allowing a natural pool to be formed underneath.

## Sampling and identifications

It is important to follow the ethical principle of not disturbing the living animals. The investigation carried out by the authors did not cause any evironmental effects or any harm to the animals. The pool was not disturbed or entered, all observations and measurements were made from the perimeter of the pool (fig. 3 top) or in the dry edge to find remains of dead animals. The duration of external observations of the pool water was for a minimum of 10 minutes on each visit. It was often difficult to see any live animals swimming due to the high turbidity of the water. Where possible, live animals were photographed. The remains of dead animals were counted, gathered and kept in separate bags. Only whole, individual remains were gathered. On examination, the shells were well preserved and the furca segments of the abdomen protected by rings of fine bone, including the last one called telson (fig. 6B), which allows generic assignment (fig. 3 bottom and 4 bottom), because it has a supraanal paddle, which forms the furca, as is the case with the other gender, Lepidaurus to supplement the Triopidae family.

Following Boix (2002) we take into account three aquatic habitat types for large branchiopods: a) "Temporary ponds" (With the substrate vegetated and dimensions exceeding 100 $m^2$ of surface area and 0,5 m of depth); b) "Puddles" (unvegetated substrate); and c) Shallow temporary pools/ponds" (with the substrate vegetated and shallow water, less than 0,5 m of water depth). The Basseta has to be considered in the category "Puddles": clay substrate, without vegetation, turbid water and of small size, even though its surface area is 200 $m^2$.

As far as the terminology is concerned, the author followed Alonso (1986 and 1996) and in terms of systematic, Alonso (1996), Martin & Davis (2001) and Korn et al. (2006, 2010).

Systematic
Kingdom: ANIMALIA Linné, 1758
Phylum: ARTHROPODA Latreille, 1829
Subphylum: CRUSTACEA Brünnich, 1772
Class: BRANCHIOPODA Latreille, 1817
Subclass: PHYLLOPODA Preuss, 1951
Order: NOTOSTRACA Sars, 1867
Family: TRIOPSIDAE Keilhack, 1909
Genus: ***Triops*** Schrank, 1803

Fig.3 bottom; fig. 4 top and bottom and fig. 6B and 6D.

| Period 1955-1997 Sant Jordi del Maestrat | Annual rainfall | Maximum annual daily rainfall | Number of rain days per year | Maximum monthly rainfall per year | Minimum monthly rainfall per year |
|---|---|---|---|---|---|
| n | 42 | 42 | 42 | 42 | 42 |
| Mean | 577.55 mm | 81.52 mm | 83.81 | 176.68 mm | 1.75 mm |
| Standard deviation | 191.98 mm | 38.09 mm | 18.20 | 84.49 mm | 2.80 mm |
| Maximum | 1083.4 mm | 187.1 mm | 124 | 398.1 mm | 10.3 mm |
| Minimum | 291.4 mm | 35 mm | 53 | 41.6 mm | 0 mm |

**Table 1** | Precipitation at Sant Jordi del Maestrat (el Baix Maestrat), period 1955-1997.

**Taula 1** | Precipitacions a Sant Jordi del Maestrat (el Baix Maestrat), període 1955-1997.

## Results

After an accidental first observation of *Triops* by J. Brewster, the Basseta has been visited periodically. Eventually, coinciding with a low water level and low ambient temperatures on 17/2/2013, observations were made and 11 remains of individuals were observed and photographed on the periphery of the water surface (fig. 3 and fig. 4 top) and 3 living specimens swimming. However, due to the poor clarity of the water, they are not seen in the photographs. On 26/2/2013, with water levels even lower, the remains of another individual was found and also 5 were observed swimming, one of which was less deep and was photographed (fig. 4 bottom)

The carapaces of the remains of the individuals measure between 23 and 26 mm in anteroposterior length. In late February and early March 2013 it rained and filled the Basseta. On subsequent visits, the water was very murky and no observations of individuals could be made or extract remains on the periphery of the pool.

During the visit of 17.02.2013, in the piles of yellow marl beside the pool, a fossil of a marine gastropod was found, from the family Cassiopidae Kollmann 1979. (fig. 6A). During the visit of 24/03/2013, at 16h 30', with the water temperature at 17.5 ° C, samples were taken for analysis, which gave the results listed in table 2. During the visits of 24/03/2013 and 12/05/2013, with a high water level in the pool, there were a high number of tadpoles of natterjack toad (*Bufo calamita*) (fig. 6H) and also were present tadpoles of Perez Frog (*Pelophylax perezi*) (fig. 6I). In the last of these visits individuals were observed with and without visible limbs, *B. calamita* (fig. 6F). On neither visit due to the depth and turbidity of the water, were live or remains of *Triops* observed. It is difficult to assess the size of the population, but given the small size of the Basseta, it is likely to be small.

The analytical data of water samples collected is in appendix 1.

**Figure 3 |** Top: overview of the Basseta, looking for specimens. Bottom: remains of *Triops*. Photos: E. Forner, 17/02/2013.

**Figura 3 |** Superior: vista general de la Basseta, cercant espècimens. Inferior: Restes de *Triops*. Fotos: E. Forner, 17/02/2013.

**Figure 4 |** Top: Remains of *Triops*. Photos: E. Forner, 17/02/2013.Bottom: *Triops* exemplary lives. Photos: J. Brewster, 02/26/2013.

**Figura 4 |** Superior: Restes de *Triops*. Fotos: E. Forner, 17/02/2013.
Inferior: exemplar viu de *Triops*. Fotos: J. Brewster, 26/02/2013.

## Discussion

Considering the opinion of Korn et al. (2006) there are few morphological characters that differentiate *T. cancriformis* and *T. mauritanicus simplex* and considering the amount of material available, so far it has been chosen not to assign species to the population of the *Triops* of the Basseta.

The existence of *Triops* in the Basseta in the Serra d'Irta seems to be an extraordinary result of chance and great persistence of life, which is extraordinary because of the very existence of the Basseta by the sea, and in a climate as dry as experienced in this region. Firstly, because it would not be possible without the impermeable marl outcrops of the Cretaceous period. However, in the last hundred thousand years, the existence of the Basseta could have been prevented by the action of Quaternary fluvial deposits that could have covered the Cretaceous sediments, as has occurred generally throughout the coastline. Looking at the photograph (fig. 5) Air Flight 1956 near the Basseta what you see is the alluvial fan of the ravine Escutxa, covered by the quaternary permeable hard crust (known as "taparàs"), features that hinder cultivation and, in any case, would have prevented the formation of a pool. Furthermore, the existence of Cretaceous materials is very low in all the Serra d'Irta area which comprises almost entirely of fully marine Jurassic sediments, consisting of permeable calcium packages. It is fortuitous that we have this and the characteristics of the type of marl. The origin of these impermeable marls provides valuable information about the only fossil found so far (fig. 6A): a marine gastropod family Cassiopidae. This family is nowadays extinct in the neighbouring marine environments but it was associated with continental influence (such as, deltas, estuaries and mangroves), with a sea water salinity not completely marine (Mennessier, 1984; Cleevely & Morris 1988; Forner, 2009). This would explain the very fine-grained fluvial sediments, which produce impermeable marls in a marine sedimentary basin that have allowed the existence of the pool. It is difficult to date when the fine marine sediments were generated, but during the broad range (Berriasian-Barremian) of the Cretaceous period. It is a very complicated and a fortuitous set of circumstances which have allowed the formation and existence of the Basseta considering the small dimensions and the closeness of the sea, and for the continuity of the water needed to enable the colonization by *Triops*.

The origin of the pond, with high probability, is strictly natural, but which sobsequently been used by humans. This has allowed a much wider horizon to exist if we include the recent colonisation of *H. sapiens*, with the ullikely occupation by *Triops*. I should add that it also seems extraordinary that the human madness of urbanization in recent decades has not destroyed the Basseta.

Also exceptional is that this small pool has not been contaminated by pesticides. The area is separated from the fertile orchards of the Pla de Vinaròs, la Vall d'Alcalà and la Plana, by the Serra d'Irta which affords protection from pesticides. (table 2). We analysed 92 potential products pollutants caused by pesticides, and none has tested positive. In fact almost all are below the detection limit for the technique used. The results of the analysis show no effects of eutrophication (dissolved forms of nitrogen and phosphorus in low concentration), and no contamination by heavy metals (cadmium, copper, zinc, etc.).

It is difficult to explain how, with all this in mind, concerning the pool, and in addition to the extraordinary presence of *Triops*, surviving (without discarding various recolonisations which are also quite improbable) in a small pool, with no vegetation, close to the shoreline, more than 36 km away from the nearest previously recorded sighting (fig. 2). And even if they have occasionally suffered the aggression of humans: the last one, concreting of the pool, it is difficult to understand how


**Figure 5 |** 1956 aerial photography, which shows the alluvial fan of the ravine Escutxa, triangular, covering Cretaceous marls, just south of the border to Basseta.

**Figura 5 |** Fotografia aèria de 1956, on s'aprecia el con de dejecció del barranc de l'Escutxa, de forma triangular, tapant les margues del Cretaci, just fins al límit sud de la Basseta.

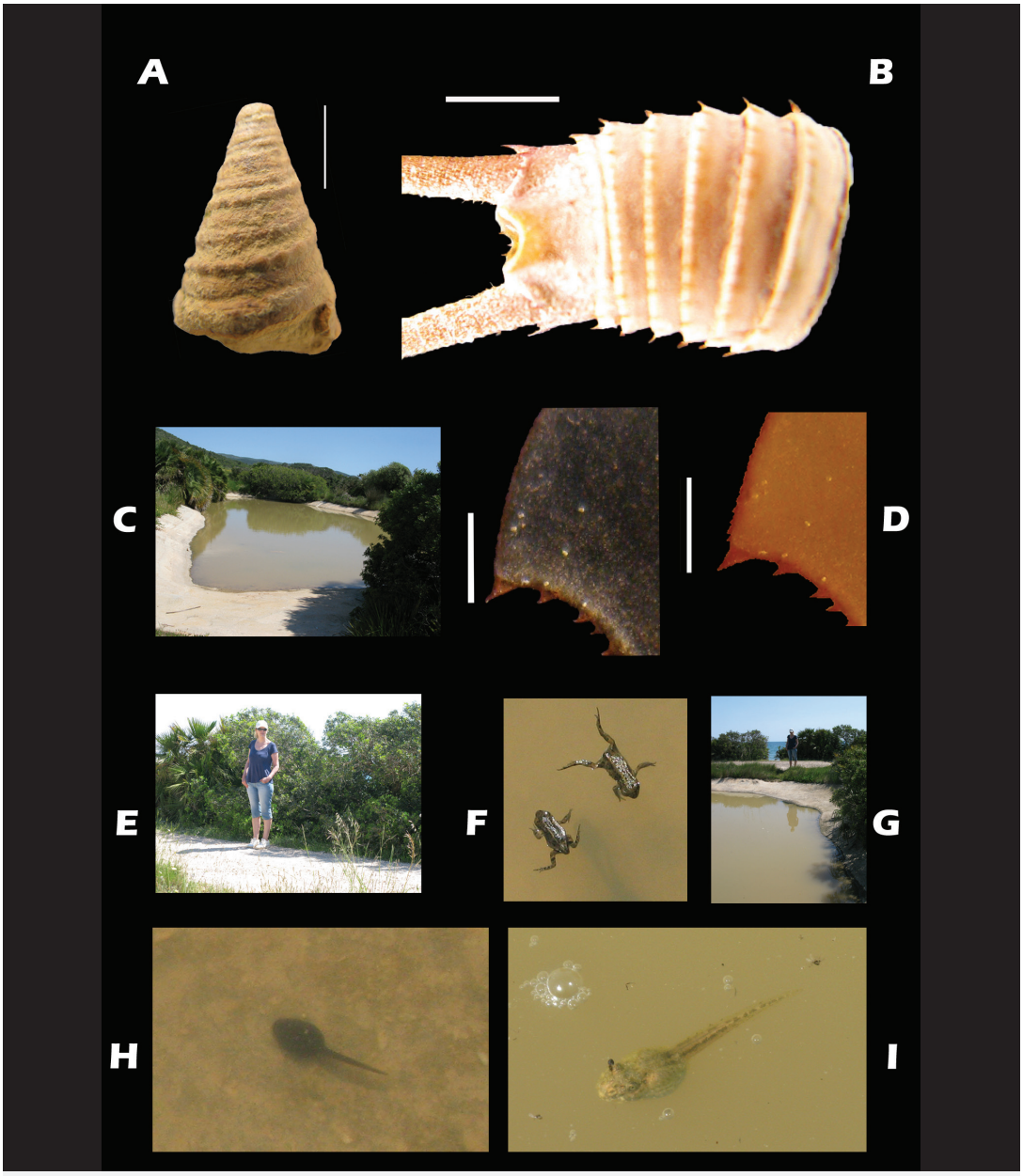


**Figure 6 |** A fossil of the Cretaceous impermeable marls of the Basseta: family Cassiopidae. B detail of ventral telson and abdominal rings last remains of *Triops*. C. High levels of water Basseta 12/05/2013. D posterodorsal left corner of the shell, two specimens. E detail of the lace plant (*Pistacea lentiscus*, *Olea europaea* and *Chamerops humilis*) that separates the sea and the Basseta, height 1,80 m benchmark. F specimens of *Bufo calamita*, no tail. G Proximity of the sea to the Basseta: 33 m with a calm sea. H *Bufo calamita* larvae I *Pelophylax perezi* larvae. Photos E. Forner, C, E and G 05/12/2013. Scale bars: A: 10mm, B: 2mm and D: 1 mm

**Figura 6 |** A fòssil de les margues cretàcies impermeables de la Basseta, família Cassiopidae. B detall de la part ventral del tèlson i últims anells abdominals de restes de *Triops*. C. Nivell alt de l'aigua de la Basseta 12/05/2013. D angle posterodorsal esquerre de la closca de dos exemplars. E detall del cordó vegetal (*Pistacea lentiscus*, *Chamerops humilis* i *Olea europaea*) que separa la Basseta de la mar, alçada model de referència 1,80 m. F exemplars de *Bufo calamita*, sense cua. G proximitat de la Basseta a la mar: 33 m amb la mar en calma. H Larva de *Bufo calamita*. I larva de *Pelophylax perezi*. Fotos E. Forner, C, E i G de 12/05/2013. Barres d'escala: A : 10 mm; B : 2mm i D : 1 mm.

they could survive there, since *Triops* leave their eggs which are resistant to desiccation in the sediment, which was then covered by concrete.

To colonise such extreme habitats, the adaptations of *Triops* are very unusual. The eggs are resistant to desiccation and generally do not hatch if there is no draining after a wet period (Alonso, 1986 and 1996). If it was not like this, after a long period with water and then a drought there would be no reserve of eggs in the soil of the pool to ensure the next generation. Besides, this prevents the colonisation of permanent water. A good example is found in the highlands of Albarracin, in Teruel, where dams are very close, only separated by 4,5 km, and have similar features. However, one dries almost every year and the other not. *T. cancriformis* only lives in the temporary pool. (Escribà et al., 2009). In addition Alonso (1996) cites the eggs can withstand temperatures up to 80 ° C and can pass through the gut of vertebrates without suffering any damage. In fact, the only reasonable hypothesis we have found to explain how a settlement would be in the Basseta, is by birds, by the internal transport in the digestive tract or in transporting externally through eggs attached by mud stuck to their legs (Sánchez et al., 2007). Now, the reason why a bird has come from the Ebro Delta to Basseta and has made a stop at the pool is more difficult to explain. Of course, everything is possible, if given the passing of a very long period of time. If the males do not need to reproduce the question is more easily answered.

The final point to clarify, the pool was modified using concret, at present has no vegetation. Alonso (1996) indicates that *T. cancriformis* feeds on organic detritus and submerged plants and that they can survive with very little food. It also indicates that they often feed on mosquito larvae. Perhaps this and other invertebrates are the food source. Exploiting other pool inhabitants is a question that should be studied further. Boix et al. (2006) suggest that large specimens of *T. cancriformis* in Espolla (Girona) are greedy predators. In fact, in some places the *Triops* have been postulated as a weapon of biological warfare against mosquito larvae in temporary waters (Tianyun & Mula, 2002). All this forms a cluster of highly unlikely circumstances that conspire to keep the existence of this durable animal, perhaps 200 million years old, in a tiny temporary pool by the edge of the sea. Hopefully men will not affect its future survival.

This new recording in the Natural Park of the Serra d'Irta fits the observation made by Boix (2002), who argues that most current observation points are included in areas that have some kind of protection. Perhaps, given the increasing pollution and pressure on the environment exerted by the human species, these are the only restricted pockets where they can live.

If *Triops* has lived in the Basseta so far, we should not alter the current conditions. Some preliminary protection tips would be:

1) To no extract the pool sediments containing the reserve of eggs. Normally the pool sediments are periodically cleared out. If this is necessary, perhaps the pool could be divided into 2 halves, cleaning only one side at a time and so preserving the whole;

2) To preserve the fragile band of vegetation that protects the pool from the Sea;

3) To evaluate the protection of the species by law, and

4) To forbid commercialization of exotic *Triops* (now the American *T. longicaudatus*, eggs can be bought on the internet) to prevent colonization by exotic species, which may eliminate the native population. On the other hand, perhaps we should establish a program to monitor the population of *Triops* in the Basseta, that should be respectful to the animals. This would make observations of the *Triops* and other small ecosystem components, as described in the methods section, and keep track of the cycles of water in the pool, and measure the basic characteristics i.e: level, temperature, conductivity, pH and dissolved oxygen concentration. A survey study in the neighbouring area in order to find more pools with *Triops* presence would be another action to take into account.

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*Data d'arribada 2 agost 2013*
*Data d'acceptació 29 novembre 2013*

| Parameter | | | 24/03/13 | | |
|---|---|---|---|---|---|
| | | **Microbiological** | | | |
| *Escherichia coli* (ufc/100 ml) | 1,6E +01 | Enterococcus (ufc/100 ml) | 6,2E +01 | Total coliforms (ufc/100 ml) | >8,0E +02 |
| *Clostridium perfringens* (ufc/100 ml) | 1,5E +01 | | | | |
| | | **Physicochemical** | | | |
| PH | 7.83 | Isophenphos metil (µg/l) | <0,03 | Fipronil (µg/l) | <0,1 |
| Hardness (mg Ca/l) | <46 | Lindane (µg/l) | <0,02 | Flusilazole (µg/l) | <0,1 |
| Conductivity at 20º C (µS/cm) | <250 | Malathion (µg/l) | <0,03 | Imidacloprid (µg/l) | <0,1 |
| Suspended particles (mg/l) | 26 | Metolachlor (µg/l) | <0,03 | Iprovalicarb (µg/l) | <0,1 |
| DBO5 (mg O2/l) | <3 | Pirimiphos-methyl (µg/l) | <0,03 | Isoproturon (µg/l) | <0,1 |
| DQO (mg/l) | <100 | Procymidone (µg/l) | <0,03 | Kresoxim-methyl (µg/l) | <0,1 |
| Ammonium (mg NH4/l) | <0,35 | Trifluralin (µg/l) | <0,02 | Mepanipyrim (µg/l) | <0,1 |
| Nitrite (mg NO2/l) | <0,05 | Lambda cyhalothrin (µg/l) | <0,1 | Myclobutanil (µg/l) | <0,1 |
| Nitrate (mg NO3/l) | <5 | Cypermethrin (µg/l) (sum of isomers) | <0,1 | Molinato (µg/l) | <0,1 |
| Residual free chlorine (mg Cl2/l) | <0,2 | Ciflutin (µg/l) (sum of isomers) | <0,1 | Paraoxon methyl (µg/l) | <0,1 |
| Total chlorine (mg Cl2/l) | 0 | Deltamethrin (µg/l) | <0,1 | Pyrifenox (µg/l) | <0,1 |
| Oxidizability(mg O2/l) | 4.78 | Permetrina (µg/l) (sum of isomers) | <0,1 | Simazine (µg/l) | <0,1 |
| Not ionized amonia | 0.007 | DDE (µg/l) | <0,02 | Tebuconazole (µg/l) | <0,1 |
| Surfactant agents (µg LSNa/l) | <100 | DDD (µg/l) | <0,02 | Terbuthylazine (µg/l) | <0,1 |
| Phosphorus (mg P/l) | <0,1 | O-P'DDT (µg/l) | <0,02 | Terbutryn (µg/l) | <0,1 |
| Dissolved mercury (mg Hg/l) | <0,00003 | P-P'DDT µg/l) | <0,02 | Triclorfon (µg/l) | <0,1 |
| Dissolved Zn (µg Zn/l) | 0 | Aldrin + Dieldrin (µg/l) | <0,03 | Acetamiprid (µg/l) | <0,1 |
| Dissolved cooper (µg Cu/l) | 14 | Endosulfan (a+b+sulfato) (µg/l) | <0,03 | Ametrina (µg/l) | <0,1 |
| Dissolved Cd (µg Cd/l) | <0,5 | HCE + Heptachlor (µg/l) | <0,03 | Carbaryl (µg/l) | <0,1 |
| Chloride (mg Cl/l) | 25 | DDE+DDD+DDT (µg/l) | <0,025 | Dimethoate (µg/l) | <0,1 |
| Sulphate (mg SO4/l) | <10 | Clorprofam (µg/l) | <0,03 | Malaoxon (µg/l) | <0,1 |
| HCB (µg/l) | <0,01 | Fenitrotion (µg/l) | <0,03 | Metalaxyl (µg/l) | <0,1 |
| Alachlor (µg/l) | <0,15 | Metil-paration (µg/l) | <0,03 | Methiocarb (µg/l) | <0,1 |
| Aldrin (µg/l) | <0,03 | Pirimetalin (µg/l) | <0,03 | Omethoate (µg/l) | <0,1 |
| Bromopropylate (µg/l) | <0,03 | Vinclozolin (µg/l) | <0,03 | Pirimicarb (µg/l) | <0,1 |
| Chlorfenvinphos (µg/l) | <0,05 | Alpha HCH (µg/l) | <0,02 | Prometryn (µg/l) | <0,1 |
| Chlorpyrifos (µg/l) | <0,02 | Beta HCH (µg/l) | <0,02 | Propazine (µg/l) | <0,1 |
| Chlorothalonil (µg/l) | <0,03 | Atrazine (µg/l) | <0,1 | Simetryne (µg/l) | <0,1 |
| Diazinon (µg/l) | <0,03 | Azoxitrobin (µg/l) | <0,1 | Tiabendazole (µg/l) | <0,1 |
| Dieldrin (µg/l) | <0,03 | Bitertanol (µg/l) | <0,1 | Benzo(a)pireno (µg/l) | <0,0025 |
| Alpha endosulfan (µg/l) | <0,03 | Bromacil (µg/l) | <0,1 | Benzo(b)fluoranthene (µg/l) | <0,025 |
| Beta endosulfan (µg/l) | <0,03 | Cadusafos (µg/l) | <0,1 | Benzo(g,h,l)perylene (µg/l) | <0,025 |
| Endosulfan sulphate (µg/l) | <0,03 | Carbendazim (µg/l) | <0,1 | Benzo(k)fluoranthene (µg/l) | <0,025 |
| Endrin (µg/l) | <0,03 | Cianzina (µg/l) | <0,1 | Indenol(1,2,3-cd)pireno (µg/l) | <0,025 |
| HCE endo (µg/l) | <0,03 | Cyproconazole (µg/l) | <0,1 | Sum HAP's (µg/l) | <0,025 |
| HCE exo (µg/l) | <0,03 | Diuron (µg/l) | <0,1 | Antrracene (µg/l) | <0,025 |
| Heptachlor (µg/l) | <0,03 | Ethoprophos (µg/l) | <0,1 | Fluoranteno (µg/l) | <0,025 |
| Isodrin (µg/l) | <0,03 | Fenhexamine (µg/l) | <0,1 | | |

**Annex 1 |** Analyses of the Basseta water. Taken on the 24/03/2013. Abbreviations: cfu = colony forming units; < = less than the detection limit of the technique used.

**Appendix 1 |** Analítica de l'aigua de la Basseta. Mostra del 24/03/2013. Abreviatures: ufc = unitats forjadores de colònies; < = menor que el límit de detecció amb la tècnica emprada.