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Occurrence of *Hydra vulgaris* in a Pond of the Botanical Garden of the Universidad Autónoma de Aguascalientes, México

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Abstract

The genus *Hydra* is a Cnidarian polyp that belongs to the Class Hydrozoa, Order Anthoathecata. Moreover, they are common in freshwater environments, inhabiting the photic zone of lentic bodies of water such as lakes, streams or ponds, belonging to the periphyton, nonetheless, they can be observed in the benthic zone in some cases. The polyps range from 1 to 15 mm in body length and are predators, capturing their prey with tentacles full of stinging cells. In addition, they have a remarkable regeneration power, and reproduce both sexually and asexually. Its presence in Mexican waters is little-known and the occurrence and roles must be extensively studied.

Keywords: Cnidaria; Mexico; Freshwater; Regeneration; Polyps

Introduction

Gasca [1] states that the medusozoa (jellyfishes) include three large groups: Cubozoa, Scyphozoa and Hydrozoa, which together with the Anthozoa (corals and anemones) form the phylum Cnidaria. All cnidarians are acoelomates, diploblastic, tissue-building metazoans, without organs as such, sharing the presence of highly complex subcellular organelles called cnidoblasts which can be of different kinds. Most of them function to inject toxin and poison the prey or aggressor.

The genus *Hydra* is a Cnidarian polyp belonging to the Class Hydrozoa, Order Anthoathecata, with two Families: Hydridae and Olindiidae [2]. The Swiss naturalist Abraham Trembley in 1774 published the first record of the genus *Hydra* in his book *Memories*, which provides more than 50 discoveries in the fields of natural history, taxonomy, morphology, developmental biology, behavior, physiology, and ecology of *Hydra*. These organisms are recurrent in freshwater environments, inhabiting the photic zone of lentic water bodies such as lakes, streams, or ponds, forming part of the zooplankton belonging to the periphyton or in some cases found in the benthos. Together with placozoans, porifera and ctenophores, cnidarians are diblastic organisms, having two cell layers: endoderm and ectoderm, which are attached by an acellular layer: the mesoglea [3].

The average size of this genus varies from 1 to 15mm in length. Their general morphology ranges from the hydrant, where the hypostome region with the mouth and tentacles is located, to the distal part of the body column where the hydrocaule (pedal disc) is located, which they use to attach or fix themselves to some substrate, usually rocks or aquatic plants [4].

Hydras are predatory organisms; their carnivorous diet consists mainly of cladocerans and copepods. Their predation mechanism is based on the secretion of chemical substances known as allomones.

Currently, allomones are considered secondary metabolites that can affect the growth, health, population biology or behavior of individuals of other species. Recently, it has been suggested that there are two types of allomones, offensive and defensive, the former being used by the predator organism to paralyze and dominate prey, while defensive allomones are substances needed to deter predators or territorial competitors [5]. The structures responsible for secretion of the metabolite in hydras are nematocysts, stinging cells that are restricted to epidermal structures [6].

The correct identification of nematocysts is essential for the taxonomy of the genus. In hydras there are different types of

nematocysts: Stenotele, Holotrichous Isorhiza, Atrichous Isorhiza and Desmoneme, each fulfilling a different role; Desmoneme and Stenotele are responsible for food capture, the former for entangling prey and the latter for injecting its paralyzing venom. The Holotrichus Isorhiza, on the other hand, distributes venom throughout the hydra's body and is used in defense against predators. Finally, the fourth type, Atrichous isorhiza, is an adherent nematocyst used for locomotion and anchoring tentacles to a substrate [7]. These organisms can reproduce sexually and asexually. In the former, germ cells are differentiated from unfavorable environmental stimuli, and in asexual reproduction it occurs by budding during the hot months of the year [7].

Materials and Methods

The sampling was carried out in a water body with coordinates 21° 54' 41.77" N 102° 19' 11.59 W. A Wisconsin net of a 54-micron mesh opening was used. Some specimens were narcotized with menthol, fixed in 4% formalin, and preserved in 50ml bottles. Microphotographs were taken with a digital camera mounted on a NIKON Eclipse optical microscope using live specimens (Figure 4). A JEOL LV 5900 scanning electron microscope was used for ultra-structure observation. Specimens used for scanning microscopy were dehydrated in gradual alcohols of 70, 80, 90, 96%, and Absolute at 10 minutes intervals; a critical point chamber was used to remove the remaining moisture using liquid CO_2. To get the images of dehydrated specimens, they were placed in aluminum stubs and covered with gold. The location of the pond where *H. vulgaris* specimens were collected was mapped (Figure 1).

Results

Some interesting characters of *Hydra* are showed in this work. For example, the ultrastructure of the surface of the tentacles (Figure 2A, 2B & 2D; Figure 3A, Figure 4A, 4C & 4D). The six tentacles are placed in the anterior part of the animal. The tentacles whose function is to capture prey through the use of pear-shaped paralyzing Stenostele (Figure 4A & 4B). In this case, *Hydra* is capturing *Simocephalus* sp., one Daphniid (4C).

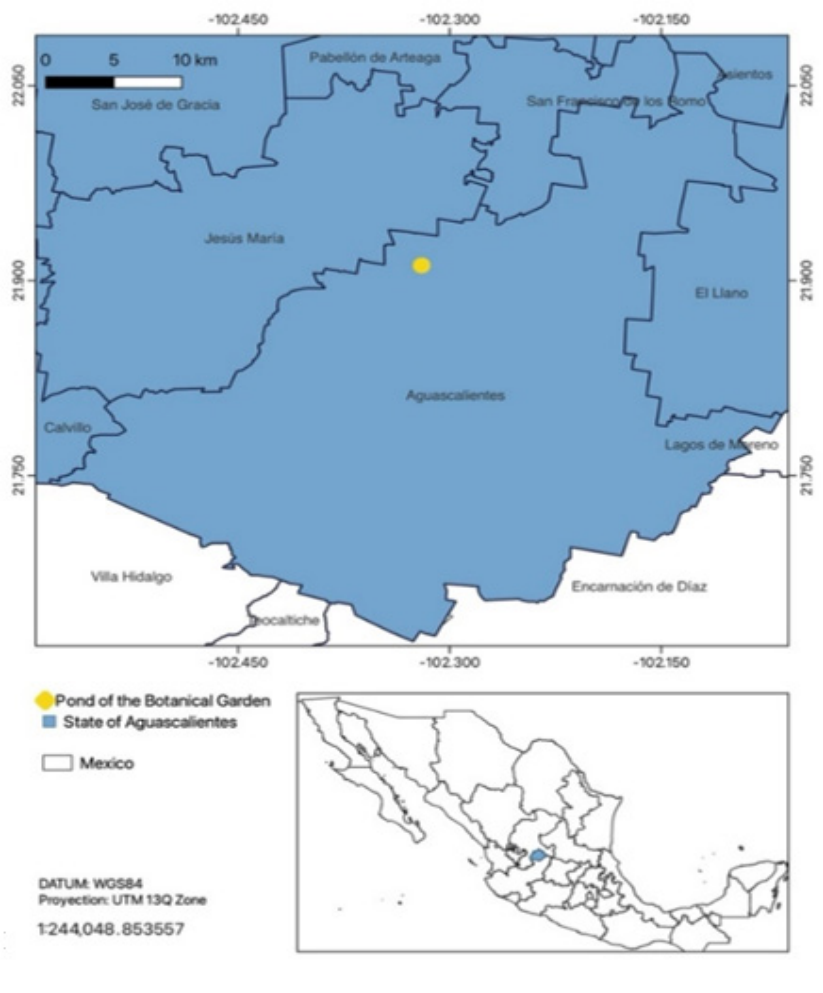

Figure 1: Map showing the locality of *Hydra vulgaris* in yellow dot.

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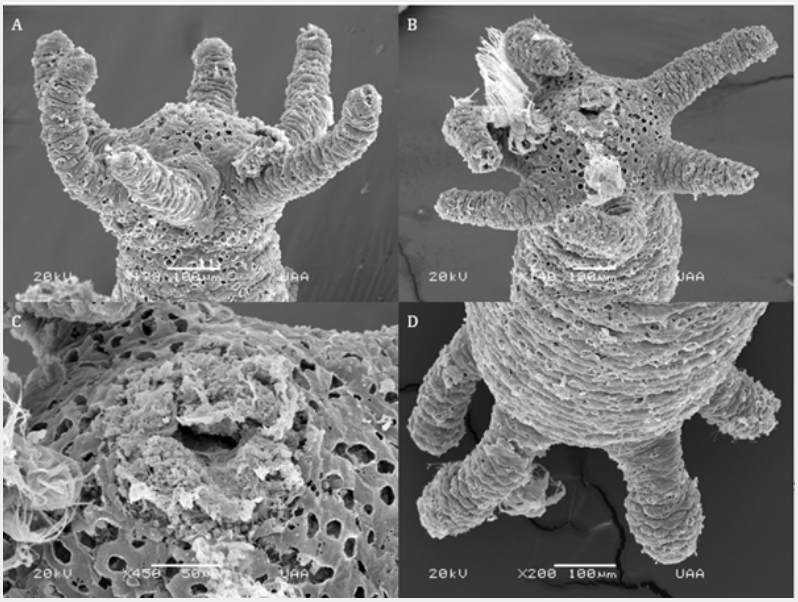

Figure 2: The apical part of *H. vulgaris*. A-C Hypostome (mouth), food leftovers are appreciated in pictures B and C.

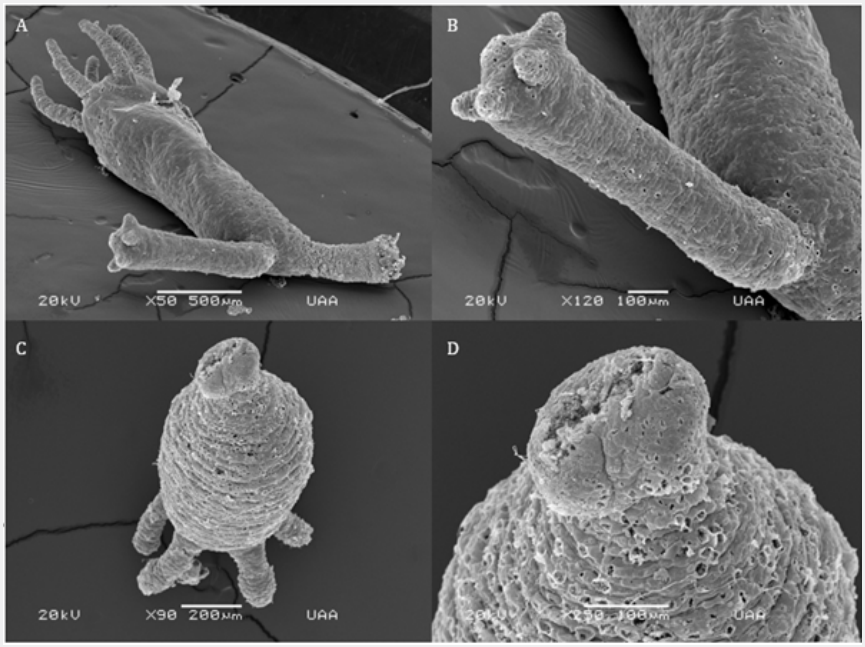

Figure 3: A-B Germination producing a bud. C-D Basal disc.

The hypostome or the mouth is visible, is a kind of aperture were the food (preys) are introduced due the tentacles (Figure 2A-2C). The posterior part shows the basal disc (Figure 3C & 3D), this structure whose function is to attach to the substrate to start its sessile life in some algae or some other organism and thus capture its prey.

Hydra vulgaris reproduces asexually by budding (Figure 3A & 3B), in which this genus produces offspring through a type of small copy, which will later come off as a new animal that will become independent and settle in its own habitat. The accompanying plankton that was found during the collection of the *Hydra* is constituted by Phytoplankton of the group of Chlorophyta with the species, *Closterium sp., Pediastrum duplex*, Scenedesmus sp. (Figure 5A). Also, Ocrophyta, with various genera of pennal diatoms such as *Achnanthes* sp., *Navicula* sp., *Pinnularia* sp., *Gomphonema* sp. and others (Figure 5C).

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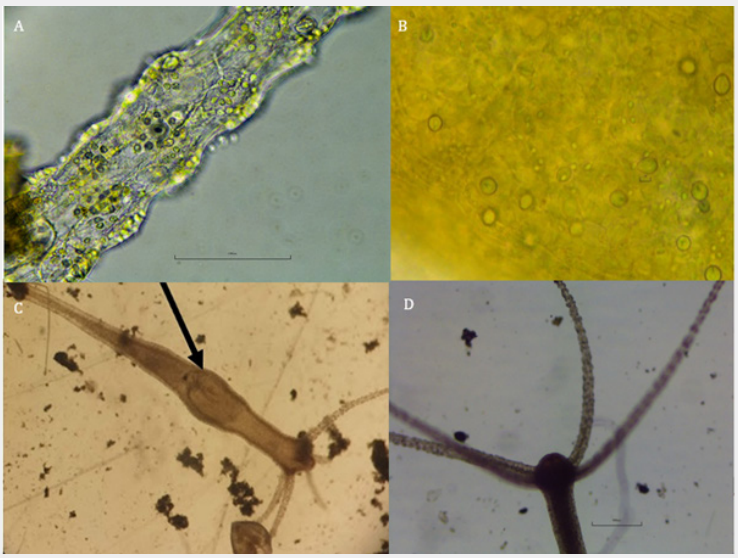

Figure 4: Photomicrographs of *Hydra vulgaris* taken with a NIKON Eclipse optical microscope. A. Tentacle showing the nematocists (10x) B. Closer view of the Stenostele nematocysts (40x) C. *H. vulgaris* digesting a cladoceran (4x) D. Apical view of *H. vulgaris* showing the moving tentacles (4x).

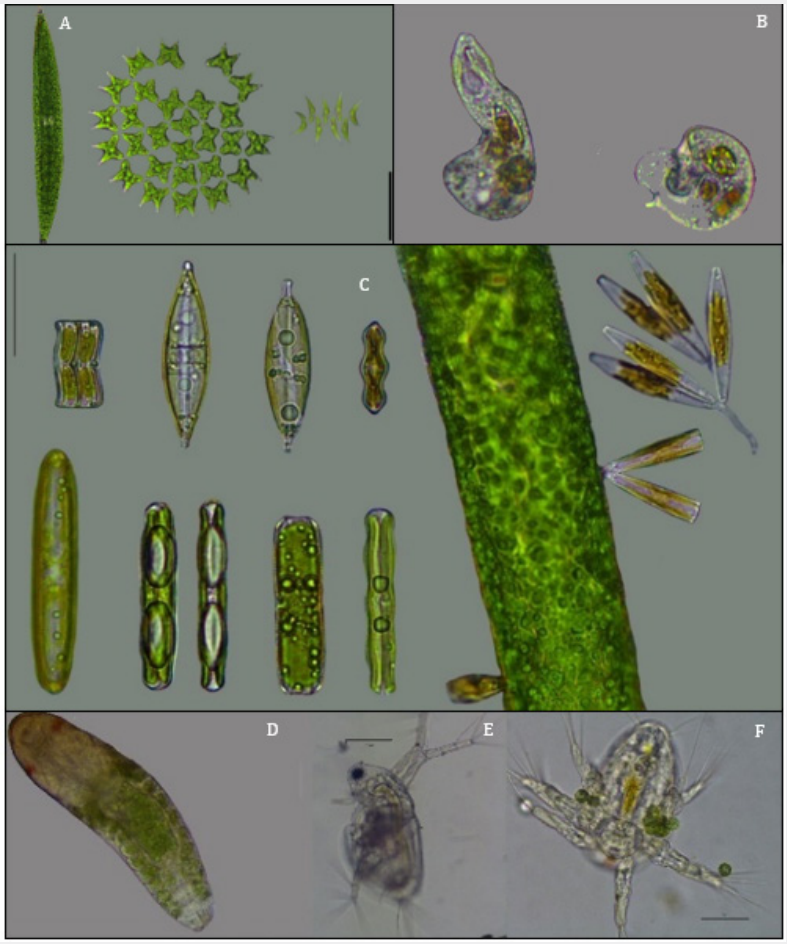

Figure 5: Accompanying plankton. A. Chlorophytes (40x. Scale barr, 50µm) B. Flagellates (40x. Scale barr 50µm) C. Diatoms (40x. Scale barr 50µm) D-F. Zooplankton (40x. Scale barr 50µm).

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The zooplankton is composed by various groups as Protists Flagellates, *Peranema* sp. (Figure 5B); Arthropoda, including Insect egg (Figure 5D), Cladocera, *Moina* sp. (Figure 5E), Copepoda nauplius (Figure 5F).

Discussion

Worldwide, different taxa of the genus *Hydra* Linnaeus, 1758 (Cnidaria; Hydrozoa) have been used as objects of study in the areas of toxicity, genetics, histology, and animal physiology in order to study regenerative processes in tissues, or the damage of certain heavy metals in these tissues to determine parameters of environmental quality in bodies of water. On the other hand, Negro et al. [8] mention that unlike all cellular studies in hydras, there is very little knowledge about the relationship between these cnidarians and the aquatic environments they inhabit and the ecological roles with which they are intertwined. That is why although the results show the accompanying plankton in the water sample (Figure 5) as an attempt to glimpse the possible ecological roles that may be taking place, this is a one-time finding that has not been followed up, and further research is required.

In Mexican waters, the available knowledge about medusozoans is very scarce, as for certain regions and most taxa the available information is virtually non-existent. According to Martell & Soto [9], there are two main problems in the possible causes of this lack of knowledge: holobenthic species (which constitute the majority in number of species in Medusozoa) continue to be excluded from inventories, perpetuating the separation between species lists in the benthos and the water column; and spatial bias also persists, as freshwater bodies and deep marine waters have received less attention from researchers, so we do not know the real diversity of medusozoans in genera such as Craspedacusta and Hydra in the country. Another reason could be the lack of "charisma" of the group, as due to their small scale they are invisible compared to the very obvious macroscopic groups. This directly affects conservation efforts in freshwater ecosystems, as they have concentrated on large animal and plant species, almost always overlooking the fact that micro-organisms play a fundamental role in these ecosystems. Of particular concern is that freshwater bodies are among the most threatened habitats in the world due to overexploitation, water pollution, stream modification, habitat destruction and degradation, and invasive species [10]. In order to conserve, therefore, the knowledge is indispensable. Without knowing what is found within micro-ecosystems, the consequences of disturbances are completely unknown: it has been documented that severe changes in water bodies of all types are damaging the distribution and presence of organisms growing in them, specifically in freshwater, socio-economic development impacts on water quality, biotic communities and ecological integrity [11]. To contribute more significantly to the knowledge of this group in the state, it is necessary to increase the sampling effort and not just leave this report as a one-off discovery, but as a systematised one [12].

Conclusion

Hydra vulgaris is a non-registered freshwater cnidarian in the state of Aguascalientes, Mexico. Its presence in this state gives rise to a new line of research in which its usefulness as a bioindicator can be studied, as it is a diblastic organism and therefore highly sensitive to environmental changes. Its accession to the inventory of cnidarians in Mexico is important as the knowledge of the presence of the group in the country is scarce. Furthermore, knowing the ecological role of *H. vulgaris* in the ecosystem and its presence in the rest of the state, contributes to the knowledge of the state's aquatic ecosystems and thus to the proper conservation of its water bodies.

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