

## **Alien Species & Urban Parks: Tools for Environmental Education**

**González García, Víctor**

*Atlantic Botanic Garden of Gijón, Spain*

**Torralba-Burrial, Antonio**

*University of Oviedo, Spain*

**Arias, Andrés**

*University of Oviedo, Spain*

### **Abstract**

Alien or exotic species are a concern, not only for native biodiversity but for human health and economy. Urban parks and green areas may act as an entry route for these exotic species *via* gardening, pet escapes or abandonment. Thus, the urban parks and the exotic species they harbor represent a great opportunity for environmental education by bringing the population closer to nature and raising awareness about the problems that alien species can cause. Collaboration between researchers and citizens (citizen science) is a crucial step in the control of exotic species, mainly in their prevention/early colonization phase. Here we propose the use of these parks to promote knowledge about alien species that may become invasive, both in formal (elementary and high school) and informal environmental education.

*Keywords: Citizen Science; Environmental Education; Alien Invasive Species; Urban Ecology. Biological Invasions*

## 1. Introduction & Background

Nowadays, the spreading of exotic or alien species (i.e. species that are introduced, accidentally or intentionally by humans, outside of their natural geographic range) are one of the major threats for biodiversity conservation worldwide (Davis *et al.*, 2018). Globalization has allowed the transit of these species all over the world due to human activity, creating environmental, economic and health problems wherever they establish (Pyšek *et al.*, 2020). Once they are fully established, eradication and control are highly expensive and with low success rates when large areas are invaded. In this framework, prevention strategies for their establishment, including environmental education on prevention, detection, risk, impacts and need for management of alien species, could be a keystone (Verbrugge *et al.*, 2021).

Cooperation between researchers and citizens is a keystone to detect these species before they become a real concern for environment and society (Davis *et al.*, 2018). Lately, this cooperation has been facilitated thanks to tools such as citizen science and development of smartphone apps, such as *iNaturalist* or *IAS in Europe*.

Furthermore, urban parks represent an opportunity to approach people to nature and make them aware of invasive species and the problems they carry. Urban biodiversity, including organisms living in urban and periurban parks, is a mix between those which come from the matrix that surrounds the city and those introduced (intentionally or unintentionally) by its human inhabitants (Goode, 2014). Parks are an important entry for alien species, since an important part of alien species are ornamental, plants, pets or associated species (Guo *et al.*, 2019; Pyšek *et al.*, 2020).

Since they are manageable spaces with a high presence of alien species, they could be a tool for education too. Several activities could be carried out within them, focusing them to elementary or high school students, by including these species in subjects taught in scholar centers (biology, natural sciences, technology, philosophy, ICT), or to citizens visit parks in a more passive (courses, routes) or active way (e.g., voluntary services detecting or eradicating them, reforestation with native species). Involvement of local authorities and public administration is needed to implement infrastructures to control these species and inform about them to people.

## 2. Objective

The main aim of this communication is to present a new tool for teaching biological invasions and biodiversity conservation in the context of Environmental Education to citizens and scholars in an urban environment.

## 3. Identification of urban park environmental education possibilities

Urban parks are widely used by citizens, not only as passageways, but also places of recreation, from the perspectives of leisure, health and learning (Wan *et al.*, 2020). Nevertheless, perception of the urban nature present in parks varies between citizens, according to their expectations, observations or knowledge about it (Hoyle, 2020). A preliminary analysis of citizens users' patterns of urban parks and biodiversity observations was carried out in an environmental course of the Programme for Mature Students (older than 50 years) of the University of Oviedo (PUMUO) in 2021.

Questionnaires on students' perceptions (n=22, age between 52 and 73 years, media 63 years old, 58% woman) shown that visit urban parks usually (72% at least weekly) but they do not observe urban biodiversity frequently (87% not observing or only occasionally). Urban parks located at Oviedo city center were the most visited parks (Campo de San Francisco: 59% students), but some periurban parks also were visited usually (Parque de Invierno 36%, Monte Naranco 23%, Purificación Tomás 14%). Regarding invasive species, they had doubts about the concept. Although most of the species that they considered invasive were invasive (59% Pampas grass, 27% yellow-legged hornet), a minority also mentioned as invasive those native species with negative social perceptions (seagulls, nettles, brambles).

## 4. Description of the environmental education proposal

### 4.1 Chosen urban parks

Two urban/periurban parks near Oviedo (Asturias, N Spain) were chose to this didactic proposal: Purificación Tomás (Oviedo) and La Cebera (Lugones). The parks were visited on 16<sup>th</sup> September 2021, searching for alien species.

Purificación Tomás has an extension of 200 000 m<sup>2</sup> and vegetation is formed for fruit trees,

mainly apple trees (*Malus domestica*), pear trees (*Pyrus communis*) and cherry trees (*Prunus* spp.), but also plantations of pine trees (*Pinus radiata*) and eucalyptus (*Eucalyptus globulus*). Other trees found in the park were chestnut tree (*Castanea sativa*) and maples (*Acer pseudoplatanus*), among many others. Several nonnative species were found, such as chestnut gall wasp (*Dryocosmus kuriphilus*), crowngrasses (*Paspalum* sp.) and yellow-legged hornet (*Vespa velutina* subsp. *nigrithorax*). It was found a native species that is considered as a plague, pine processionary (*Thaumetopoea pityocampa*), and domestic rabbits (*Oryctolagus cuniculus* var. *domesticus*) that have been abandoned by particulars in the area.

On the other hand, La Cebera is a more naturalized park with a great extension of native forest mixed with ornamental trees and a larger area, with 340 000 m<sup>2</sup>. Historically, these terrains were used to shelter an explosives factory and nowadays some ruins remain. The more remarkable conserved structure is the artificial lake in the middle of the park. Within it we found a plenty of nonnative species: the American crayfish (*Procambarus clarkii*), goldfishes (*Carassius auratus*), Koi carps (*Cyprinus carpus* var. *koi*), blackbass (*Micropterus salmoides*), American sliders (*Trachemys scripta* ssp.), cooters (*Pseudemys* spp.) false map turtles (*Graptemys pseudogeographica*) and hybrids between a native and an exotic duck (*Anas platyrhynchos* x *Cairina moschata*). It was found other alien species outside the lake, such as Pampa's grass (*Cortaderia selloana*), butterfly bush (*Buddleja davidii*) or false acacia (*Robinia pseudoacacia*).

#### 4.2 Informative panels and traps proposed as teaching resources

Some species inhabit Purificación Tomás park are usually controlled to limit risks to humans or pets: the yellow-legged hornet and the pine processionary. Additionally, domestic rabbit could be a vector for diseases too. Knowing this, regular establishment of traps for both insect species is proposed. Control of the feral rabbits could be more conflictive due to animalism people or social concerns to lethal control on some mammals and birds, thus a softer management is suggested, including their capture, microchipping, veterinary monitoring and sterilization (Sogliani *et al.*, 2021).

On La Cebera park, most of exotic species are secluded in the artificial lake, connected to Nora River through a small channel that could be used to invade the river. Maybe placing some nets of different sizes could avoid than the pond will be a source point of alien species.

Nevertheless, some species such as American crayfishes and yellow-eared sliders can move in land, so only eradicate them could prevent their breakout.

Some informative panels could be placed around the lake (Fig.1) so people could get informed about the different species inhabiting there. Some of these panels could be simple (one panel = one species) or comparative (Fig.2), two species in the same panel, being both invasive but morphologically similar (e.g. yellow-eared glider and false turtle map) or one native and another exotic but enough similar to be misidentified (e.g. yellow-legged hornet and European hornet). These panels should be made of resistant to environment materials, such as stainless steel (resistant to rust) and acrylic paint (resistant to moist and sunlight).

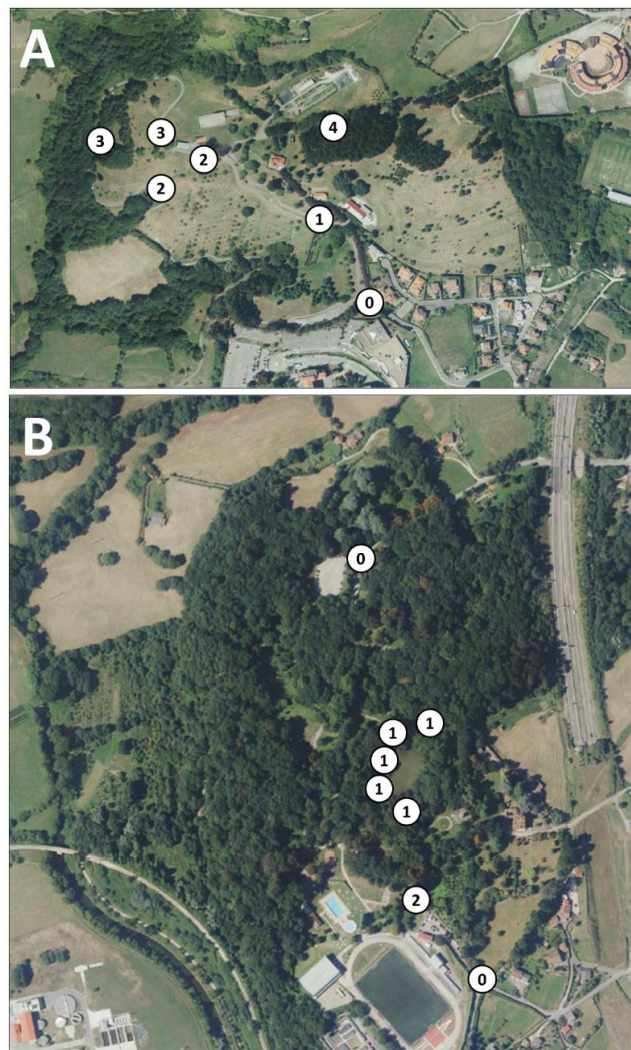



Figure 1. Potential locations to place the informative panels in (A) Purificación Tomás (0-General information, 1 Yellow-legged hornet, 2-Domestic rabbit, 3-Chestnut gall wasp, 4-Pine processionary) and (B) La Cebera (0-General information, 2-Yellow-legged hornet). Orthophotografy by PNOA.

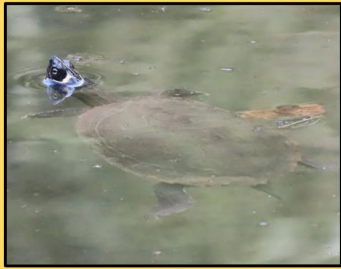
### YELLOW-BELLIED SLIDER

*Trachemys scripta scripta*

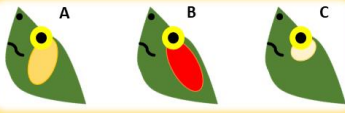


### FALSE MAP TURTLE

*Graptemys pseudogeographica*




**Where does it come from?**  
It comes from **Northwest of Mexico and Southeast of USA**. It has been arriving at Spain as a pet since 1983, although its sale is now forbidden.



A. Yellow bellied slider *Trachemys scripta scripta*  
B. Red eared slider *Trachemys scripta elegans*  
C. False map turtle *Graptemys pseudogeographica*

**Where does it come from?**  
It comes from **USA**. As well as American sliders, they came to Spain as exotic pets.

**What damages does it cause?**  
This reptile **compete against native tortoises**, such as the European pond turtle and the Spanish pond turtle, since this American tortoises can grow larger and beget more descendants.  
Besides that, they are omnivorous, feeding on aquatic plants, invertebrates, amphibia and small fishes, **changing population dynamics**.  
What is more, they can be **carriers of diseases** such as salmonellosis, which can be transferred to both animals and humans.



WANT TO KNOW MORE?

**What damages does it cause?**  
This turtles cause the **same ecosystem breakdown as American gliders**.

**How can both species be controlled?**  
The most effective method is **prevention**.  
When they are already established, the most common method is to **capture** them by using floating traps, with fishing webs and **remove** their eggs directly from their nests.  
**Delimit and limit their displacement** by using fences that surround lagoons that are inhabited by these turtles.

### CHESTNUT GALL WASP

*Dryocosmus kuriphilus*





**Where does it come from?**  
This insect comes from **China** and was recorded in Spain for first time in Catalonia in 2012. Next year, in 2013, it was already seen in Cantabria and Andalusia.



WANT TO KNOW MORE?

**What damages does it cause?**  
Gall formation induced by the laying of the eggs interrupts both growth of young shoots and catkins, **causing losses** of up to 80% of **fruit formation**.

**SPRING:** Adult wasp emerge from the galls.

**SUMMER:** Females lay eggs in dormant buds of chestnuts (*Castanea sativa*)

**AUTUMN:** Larvae grow inside the gall.

**WINTER:** Larvae pupate until the next season.



Figure 2. Examples of possible information panels. On the top, a double panel which makes easier to differentiate between two different species of alien tortoise species, the American glider and the false map turtle. On the bottom, a panel with information about a single alien species, the chestnut gal wasp. QR codes are useful since they can provide readers with more information.

Source of Chestnut gall wasp image: From “Wikimedia commons”, by Gyorgy Csoka, 3<sup>rd</sup> November 2021 ([https://commons.wikimedia.org/wiki/File:Dryocosmus\\_kuriphilus.jpg](https://commons.wikimedia.org/wiki/File:Dryocosmus_kuriphilus.jpg)).



### 4.3 Educative proposals

Both urban parks represent an opportunity for both formal and non-formal education, although with a different profile.

In one hand, Purificación Tomás could fit better in formal education due to its closeness to Oviedo city, so mobility from scholar centers would be easier for teachers and students. Several activities could be carried out both in the parks and inside the scholar centers, since they could be transverse to some subjects taught in elementary schools (e.g., Natural Sciences, Social sciences) and high schools (Biology & Geology, Plastic and Visual Arts, Information and Communication Technology, Technology and Philosophy or Ethics) (e.g., Lucha López *et al.*, 2018; Torres-Porras *et al.*, 2017).

More evident subjects would be Natural Sciences and Biology & Geology, where an introduction to alien invasive species could be made: their biology, ecology, recent history and concerns (adapting the content to the course and accompanied by the necessary resources to facilitate its understanding such as infographics and presentations). In high school could be deepened in some facets such as genetics, population dynamics and communities. How their populations change through time? Which individual traits are beneficial or harmful for their survival? Are those traits inheritable? Are those species integrated within the trophic web? Are they prey or predators for other native or nonnative species? Are they ecosystem engineers? These and other questions could act as a base for works and didactic units. What is more, if this study would be carried out in successive generations of students it would be possible to make a monitoring of these species.

In other subjects such as Social Sciences, Philosophy or Ethics could be a space to raise debates about alien species. How could students manage them? Is it moral or ethical to use them in gardening or as pets? Why some species are harder to manage from a social point of view? Why is there controversy with parrot management but not with yellow-legged hornet one? This could make students to think and reach their own reasoning.

Finally, in Plastic and Visual Arts and ICT, students could be encouraged to make their own informative panels, to do talks to their schoolmates with audiovisual material or even to initiate them in the use of apps made to detect species in general (*iNaturalist*, *PlantNet*) or those made to detect exclusively invasive species (e.g., *IAS in Europe*).

Talking about Technology, some structures could be made in their workshops, such as shelters for native species (bird houses, amphibian shelters, insect house) or traps for nonnative species, specifically for yellow-legged hornet, since their traps are of easy construction, but students should study about them and the consequences on native fauna when they are used or made wrongly.

On the other hand, La Cebera is a wilder environment that could be used for non-formal education, such as rambles with different experts which could explain about the park story, its biodiversity and, finally, about the invasive species that can be found there.

## 5. Conclusions

Both urban parks, Purificación Tomás and La Cebera, represent an opportunity for environmental education since they are (i) next to populated cities, (ii) an entry for alien species, (iii) manageable, so the transit of these alien species between them and natural environment is mostly nonexistent and (iv) some of them are easily accessible since they are bounded to their environment, especially aquatic ones.

Therefore, using these parks as a tool for education could entail that spaces that are presumably a hive for alien species and destined just to spare time, could become in spaces dedicated to bring people closer to nature and raise awareness among citizens of (i) importance of preserve their natural environment, (ii) of difficulties that alien species can lead to and (iii) the importance of their premature detection and the necessity of control their way of entry that are more citizen-dependent (e.g. gardening or exotic pets). Raising awareness through education can be the solution to the problem of IAS.

## References

- Davis, E.; Caffrey, J. M., Coughlan, N. E., Dick, J. T. A. & Lucy, F. E. (2018) Communications, outreach and citizen science: spreading the word about invasive alien species. *Management of Biological Invasions*, 9(4), 515-525.
- Goode, D. (2014). *Nature in towns and cities*. London, United Kingdom: HarperCollins Publishers.
- Guo, W. Y., van Kleunen, M., Pierce, S., Dawson, W., Essl, F., Kreft, H., ... & Pyšek, P. (2019). Domestic gardens play a dominant role in selecting alien species with adaptive strategies



- that facilitate naturalization. *Global Ecology and Biogeography*, 28(5), 628-639.
- Hoyle, H. (2020) What is urban nature and how do we perceive it? In N. Dempsey & J. Dobson (eds) *Naturally challenged: contested perceptions and practices in urban green spaces* (pp. 9-36). Cham, Switzerland: Springer Nature.
- Lucha López, P., Sáez Bondía, M.J. & Claver Giménez, A.M. (2018). Un plano antiguo de los árboles y arbustos de un parque próximo al cole... ¿Lo actualizamos? *Alambique: Didáctica de las ciencias experimentales*, 92, 69-73.
- Pyšek, P., Hulme, P. E., Simberloff, D., Bacher, S., Blackburn, T. M., Carlton, J. T., ... & Richardson, D. M. (2020). Scientists' warning on invasive alien species. *Biological Reviews*, 95(6), 1511-1534.
- Sogliani, D., Cerri, J., Turetta, R., Crema, M., Corsini, M., & Mori, E. (2021). Feral rabbit populations in a peri-urban area: insights about invasion dynamics and potential management strategies. *European Journal of Wildlife Research*, 67(3), 1-9.
- Torres-Porras, J.; Alcántara, J.; Arrebola, J.C.; Rubio, S.J.; Mora, M. (2017) Trabajando el acercamiento a la naturaleza de los niños y niñas en el Grado de Educación Infantil. Crucial en la sociedad actual. *Revista Eureka sobre Enseñanza y Divulgación de las Ciencias*, 14 (1), 258-270.
- Verbrugge, L. N., Dawson, M., Gettys, L. A., Leuven, R. S., Marchante, H., Marchante, E., ... & Vanderhoeven, S. (2021). Novel tools and best practices for education about invasive alien species. *Management of Biological Invasions*, 12(1): 8–24.
- Wang, Y., Kotze, D. J., Vierikko, K., & Niemelä, J. (2019). What makes urban greenspace unique—Relationships between citizens' perceptions on unique urban nature, biodiversity and environmental factors. *Urban Forestry & Urban Greening*, 42, 1-9.