

# Contents

## Invasive alien species in aquatic environments

### Practical information and management insights

## Volume 3

## Management insights (cont.)

## Animal species



## Insects

- 162** ■ **Asian bush mosquito**
- Species fact sheet
  - Managing the Asian bush mosquito in Natoye (Wallonia, Belgium)

## Molluscs

- 168** ■ **Chinese pond mussel**
- Species fact sheet
  - Eradication of a population of Chinese pond mussels in the Romé pond (Meurthe-et-Moselle department)

## Crustaceans

- 174** ■ **Red swamp crayfish\***
- Species fact sheet
  - Managing red swamp crayfish in the Brenne regional nature park (Indre department)

## Amphibians

- 181** ■ **American bullfrog\***
- Species fact sheet
  - Managing the American bullfrog in the Périgord-Limousin regional nature park (Dordogne department)

## Reptiles

- 188** ■ **Chinese stripe-necked turtle**
- Species fact sheet
  - Early preventive work against Chinese stripe-necked turtles on Réunion Island
- 195** ■ **Red-eared slider turtle\***
- Species fact sheet
  - Testing management methods for red-eared slider turtles on the Courpain site (Loiret department)
  - Managing a population of red-eared slider turtles on the Vieux Salins site in Hyères (Var department)

## Mammals

- 203** ■ **Northern raccoon**
- Species fact sheet
  - Management of Northern raccoons by the Association of certified trappers in the Gironde department

\* Management reports for these species are also available in volume 2 (2015).



# Asian bush mosquito

(*Aedes japonicus*)

This mosquito originated in Japan. Adults often lay eggs in used tires that are transported by ship from one continent to another for repair or recycling, thus enabling the species to spread. It is not considered a major vector of disease, however its bite is painful.

## Description

- Adults range from dark brown to black, with white spots on the body and legs
- The antenna are long with hairs between each section
- Larvae range from yellowish-brown to dark in colour, are limbless, thin and have a long respiratory siphon on the eighth segment
- Should not be confused with the Asian tiger mosquito (*Aedes albopictus*), which has clearer stripes on the abdomen

## Ecology and reproduction in its original environment

- Forest species, however it is also found in urban environments
- Larvae develop in holes in trees and rocks, near water
- The eggs are particularly resistant and can survive (dormancy) several months without water
- Full larval development takes two to three weeks Adults live two months, on average
- Adults may be observed from the beginning of spring until the beginning of autumn
- They feed essentially on mammals, including humans
- They are not a major vector of disease, however they are a potential vector of the West-Nile virus

## Documentation

- Fontenille, D., Jourdain, F. et Perrin, Y. 2013. *Aedes japonicus* : quel risque pour la France métropolitaine ? Note du CNEV. 12 pp.
- Lutte contre le moustique japonais en Wallonie. Site internet du Service Public de Wallonie : <http://biodiversite.wallonie.be/moustiquejaponais>
- *Aedes japonicus* – Factsheet for experts. European Centre for Disease Prevention and Control. [En ligne]. Disponible sur : <https://ecdc.europa.eu/en/disease-vectors/facts/mosquito-factsheets/aedes-japonicus>
- Invasive Species Specialist Group (2017) Species profile: *Ochlerotatus japonicus japonicus*. [En ligne]. Disponible sur : <http://www.iucngisd.org/gisd/speciesname/Ochlerotatus+japonicus+japonicus>

Authors: Doriane Blottière, IUCN French committee.

Classification	
Order	Diptera
Family	Culcidae
Genus	Aedes
Species	A. japonicus (Theobald, 1901)







# Asian bush mosquito (*Aedes japonicus*)

## Managing the Asian bush mosquito in Natoye (Wallonia, Belgium)

### Wallonian interdepartmental group against invasive species (CiEi)

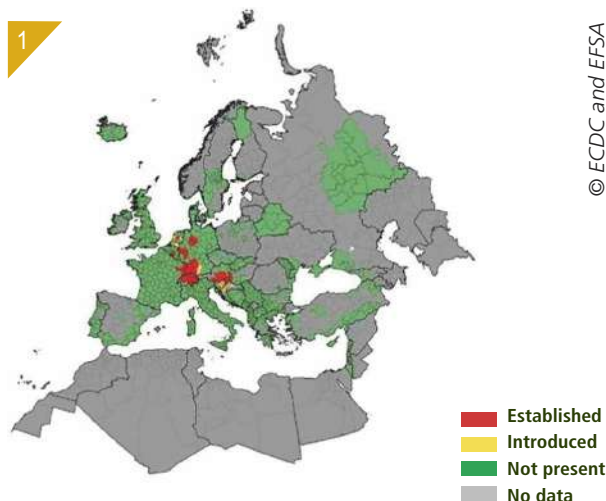
- Since 2009, the CiEi has been responsible for coordinating efforts to limit the damage caused by invasive species in Wallonia. It federates three departments of the Wallonian public service, namely the Natural environment and agriculture department (DEMNA), the Nature and forests department (DNF) and the Rural and rivers department (DRCE).
- The main missions of the CiEi are to:
  - implement the European regulation 1143/2014;
  - set up preventive measures and adapt the regulatory framework as needed;
  - coordinate operations against invasive alien species;
  - develop an alert system;
  - improve knowledge on the species,
  - inform managers and the general public.
- Contact : [invasives@spw.wallonie.be](mailto:invasives@spw.wallonie.be)

### Avia-GIS

- Avia-GIS is a private Belgian company (SME) founded in 2001 and specialised in collecting, processing and analysing spatial data used to develop space and time-based information systems in the fields of veterinary and public health. It works specifically on emergent zoonoses and vector-borne diseases.
- The company strives to optimise information systems on health issues and to propose management techniques for pests.
- Contact : Dr. Guy Hendrickx : [ghendrickx@avia-gis.com](mailto:ghendrickx@avia-gis.com) et Dr. Veerle Versteirt : [vversteirt@avia-gis.com](mailto:vversteirt@avia-gis.com)

### Intervention site

- The Asian bush mosquito has now spread to several areas in Europe and its range grows each year.
- It was first discovered in Belgium in 2002, on the storage site of a company that imported used tires, located in the village of Natoye (town of Hamois, Namur province).
- The village lies in the basin of the Meuse River and in the “Vallée du Bocq” Natura 2000 zone (BE35010).



© ECDC and EFSA



© CiEi

1. Distribution of Asian bush mosquitoes in Europe in 2017.

2. The village of Natoye in Belgium.

In the Natura 2000 zone, there are eight sites of high biological value, the equivalent of ZNIEFF sites in France, that include former quarries, hay meadows, megaphorbia, pools and ponds, etc.

- The monitoring campaigns run over the following years (MODIRISK project from 2007 to 2010 and the project of the Institute for tropical medicine in 2011 and 2012) confirmed the presence of the insect and indicated only limited expansion from the introduction site.
- An initial campaign to eliminate the population was carried out in 2012. The colonised sites that had been detected were treated with a highly specialised bacterial insecticide, *Bacillus thuringiensis* var. *israelensis* (Bti).
- Subsequently, following an initiative by the Wallonian

Environmental ministry, a more structured campaign against the Asian bush mosquito was launched in Natoye from 2013 to 2015, in view of reducing the environmental and health risks arising from the installation of the species. This was the first time that such a large project against mosquitoes was undertaken in Belgium.

■ The intervention took place over a zone spanning approximately 30 square kilometres around two colonies detected in Natoye. The towns of Hamois and Ciney were major participants in the monitoring and work. Additional inspections were also carried out in the nearby towns.

## Disturbances and issues involved

■ The bite of an Asian bush mosquito is more painful than that of the native mosquitoes. In addition, contrary to the native mosquitoes that generally bite at night and inside homes, the Asian bush mosquito bites primarily during the day in gardens and wooded areas.

■ It is not considered a major vector of disease, either in its original range or where it has since been introduced. However, laboratory tests have shown that it is a potential vector of several viruses, including dengue fever and chikungunya.

■ In Europe, the Asian bush mosquito may currently be the vector of a single virus, namely the West-Nile virus. To date, the latter virus has not been detected in Belgium in either native or alien mosquitoes.

■ The Asian bush mosquito is likely to compete with the native mosquitoes that develop in holes in trees, e.g. *Aedes geniculatus* and *Anopheles plumbeus*.

## Interventions

### ■ Discussions with other stakeholders and partners

■ The project manager, the Wallonian public service (SPW), put Avia-GIS in charge of the technical support and logistics. The other partners in the project were the towns of Hamois and Ciney, the Haute-Meuse river board, the Namur Province and the permanent Environment and health group.

### ■ Objective of the interventions

■ The objective was to precisely map the distribution of Asian bush mosquitoes around Natoye and to eradicate them.

■ The map of mosquito distribution was prepared in 2013. Two risk zones were identified:

- a high-priority zone within 1 500 metres around the central point (centroid) of the introduction area;
- low to moderate-priority zones in two nearby areas.

### ■ Time line of the interventions

■ The work took place each year from May to October, in 2013, 2014 and 2015.

■ In 2014 and 2015, the work focussed on the areas where the species was detected in 2013. With the exception of four urban areas in the towns, the intervention took place essentially in wooded areas.

■ Monitoring was organised in 2016 to check the effectiveness of the work.



3. A pile of tires stored in the open air where rain water stagnates, providing a particularly favourable environment for the development of the mosquitoes.



■ All of the field work, from the planning of the monitoring activities to the mapping of the detected colonies, was done with the assistance of the VECMAP software ([www.vecmap.com](http://www.vecmap.com)), developed by Avia-GIS for monitoring and mapping the vectors of diseases.

### ■ Intervention steps

■ Inspections were run on all the potential sites for larvae (small water bodies, recipients, holes in trees, etc.) in the high-priority zone. The larvae were identified by the experts from Avia-GIS and positive sites for *Aedes japonicus* were destroyed (removal of objects and equipment, filling of natural sites with soil or sand) or treated with a biological insecticide.

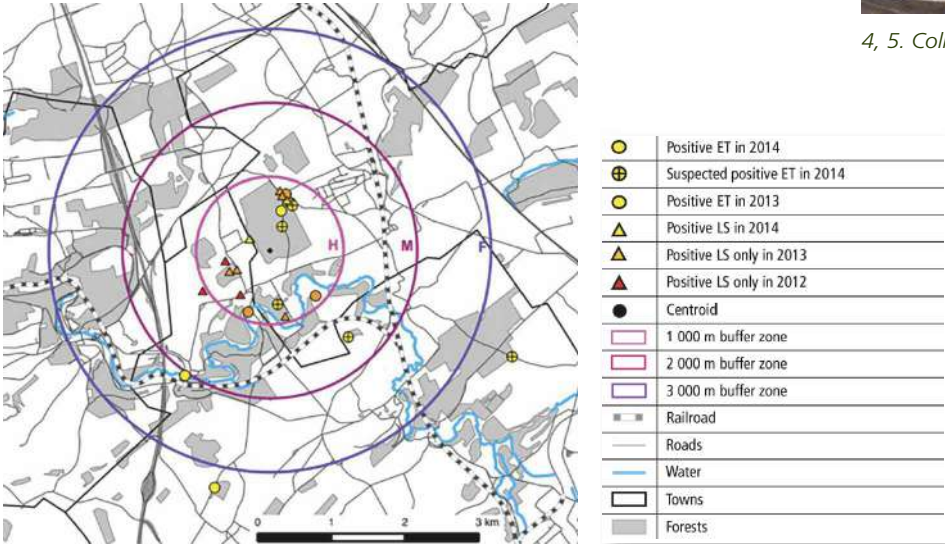
■ Egg traps (or sentinel traps) were laid in the targeted zones (gardens in the urban areas, farms, wooded lots and roads). This type of trap consists of a black pot, one to three litres in size, filled with water and a floating square of polystyrene, approximately 5 x 5 cm, that serves as an attractive laying spot for mosquitoes. The eggs do not develop if they are not covered by a rising sheet of water. This system makes it easy to remove the polystyrene and count the number of eggs in order to evaluate the local population of the mosquito species in question. The eggs were identified genetically.

■ In the low and moderate-priority zones, the same work was done, but with a lower sampling rate for traps and larval sites (50% sampling rate in the moderate-priority zone and 25% in the low-priority zone).

### ■ Efforts to raise awareness

■ In order to eliminate a maximum number of larval sites, efforts were made to raise the awareness of the local population.

■ Avia-GIS provided training to municipal employees, the agents of the Wallonian public service and the agents of the Haute-Meuse river board on how to detect larval sites and to install egg traps.



Zone monitored in 2014 with three priority levels around the introduction site.  
(ET = egg trap, LS = larval site)



4, 5. Collecting larvae in tires.



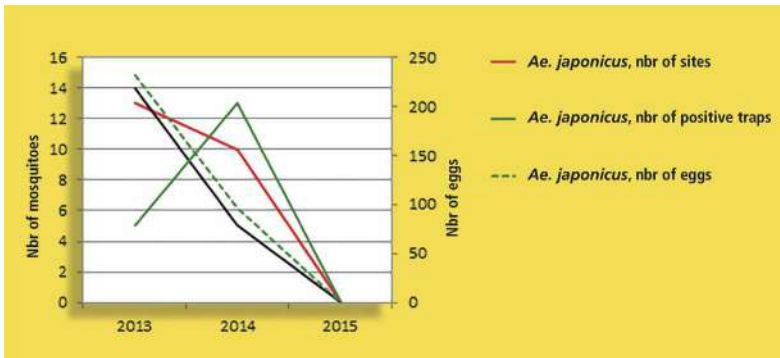
## Results and costs

### ■ Results

- During the management work, ten distinct colonies of the Asian bush mosquito were detected.
- In 2013, the sites were treated where the presence of the mosquitoes had been confirmed. The sites at risk were treated preventively and closely monitored. In a circle (radius 4 km) around the known sites, the forests, river banks, roads, trails, farms and 131 properties in the Natoye urban area were all carefully inspected. The Asian bush mosquito was found on 13 larval sites and in five egg traps, where a total of 231 eggs were collected.
- In 2014 and 2015, the campaign was repeated in order to maintain the pressure on the species. Given that no mosquitoes were observed in the surrounding areas, the monitoring effort focussed on the sites where they were observed in 2013 and in the zone at risk of dispersal. In 2014, the Asian bush mosquito was detected on ten larval sites and in 13 egg traps, with 97 eggs collected. In 2015, no traces of the mosquito were detected on the sites or in the traps.
- From 2013 to 2015, the populations of other mosquito species declined in parallel with the number of Asian bush mosquitoes detected.
- In 2016, the Wallonian public service monitored eight sites within a 3-kilometre radius of the initial site, however, the Asian bush mosquito was not detected.
- The fact that no Asian bush mosquitoes were detected in 2015 and 2016 confirmed that the management campaign succeeded in eliminating them completely from the monitored zone.



6. Egg trap.



Changes in the number of larval sites and traps indicating the presence of Asian bush mosquitoes, and in the number of collected eggs, from 2013 to 2015.

### ■ Costs

- The operation required a total of 146 man-days in the field.
- The total cost amounted to 133 917 euros for the interventions over three years.

Breakdown of human resources invested each year (man-days).

Year	Forest workers	Municipal workers	Water management (SPW)	CI Ei	Avia-GIS
2013	19	14	7	9	22
2014	7	5	5	5	14
2015	7	5	5	5	14
2016	-	-	-	3	-
TOTAL	33	24	17	22	50



Total costs per year.

Year	Cost (€)
2013	59 367
2014	44 607
2015	29 942
2016	-
TOTAL	133 917

## Information on the project

- The residents of the two towns were encouraged to participate via distributed letters and documentation.
- The Wallonian public service prepared a web page dedicated to the Asian bush mosquito that has been accessible to the public since March 2013 (<http://biodiversite.wallonie.be/moustiquejaponais>).
- A brochure titled “Mosquitoes - Simple measures to avoid their proliferation in our gardens” was distributed to the local population.
- A “spring cleaning” was organised to eliminate potential sites in gardens (recipients, old tires, etc.). A letter from the town council was distributed to all residents of Natoye and the town organised a day for free waste collection (29 April 2013) to raise awareness among the population.
- A personalised letter was sent to the land owners selected for inspections.
- Two public meetings were organised, the first on 27 March 2013 by Avia-GIS, the second on 3 April 2014 by the SPW for the residents of Natoye and Ciney.
- All the above activities were covered by the local and regional press.

## Outlook

- A new project (MEMO) was launched in 2017 to limit the introduction of alien mosquitoes in Belgium. This research project is funded by numerous public authorities in Belgium, namely the Flemish, Wallonian and Brussels administrations, the Federal public service (SPF) and the Public health and Food and environmental safety services. A cooperation agreement was signed to organise the collaborative effort in the fields of public health and the environment (NEHAP) over a three-year period. The Institute for tropical medicine in Antwerp is in charge of monitoring a network of potential introduction sites of alien mosquitoes in Belgium, including the Natoye site.

## Regulations

- No specific regulations currently exist concerning the Asian bush mosquito in Belgium or France.

Authors: Dr. Veerle Versteir and Dr. Guy Hendrickx, Avia-GIS, Céline Prévot and Etienne Branquart, Wallonian interdepartmental group against invasive species (CiEi), and Doriane Blottière, IUCN French committee. January 2018.



© SPW - CiEi



© SPW

- 7, 8. The brochure titled “Mosquitoes - Simple measures to avoid their proliferation in our gardens”.
- 9. A screen shot of the home page of the web site on the Asian bush mosquito.

## For more information

- Internet site on the Asian bush mosquito: <http://biodiversite.wallonie.be/moustiquejaponais>
- “Les Moustiques, des gestes simples pour éviter leur prolifération dans nos jardins”. Cellule interdépartementale espèces invasives. Service public de Wallonie. 2 pp.



2018 edition







# Chinese pond mussel

(*Sinanodonta woodiana*)

Freshwater mussel, originated in South-East Asia. Introduced in Europe via Romania in the 1960s, in the form of glochidia (larval stage) in imported fish.

## Description

- Bulging shell, 15 to 30 cm long, thick and solid, highly convex lower edge
- Variable colour, clearly marked ridges
- Inner face covered with pink nacre
- Characteristic 5 to 8 ridges (thick, raised lines) near the summit (hinge) of the shell, clearly defined and distant from each other

## Ecology and reproduction

- The mussels develop on beds with a fine grain size (mud, sand, gravel) in lentic waters
- The primary food source is phytoplankton
- They are highly tolerant of pollution and can live in both warm and cold waters
- Reproduction takes place in the summer and several emissions of larva are possible
- The larva, called glochidia, have a hook that attaches to the gills of fish (encystment). This technique enables their dissemination
- The glochidia do not target a specific host, though frequent hosts are grass carp, black carp, bighead carp, silver carp and topmouth gudgeon

## Documentation

- Adam B. 2010. L'Anodonte chinoise *Sinanodonta woodiana* (Lea, 1834) (*Mollusca, Bivalvia, Unionidae*) : une espèce introduite qui colonise le bassin Rhône-Méditerranée. MalaCo 6 : 278-287.
- Bastin K., Mandorlo G. et Charles L. 2014. Découverte de l'Anodonte chinoise *Sinanodonta woodiana* (Lea, 1834) (*Mollusca, Bivalvia, Unionidae*) dans la Sèvre Nantaise (Poitou-Charentes, France). MalaCo 10 : 2-4.
- GT IBMA. 2016. *Sinanodonta woodiana*. Base d'information sur les invasions biologiques en milieux aquatiques. Groupe de travail national Invasions biologiques en milieux aquatiques. UICN France et Agence française pour la biodiversité.
- Lamand F. (Coord.). 2015. Espèces exotiques envahissantes des milieux aquatiques et associés en France métropolitaine : recueil de fiches d'identification. Onema, Délégation Nord-Est. 173 pp.

Author: Doriane Blottière, IUCN French committee.

### Classification

Order	<i>Unionida</i>
Family	<i>Unionidae</i>
Genus	<i>Sinanodonta</i>
Species	<i>Sinanodonta woodiana</i> (Lea, 1834)





# Chinese pond mussel

(*Sinanodonta woodiana*)

## Eradication of a population of Chinese pond mussels in the Romé pond

(Meurthe-et-Moselle department)

### Lorraine nature conservatory (Lorraine CEN)

■ The Lorraine CEN is a regional group created in 1984 to protect the natural environment through land preservation and the management of specific sites of remarkable biological and ecological value. To that end, the Lorraine CEN is active in four major fields:

- knowledge: initial assessments for selection of sites to be protected, management plans and ecological monitoring of sites;
- protection of sites through their purchase or rental, or via management agreements;
- direct management, subcontracted management (teams from a social reintegration association) or in conjunction with a group of farmers;
- information to raise the awareness of the general public on the need to protect these natural areas.

■ In 2016, the Lorraine CEN managed 319 sites covering a total surface area of 6 244 hectares.

■ Contact: Jean-Baptiste Schweyer, member of the Lorraine CEN scientific council and manager of the Romé pond  
- jbschweyer@free.fr

### Intervention site

■ The Romé pond is located in the town of Royaumeix (Meurthe-et-Moselle department), in the Reine state forest, a wet forest in the Woëvre region.

■ The site covers 80 hectares, of which water bodies represent 60. The pond was created by monks in the 1100s, similar to most of the ponds used for fish farming in the forest.

■ The Romé pond was put up for sale in 2014 and purchased by the Lorraine public land agency (EPFL) which put the Lorraine CEN in charge of its management (99-year lease).

■ The pond was then emptied in October 2014, for the first time in 29 years. At that time, the massive presence of Chinese pond mussels (*Sinanodonta woodiana*) was



1. Map showing the intervention site.

discovered. This was the first time that the alien species was observed in the Grand Est region of France.

■ The presence of the bivalve mollusc in the Romé pond was thought to be due to the illicit introduction of grass carps (*Ctenopharyngodon idella*) after the year 2000 (Bernard Latasse, personal publication).

■ The Lorraine CEN scientific council decided to leave the pond empty for a prolonged period to eradicate the alien species that is considered invasive, in order to ensure that it did not disseminate to nearby ponds and rivers.

### Disturbances and issues involved

■ The large size of Chinese pond mussels (up to 25 centimetres for a weight of 900 grammes) means that they can filter several cubic metres of water per day. The quantity of plankton consumed multiplied by the number of mussels results in a significant reduction in the availability of food for other plankton-eating organisms.

■ In addition, its highly adaptive nature, notably concerning the habitat for adults and the hosts for larvae (glochidia that can attach to the gills and fins of fish), facilitates its dissemination.

© IGN

# Interventions

## ■ Emptying the pond

- The initial analysis of the situation revealed a number of mussels much too large for their collection and destruction (the population was estimated at 60 000 mussels).
- It was decided to empty the pond and ensure it remained dry long enough to eradicate the mussel population. Once the pond had been emptied on 27 October 2014, the gates were left open to evacuate any inflows from the catchment area.
- The pond was then refilled starting in November 2015.

## ■ Population monitoring

- The population of Chinese pond mussels was monitored in two manners, namely an active search, on foot, for mussels on the surface of the pond bed and digging for mussels in the sediment using a garden fork.
- Starting in June 2015, the rapid growth of dense, herbaceous plants on the pond bed made it difficult to search for mussels on the surface, thus making it necessary to dig into the sediment. Several monitoring points, a few square metres each, were dug up using a garden fork to a depth of 25 cm. However, given the very small number of mussels (empty shells) found in the sediment compared to the large number on the surface, the inspections of the surface were considered sufficient to assess the status of the mussel population in the empty pond.
- A total of 22 visits to the pond were made, 16 during the time the pond was emptied and a further six later in 2017 to confirm that the species had been eradicated.
- The inspections covered the pond itself and the stream downstream. Water from the pond flowed to the stream through a screen (10 mm mesh). The mussels arrived in the stream because the screen was regularly cleaned and the clogging material (sediment and other solid elements, including mussels) was simply gathered using a dip net and thrown into the stream.
- Upstream of the pond, the two incoming streams did not flow year round and it was not thought that mussels could survive in them.

## ■ Monitoring dates

- On 2 February 2015, three months after the pond was emptied, a few dozen empty mussel shells were found on the surface of the mud. However, most of the mussels had dug into the sediment and were still alive.
- On 20 May and 3 June 2015, the mud had started to crack and was covered with numerous empty shells. Vegetation had invaded the pond and a minuscule stream of water continued to flow over 20 metres of the pond. A small pool of water also remained downstream of the fish trap.
- On 13 and 19 June, one thousand square metres were inspected during a test on a protocol involving ten sectors measuring 100 square metres each. A total of 185 Chinese pond mussels were found, including 43 that were still alive (i.e. a survival rate of 21%). This very thorough check, though strictly visual, nonetheless detected live mussels lying 20 cm deep in cracks in the sediment.



2. The Romé pond before being emptied.  
3, 4. The emptied pond.  
5. The natural return of vegetation in the empty pond.



■ Three sites were excavated during the summer of 2015. On 19 June, a first area, representing a few square metres of pond bed, was dug up and two empty shells of Chinese pond mussels were found. Then on 11 August, a spot in the stream, approximately five metres downstream from the pond, and the fish trap at the pond outlet were excavated and a few more shells were found.

■ On 16 July 2015, during a search lasting one hour under hot, summer conditions, six mussels were found in the pond. They had died shortly before (tissues were still soft and not significantly degraded). Two live mussels were found downstream of the pond.

■ On 24 July 2015, no live mussels were found in the pond. However, a mussel, 175 mm long, buried in the pool of water located just downstream of the fish trap, was found alive.

■ On 11 August 2015, this last mussel had died. By this time, the entire site had dried (no water anywhere).

## Results and costs

### ■ Results

■ The total population of Chinese pond mussels prior to emptying the pond was estimated at 60 000. The last live mussels were observed in July 2015, a short time before the entire area had fully dried.

■ The pond gates were closed on 13 November 2015 to refill the pond, i.e. the intervention was prolonged well beyond the death of the last live mussel observed in order to make sure that the population had been fully eradicated.

■ It should be noted that the native species of swan mussel (*Anodonta cygnea*) had totally disappeared by January 2015. The Chinese pond mussels would appear to be much more resistant. They are capable of digging deeper into the mud, down to the clay level, i.e. several dozen centimetres.

■ The weather conditions during the year 2015, with a relatively dry spring and hot summer, even searing heat from 30 June to 7 July, accelerated the drying of the mud and the death of the molluscs.

■ Predators contributed to eliminating many of the mussels. They included carrion crows (*Corvus corone corone*), grey herons (*Ardea cinerea*), muskrats (*Ondatra zibethicus*), red foxes (*Vulpes vulpes*) and wild boars (*Sus scrofa*). Predation took place on both the mussels lying on the surface and those at the bottom of the cracks in the mud. In both cases, the mussels were extracted from the shells.

■ On 24 and 27 October 2017, the pond (dewatered to capture the fish) was inspected and a few empty shells of *Sinanodonta woodiana* were found, but no live Chinese pond mussels.

■ Then on 23 and 24 November 2017, seven live Chinese pond mussels were found in an area approximately 1 000 square metres in size. They consisted exclusively of large mussels (175 mm on average). They were immediately eliminated. On 28 November, a search was made for live mussels throughout the entire emptied pond. No further mussels, adult or juvenile, were observed.

■ The seven mussels raise questions due to their presence in a small area and the fact that all the mussels were adults of similar size. No juvenile mussels were found, in spite of the favourable reproductive conditions that existed once the pond had been refilled. The presence of water at a deep level and the type of soil may have enabled the seven mussels to survive the dry period.



6, 7. Empty shells found on the mud.

■ Costs

■ Monitoring was carried out free of cost by the manager of the nature reserve. The costs may nonetheless be estimated at approximately 4 000 euros (see the table below).

Cost estimate.

Item	Item details	Estimated cost (€)
Monitoring	18 man-days in the field 8 man-days for data processing and analysis	26 days X 117 = 3 042
Travel	85 km X 22 trips = 1 870 km	1 870 km X 0.568 = 1 062
TOTAL		4 104

- A total of 22 visits to the site were made for this study, however if Chinese pond mussels are found on a comparable site, a single, in-depth visit at the end of the summer to the emptied water body may suffice. It should be followed up by a close inspection of the site the next time the water body is emptied.
- The lack of fish production during the year the water body is emptied may represent a financial loss. However, periodic emptying of fish-farm ponds (every two to six years) is a normal part of their management procedure (mineralisation of the sediments, etc.).

Information on the project

- Article published in the Est Républicain newspaper on 16 August 2015.
- Sequence on the regional France 3 television programme, broadcast on 18 and 19 August 2015.

Perspectives

- The operation was a success and the species is now considered eradicated from the Romé pond. However, the seven adult mussels found in 2017 raise questions and inspections must be organised to ensure that the species has indeed been eradicated from the site.
- The discovery of the species in the Romé pond was a first in Lorraine. Subsequently, in the Grand Est region as a whole, the species was discovered on three other sites in the Aube and Marne departments.
- Inspections on recreational water bodies and flooded quarries in alluvial valleys dating back at least 20 years (areas where grass carps were introduced in order to limit the growth of aquatic vegetation) would most likely be of assistance in improving knowledge on the distribution of the species in the Grand Est region.

Management recommendations

- The presence of Chinese pond mussels is due essentially to the introduction of grass carps and the topmouth gudgeon. Consequently, particular vigilance is required, by improving the monitoring of restocking procedures for water bodies and by informing the owners of water bodies.



8. Empty shells in the channel through the pond.  
9. A mussel measuring 25 cm.  
10. A live mussel in a crack.  
11, 12. Adult mussels found in November 2017.



- The species reproduces several times between April and September, consequently restocking with fish should be avoided in the spring. Restocking in the fall is preferable because the fish are theoretically free of glochidia (the mussel larvae).
- Fish-farm ponds that are not periodically emptied encourage the exponential growth of Chinese pond mussel populations.
- Control over the species is possible in water bodies that can be emptied, i.e. essentially fish-farm ponds. It is very difficult and even impossible in water bodies that cannot be emptied, e.g. flooded quarries in alluvial valleys and in open terrain (rivers, canals, etc.).
- If the species is discovered in a water body that can be emptied, care should be taken to strictly limit the outflow of shells (screens, filters, progressive emptying without strong currents, reduced outflow of sediment and mud, recovery of the screened waste and sediment in the fish trap, etc.).
- The water body should not be refilled until after a close inspection of the site for live animals. Pond emptying and a dry period of less than 12 months cannot ensure that the *Sinanodonta woodiana* population will be eliminated.
- Water bodies are frequently created behind weirs and dams in rivers. In this case, the flow of water is rarely interrupted, at least long enough to eliminate the species. It may be possible to divert the flow temporarily, long enough to eradicate the mussels even in the central section of the bed.
- Regular emptying of fish-farm ponds should be seen as an opportunity to inspect for the presence of *Sinanodonta woodiana*, before refilling the pond. If the species is observed, a prolonged dry period is required.

## Regulations

- The Chinese pond mussel (*Sinanodonta woodiana*) is not covered by any legal texts in France. The species has no legal status, i.e. there are no restrictions (sale, possession, release to the natural environment, etc.).
- On the other hand, regulations weigh on the fish species (grass carps (*Ctenopharyngodon idella*) and topmouth gudgeon (*Pseudorasbora parva*)) likely to transport the glochidia of the mussels. The release of grass carps requires an authorisation. Topmouth gudgeon may not be released to the environment and are listed as an invasive alien species of Union concern (European regulation 2016/1141).

Authors: Jean-Baptiste Schwyer, Lorraine CEN, Doriane Blottière, IUCN French committee, and Jean-Nicolas Beisel, University of Strasbourg – ENGEEES. January 2018.

### For more information

- Adam, B. 2010. L'Anodonte chinoise *Sinanodonta woodiana* (Lea, 1834) (*Mollusca, Bivalvia, Unionidae*) : une espèce introduite qui colonise le bassin Rhône-Méditerranée. MalaCo, 6 : 278-287.
- Bastin, K., Mandorlo, G. & Charles, L. 2014. Découverte de l'Anodonte chinoise *Sinanodonta woodiana* (Lea, 1834) (*Mollusca, Bivalvia, Unionidae*) dans la Sèvre Nantaise (PoitouCharentes, France). MalaCo, 10 : 2-4.
- Girardi, H. & Ledoux J.-C. 1989. Présence d'*Anodonta woodiana* (Lea) en France (Mollusques, Lamellibranches, *Unionidae*). Bulletin mensuel de la Société Linnéenne de Lyon, 58 (9) : 286-291.
- Mouthon, J. 2008. Découverte de *Sinanodonta woodiana* (Lea, 1834) (*Bivalvia : Unionacea*) dans un réservoir eutrophe : le Grand Large en amont de Lyon (Rhône, France). MalaCo, 5 : 241-243.
- Thomas, A. & Chovet, M. 2013. Découverte de l'Anodonte chinoise *Sinanodonta woodiana* (Lea, 1834) (*Mollusca, Bivalvia, Unionidae*) dans le canal d'Orléans (Loiret, France). MalaCo, 9 : 463-466.
- Ticot, T. & Bourdet, J.-C. 2015. *Sinanodonta woodiana* (Lea, 1834) dans le canal du Midi en Haute-Garonne (*Mollusca, Bivalvia, Unionidae*). Folia conchyliologica, 32 : 18.
- Watters, G.T. 1997. A synthesis and review of the expanding rang of the Asian freshwater mussel *Anodonta woodiana* (*Bivalvia, Unionidae*). Veliger, 40 : 152-156.





# Red swamp crayfish

(*Procambarus clarkii*)

Originated in Northern Mexico and southern sections of the United States. Introduced in France in 1976 for human consumption.

## Description

- The maximum size is approximately 150 millimetres
- Generally red in colour, but can also range from grey to blue
- Cephalothorax with a rough surface (part 1 in Figure 1)
- Incurved rostrum with converging edges (part 2 in Figure 1)
- Inward-facing points (parts 1 and 2 in Figure 1), spurs on the proximal segment above the claws (part 3 in Figure 3)
- Red tubercles on the large claws (part 4 in Figure 3)

## Ecology and reproduction

- Common habitats are rivers, lakes, ponds, marshes and canals
- The species prefers calm, turbid waters, with grass beds
- It digs tunnels into banks
- It is active primarily during the daytime
- It is an opportunistic omnivore, however it consumes primarily plants
- Sexual maturity is achieved at 6 months
- Reproduction can occur several times per year (50 to 600 eggs)

## Documentation

- GISD worldwide database on invasive species. Invasive species specialist group, IUCN:  
<http://www.issg.org/database/species/ecology.asp?si=608>
- Lorraine fishing federations. 2012. Crayfish identification guide for continental France. 28 pp.
- Nepveu C. 2002. Les espèces animales et végétales susceptibles de proliférer dans les milieux aquatiques et subaquatiques - Fiches espèces animales (Les espèces exotiques). Agence de l'eau Artois-Picardie. 98 pp.

Author: Emilie Mazaubert, Irstea

Classification	
Order	Decapoda
Family	Cambaridae
Genus	Procambarus
Species	<i>P. clarkii</i> (Girard, 1852)





# Red swamp crayfish

(*Procambarus clarkii*)

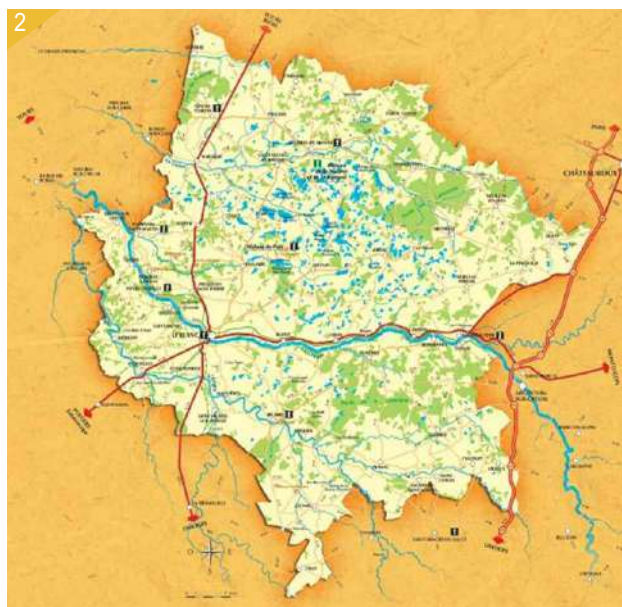
## Managing red swamp crayfish in the Brenne regional nature park

### Brenne regional nature park

- The Brenne regional nature park, created on 22 December 1989, is located in the Indre department and comprises a total of 51 towns covering a surface area of 182 700 hectares.
- The park is managed by a board in which are represented all the local governments (towns, Indre department, the region) that have approved the park charter and the French State in view of establishing a collaborative and coherent form of management for the area.
- The objective of the park is to protect and enhance the natural, cultural and human qualities of the area by implementing an innovative policy for economic, social and cultural development that respects the environment.
- Contact: Aurore Coignet, policy officer for invasive alien species - a.coignet@parc-naturel-brenne.fr

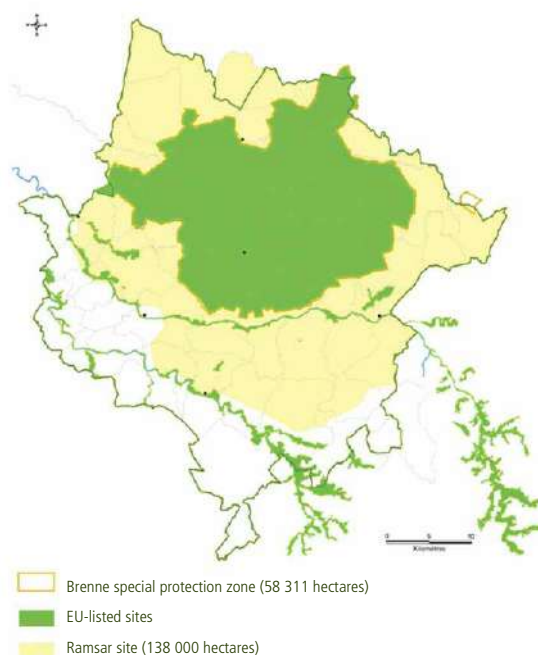
### Intervention site

- The Brenne is a true patchwork of landscapes (meadows, ponds, heathlands, forests, valleys and caves) that provide it with a wealth of ecological riches and wonderful views.
- It was listed by France as a Ramsar site (1991 Ramsar convention for the preservation of wetlands). The area is also recognised on the European level with four Natura 2000 sites. The first three are special conservation zones as defined by the Habitats directive, in the Creuse, Anglin and Grande Brenne valleys. The fourth is a special protection zone as defined by the Birds directive, which is larger than and comprises the Grande Brenne special conservation zone (see Figures 1 and 2).
- The entire park is located in the Loire River basin and is crossed by four rivers, the Indre, Claise, Creuse and Anglin.
- The man-made ponds (over 3 000) are fished each year and drained once every seven to ten years for a ten-month period over the fall and winter.
- Over 300 land owners in the Brenne are involved in fish farming and produce over 1 350 tonnes of fish (60% carp) per year. One-half of the 8 000 hectares of ponds are used for fish farming (Territorial assessment, 2009).



© PNR Brenne

### 1 Ramsar and Natura 2000 sites



© PNR Brenne

1. Map of the Brenne regional nature park.  
2. Map of the Ramsar and Natura 2000 sites in the Brenne regional nature park.



## Disturbances and issues involved

- Red swamp crayfish were first observed in the centre of the Brenne regional nature park in July 2007.
- The species is a healthy carrier of crayfish plague (*Aphanomycosis*), which has been identified as one of the main causes in the disappearance of native crayfish. In the Brenne, a test was conducted in 2012 and revealed the presence of the disease on certain sites. A few populations of white-clawed crayfish still exist in the Indre department, but none within the borders of the park.
- The presence of red swamp crayfish produces a number of ecological impacts, e.g. a reduction in aquatic grass beds, predation on molluscs and tadpoles (this aspect was confirmed by an analysis of stomach contents conducted by the regional nature park in 2011 and 2015).
- Fish farming is also affected economically due to the consumption of alevins. The reduction in the vegetation caused by red swamp crayfish in turn encourages predation of fish by birds, a non-negligible loss for fish farmers.
- Another visible impact in the Brenne is the digging of burrows resulting in severe damage to pond banks and adjacent roads. These burrows, in addition to those caused by coypus, have obliged land owners to repair the roads.

## Interventions

### ■ Objective of the interventions

- In order to coordinate the work against colonisation by red swamp crayfish and to limit the damage caused in the park, a management brigade for invasive alien species was created in October 2009.
- The team, made up of four people, carries out trapping with the towns and owners of ponds, responds to requests made by land owners and contributes to enhancing knowledge on the distribution of the species.
- The work in this field consists of three main activities, namely species management, communication and awareness-raising, and research. The research is intended to improve knowledge on the biology and ecology of the species and its dynamics in order to adjust and refine the management work.
- A database containing the updated inventory results is used to monitor crayfish populations throughout the area.
- Vast numbers of burrows enable red swamp crayfish to take cover when ponds are drained and fished. The links between ponds and the high mobility of the crayfish are factors contributing to the colonisation by the species and making it impossible to completely eradicate the species from the Brenne. That is why trapping was selected as the means to manage the species.

### ■ Discussions with other stakeholders and partners

- Immediately following the initial observations of red swamp crayfish in July 2007, a number of discussions were initiated.
- A steering committee, presided by the vice-Prefect, was created to launch coordinated and active management of the species. The committee brought together numerous local stakeholders, environmental-protection groups, Onema, the Chérine national nature reserve, the Indre fishing federation, the



3. A red swamp crayfish.  
4. A berried (gravid) female.





Intermunicipal board for sanitation and enhancement of the Brenne, researchers and scientists, the Union of fisheries' owners and operators, etc.

■ In 2008, a trip was made to the Brière regional nature park (Loire-Atlantique department), also confronted with the red swamp crayfish, to meet the elected officials and discuss the problems encountered.

■ **Research**

■ A partnership was established in 2010 with the University of Poitiers (Ecology, evolution, symbiosis lab) to learn more on the biology and ecology of the species and to improve management techniques. A study is conducted each year, e.g. on stomach contents, the typology of burrows, estimates of crayfish numbers using the capture-mark-recapture (CMR) technique, tests on different prototypes of traps and baits, etc.

■ **Management method**

■ Inventories were carried out on a total of 442 ponds. Among that total, red swamp crayfish were observed in 147 ponds.

■ Trapping was conducted in 120 ponds (owners refused access to some sites).

■ When sufficient trapping pressure is maintained year round, it is possible to capture all cohorts of crayfish, notably the berried (gravid) females and those with larvae present primarily in the fall and winter.

■ The “hoop net” used was made of rigid plastic with two entries and a central section for bait.

■ Carp offal was used to attract the crayfish. It was supplied free of cost by the Fish Brenne company (a company selling freshwater-fish products).

■ Work is also done when the ponds are fished (fall and winter). Assessments can be carried out simply by walking around the pond with the owner and looking under stones, locating burrows, etc. When red swamp crayfish are present, large numbers can generally be collected in the mud and in the fish trap.

■ A study was launched in 2013 (the Fish-crayfish interaction project) to find a means to enhance the trapping results by stocking ponds with particular species of fish. Biological control using carnivorous fish turned out to be very effective in conjunction with trapping. The results are, for the time being, positive and will serve to advise pond owners and fisheries on the best combinations of fish species to limit the populations of red swamp crayfish.

**Results and assessment**

■ **Overall trapping results**

■ Since 2007, over 522 000 crayfish have been captured and eliminated by the various stakeholders in the regional nature park (pond managers, park personnel, employees of the Chérine national nature reserve).



5. Checking the traps.  
6. A plastic “hoop net” used for trapping.

Number of red swamp crayfish trapped and eliminated since October 2009.

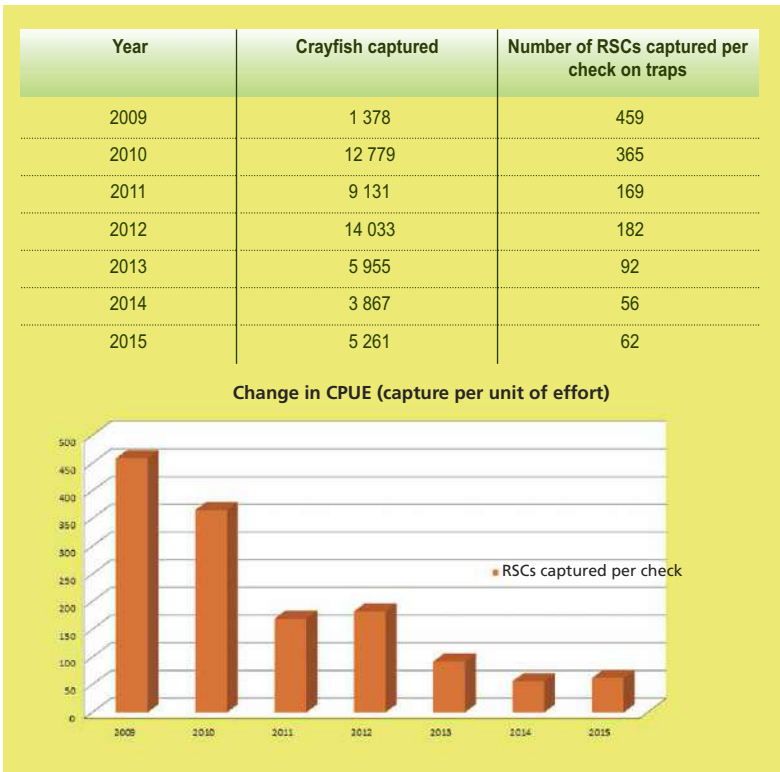
Stakeholders	2009	2010	2011	2012	2013	2014	2015	Total
Brenne brigade	11 218	43 119	8 269 *	28 257	28 728	101 627**	76 690**	297 908
Pond owners and managers	3 637	40 296	45 913	25 924	28 267	35 019	20 908	199 964
Chérine nature reserve	11 506	2 871	3 552	4 960	2 035	(trapping halted)	-	24 924
Total	26 361	86 286	57 734	59 141	59 030	136 646	97 598	522 796

\* Reduced number due to draining of two highly infested ponds.  
\*\* Fish-crayfish interaction project.

Inventory data.

Inventory data		
Year	Colonised ponds	Surveyed ponds
2009	28	40
2010	55	149
2011	92	242
2012	113	242
2013	119	378
2014	130	423
2015	147	442

■ Example of the results in a pond in the southern section of the park



Trapping results in a pond in the southern section of the park.

- Management work in the pond presented above started in 2009 and a major trapping effort was made from 2010 to 2012.
- The pond covers a surface area of 13 hectares and 15 to 20 traps were in place throughout the year. Trapping also took place in the neighbouring ponds, which made it possible to limit the number of red swamp crayfish in the series of five ponds.



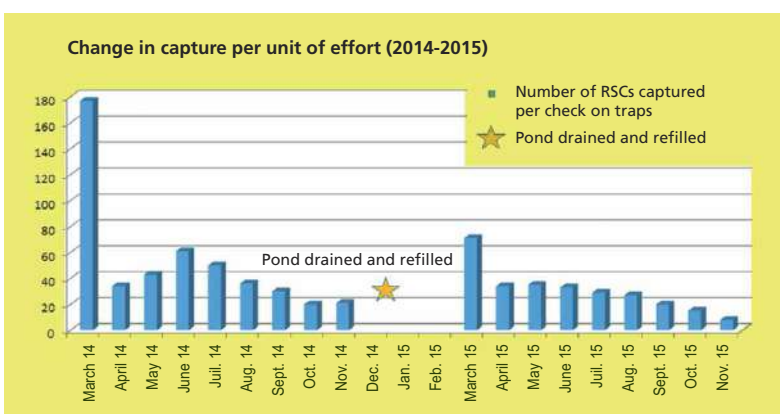
- The traps were laid twice per week, a level of pressure deemed sufficient. The neighbouring ponds were also trapped because an entire area must be trapped to be effective.
- Since 2012, both the number and size of the crayfish caught has dropped.

### ■ Results of trapping combined with stocking of carnivorous fish

- The carnivorous fish tested in this study have traditionally been used by fish farmers in the Brenne (no alien fish species were introduced). The definitive results of this project are not yet available. The Fish-crayfish interaction project (see the year-end report of the Brenne regional nature park) will end at the end of the year and should be pursued.
- A reduction in the numbers of crayfish captured was observed during the first year of the project.
- The combination of mechanical (trapping) and biological (carnivorous fish) management would seem to be an effective technique in reducing the population of red swamp crayfish. Control of the populations of red swamp crayfish can in effect be optimised by combining several management methods (in this case, trapping and stocking of carnivorous fish).



7. Teaching school children about invasive alien species.



Results of trapping combined with stocking of carnivorous fish in a study pond.

### ■ Cost of the management work

- As an example of costs, over the three-year period (2013-2015) for the Fish-crayfish project, the amount spent in managing red swamp crayfish was 245 000 euros, including salaries, travel, equipment costs, communication, presentations, meetings, etc.
- This work was funded by the EU (ERDF), the Centre regional environmental directorate and the Centre region.

### ■ Negative factors

- Red swamp crayfish continue to propagate due to their natural mobility (particularly during strong rains) and due to human causes (some travel still occurs for human consumption).
- The park alone cannot take action in all the ponds in the entire area because the human resources are not available. That is why the involvement of land owners is indispensable.
- Access is not possible to certain private properties.
- Trapping alone is not sufficient in large ponds.



## Information on the project

- A film titled “La Peste rouge” (The red plague) was made to inform the public. A travelling exhibition is also available for the towns and schools in the park.
- Presentations are made to school children, notably one titled “Meeting invasive alien species” that has been presented in primary schools every year since 2010.
- Efforts are made to raise the awareness of the general public:
  - a presentation on “Threatening species” is offered once each year during the nature excursions in the park;
  - since 2012, the park has held a stand presenting the red swamp crayfish and other invasive alien species during the Fishing Show in the Indre department. In 2015, 300 people visited the stand and received information;
  - over a dozen press articles have been published since the start of the management work.
- Dissemination of scientific information:
  - participation in conferences, symposia and training sessions on invasive alien species (IAS) and on the ponds;
  - publication of scientific articles in scientific journals, the proceedings of symposia.

## Outlook

- Assessments will continue to be carried out in the park to detect the presence of red swamp crayfish, using trapping and the environmental DNA technique (now being developed).
- Trapping pressure will be maintained on colonised ponds and monitoring will be continued on the ponds near the source populations.
- Land owners and park guards will be assisted in managing the species by combining trapping with stocking of fish that consume red swamp crayfish.
- Pond owners will receive advice and assistance in managing red swamp crayfish as well as other invasive alien species, notably invasive plants.
- Training sessions on IASs will be organised for land owners.

## Regulations

- *Procambarus clarkii* is an invasive alien species listed among the species likely to provoke biological imbalances (article L432-10 in the Environmental code). For that reason, its introduction into French waters is subject to a fine of 9 000 euros (article R432-5 in the Environmental code). Its transport and sale (living animals) are subject to authorisation (decree dated 21 July 1983).

Author: Aurore Coignet, Brenne regional nature park. January 2016.

### For more information

- Internet site of the Brenne regional nature park:  
<http://www.parc-naturel-brenne.fr/fr/accueil/un-territoire-d-exception/nature/especes-exotiques-envahissantes/97-un-territoire-d-exception/especes-exotiques-envahissantes/413-lecrevisse-rouge-de-louisiane>
- Aesturia « Premières rencontres françaises sur les écrevisses exotiques invasives », Actes du colloque sciences et gestion, 19 et 20 juin 2013, Saint-Lyphard. Collection Paroles des Marais Atlantiques. Pages 137-142.
- Report on management of red swamp crayfish and the Fish-crayfish interaction project (2013-2015). Brenne regional nature park.
- Coignet, A., F. Pinet, et C. Souty-Grosset, (2012). « Estimating population size of the red swamp crayfish (*Procambarus clarkii*) in fish-ponds (Brenne, Central France) ». Knowledge and Management of Aquatic Ecosystems, no 406: 02.
- Diagnostic de Territoire. Agenda 21 territorial. PNRB (2009) 179 pp.
- Gherardi, F., A. Coignet, C. Souty-Grosset, D. Spigoli, et L. Aquiloni., (2013). « Climate warming and the agonistic behaviour of invasive crayfishes in Europe ». Freshwater biology, 58, 1958-1967.
- Souty-Grosset, C., J. Reynolds, F. Gherardi, L. Aquiloni, A. Coignet, F. Pinet, M. Del Mar Mancha Cisneros., (2014). « Burrowing Activity of the Invasive Red Swamp Crayfish, *Procambarus clarkii*, in Fishponds of La Brenne (France) ». Ethology Ecology & Evolution 26, 23 (3 juillet 2014): 263-276.





# American bullfrog

(*Lithobates catesbeianus*)

Originated in North America. Introduced in the Gironde department in 1968 and later in the Sologne area.

## Description

- Skin colour varies from olive green to dark brown
- Creamy white underside with yellow throat in adult males
- Length 15 to 20 centimetres from nose to cloaca, 40 cm from nose to end of fully extended hind legs
- Adults vary in weight between 500 and 800 grams
- Large-diameter tympanum:
  - equal in size to the eye in females
  - two times the size of the eye in males
- A fold in the skin runs from the eye, above the tympanum, to the base of the hind legs (no folds across the back)
- The hind feet are palmed
- The characteristic call of the American bullfrog resembles the lowing of a cow.

## Ecology and reproduction

- Habitats in all types of lentic aquatic environments
- They can travel via rivers with slow currents
- Bullfrogs are active during both the night and the day
- Adults hibernate starting in the middle of the fall, tadpoles spend the winter in water
- Bullfrogs are opportunistic predators, feeding on amphibians, fish, small mammals, reptiles, insects, etc.
- Reproduction occurs between May and August, generally in the form of a single spawn comprising up to 25 000 round, transparent eggs in a gelatinous mass
- The eggs hatch after 4 or 5 days
- In France, the larvae metamorphose after 2 to 3 years and the frogs become sexually mature 2 to 4 years later

## Documentation

- Sarat E. (coord.) 2012. Vertébrés exotiques envahissants du bassin de la Loire (hors poissons) : connaissances et expériences de gestion. Office national de la chasse et de la faune sauvage, Plan Loire Grandeur Nature, 128 pp.
- Nepveu C. 2002. Les espèces animales et végétales susceptibles de proliférer dans les milieux aquatiques et subaquatiques - Fiches espèces animales (les espèces exotiques). Agence de l'eau Artois-Picardie. 98 pp

Author: Emilie Mazaubert, Irstea

Classification	
Order	Anura
Family	Ranidae
Genus	Lithobates
Species	Lithobates catesbeianus (Shaw, 1802)



1. Male American bullfrog.  
2. Rear foot.  
3. Spawn.  
4. Tadpole.





## American bullfrog (*Lithobates catesbeianus*)

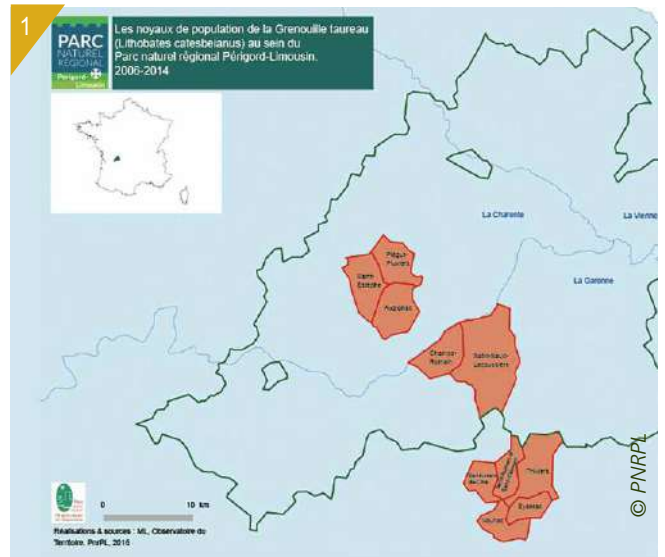
### Managing the American bullfrog in the Périgord-Limousin regional nature park

#### Périgord-Limousin regional nature park

- The park, created in March 1998, covers a surface area of 1 800 square kilometres in two departments, Dordogne (49 towns) and Haute-Vienne (29 towns).
- The park is managed by a board in which are represented all the local governments that have approved the park charter, including ten intermunicipal associations, 78 towns and six “gateway towns”, the Aquitaine region and the Dordogne and Haute-Vienne departments.
- The park is charged with implementing its charter, a sustainable-development territorial project.
- Management of invasive alien species is included in the section on preserving biodiversity in the charter (measure 17 titled “Prevent and effectively counter the introduction and proliferation of invasive alien species”).
- Contact: Frédéric Dupuy, head of the “Management of natural areas” department -f.dupuy@pnrpl.com

#### Intervention site

- There are many wetlands (peat bogs, wet meadows, megaphorbia, hygrophilic forests) ideal for amphibians in the Dordogne department.
- Since the 1960s, many ponds and pools have been created for recreational purposes, fish farming and watering of livestock. Their number has been estimated at 5 000 and the latest inventories (2001) listed 4 500 larger ponds covering 1 800 square kilometres, i.e. 1.2% of the total area.
- Located in a bocage landscape, these wetlands constitute valuable ecological corridors.
- The American bullfrog was transported to Dordogne toward the middle of the 1990s (first audible indications) by people who used the tadpoles as fishing bait.
- The population centre in Dordogne may be divided into three sub-sections:
  - around the towns of Piégut-Pluvier / Saint-Estèphe;
  - around the towns of Saint-Laud-Lacoussière / Champs-Romain;
  - around the towns of Thiviers / Saint-Romain et Saint-Clément (this area lies just outside the park, but given that Thiviers is a gateway town, it was included in the management programme).



1. Map showing the population groups of American bullfrogs in the park.

#### Disturbances and issues involved

- The main management issue concerning the species is the preservation of native amphibians impacted by its presence:
  - large quantities of other amphibians have been found in the stomachs of bullfrogs;
  - high densities of American bullfrogs result in inter-species competition because the animals fill an important ecological niche that is very similar to that of native species, particularly green frogs (*Pelophylax* spp.);
  - they can be a healthy carrier of the fungus responsible for chytridiomycosis (*Batrachochytrium dendrobatidis*), a disease that kills native species. In France, the fungus is present on 33% of the sampled sites. The average prevalence is 6%, but with significant variations ranging from 3.3% up to certain populations where 93% of the animals carry the fungus.
- The Périgord-Limousin regional nature park covers the heads of three river basins. The sectors where the species has been detected lie in two river basins (Dordogne and Charente) and there is a risk that the animals may colonise the entire downstream sections of the two basins. The basin of the Vienne River lies in the immediate vicinity, but has not yet been colonised.





## Interventions

### ■ Eradication programme (2005-2007)

- Following the launch of a the multi-year programme 2003-2007 to establish a management plan for the American bullfrog in the Aquitaine region by the Cistude nature association (see the management report [http://www.onema.fr/sites/default/files/Grenouille\\_taureau\\_R1.pdf](http://www.onema.fr/sites/default/files/Grenouille_taureau_R1.pdf)), the park decided in 2005 to eradicate the species in two sectors in its territory (Piégut-Pluvier / Saint-Estèphe and Saint-Laud-Lacoussière / Champs-Romain), in a partnership with Cistude Nature.
- Following an inventory in 2005, the eradication programme was conducted over a period of two years (2006-2007).
- The main objectives were to:
  - eradicate the American bullfrog from the colonised sites;
  - set up monitoring to detect any new sites that might be colonised and to check the results of the work done on the treated sites;
  - raise the awareness of the public and encourage people to report the presence of the American bullfrog.
- The management technique consisted of shooting the adults and sub-adults in order to eliminate primarily the reproducers.
- Over the first two years, trapping of tadpoles was also required.

### ■ Finishing the eradication work (2008-2012)

- The objective of this second programme was to finish the work to eradicate the American bullfrog from the northern section of the Dordogne department.
- The work was carried out on the two population groups that were the target of the eradication efforts in 2005-2007, plus a third group in the Thiviers area. Near Thiviers, located somewhat downstream, the species was first detected around the year 2010.
- The techniques employed comprised night shooting, gathering of spawn and trapping of tadpoles and juveniles.

### ■ Methods used

Gathering spawn	
Target	Spawn
Description	Spawn gathered twice per week from June to August on sites with adult reproducers
Human resources	Two people
Technical resources	Dip net, container, phenoxyethanol (to kill the embryos in the collected eggs)
Equipment costs	250 euros (reusable equipment)
Advantages	Eradication before the frogs disperse
Difficulties	The spawn is not always visible or accessible
Trapping of tadpoles	
Target	Tadpoles
Description	Traps laid and checked daily starting in June (prior to metamorphosis). The hoop nets are fully submerged most of the time (this may depend on the depth of the pond)
Human resources	Two people
Technical resources	Hoop nets with one or two entries
Equipment costs	180 euros per hoop net (single entry) (reusable equipment)
Advantages	This technique captures a large number of tadpoles just before metamorphosis (and dispersal)
Difficulties	This non-selective technique requires daily checks to release non-targeted species and avoid attracting predators



2. Juvenile American bullfrog.

3. Tadpole of an American bullfrog.

Daytime shooting	
Target	Juveniles
Description	Sites must be inspected to detect the young frogs. One person identifies the frog as an American bullfrog and the shooter eliminates it. The dead animals are collected with a dip net
Human resources	Two people, a shooter and a park employee to identify the animals
Technical resources	Air rifle (5.5 mm), steel pellets, cooler, dip net
Equipment costs	400 euros (reusable equipment)
Advantages	Elimination of juveniles detected visually or by their alert calls
Difficulties	Sites are not always accessible (heavy vegetation blocking access to the banks)
Night-time shooting	
Target	Sub-adults and adults (male reproducers)
Description	Sites must be inspected to detect the mature frogs. One person identifies the frog as an American bullfrog and the shooter eliminates it. The dead animals are collected with a dip net
Human resources	Two people, a shooter and a park employee to identify the animals
Technical resources	Air rifle (5.5 mm), steel pellets, cooler, dip net and searchlight
Equipment costs	450 euros (reusable equipment)
Advantages	Elimination of reproducers and limited reproduction in year n+1
Difficulties	This technique targets primarily males (due to their behaviour) and sites are not always accessible (heavy vegetation blocking access to the banks)
Draining of water bodies	
Target	All development stages
Description	The pond is drained prior to the dispersal of the juveniles. Fine screens are placed at all outlets. Tadpoles and juveniles are collected, sub-adults and adults are shot. Barriers and traps may be set up around the pond
Equipment costs	5 000 euros for a barrier and traps around the site (equipment and labour)
Advantages	Elimination of all development stages
Difficulties	Resource-consuming project

### Results and costs

#### ■ Piégut-Pluvier / Saint-Estèphe and Saint-Laud-Lacoussière / Champs-Romain sectors

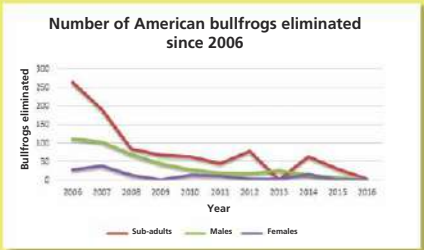
- In these two sectors, management work was carried out every year starting in 2006.
- The number of eliminated frogs dropped, which may be interpreted as a drop in the numbers of American bullfrogs.
- The number of males killed is systematically greater than the number of females killed. This is because the males are easier to detect (croaking).
- The number of eliminated juveniles is highly variable and does not accurately reflect population numbers. It depends on their density, weather conditions that may facilitate or hinder detection, and individual behaviour (skill in hiding, in avoiding traps). The spike in numbers in 2011 may be due to spawns that were not detected in 2010 or 2009.
- Out of a total of 205 ponds, only ten were inspected throughout the programme, from 2006 to 2014. Among the ten ponds in 2014, American bullfrogs had no longer been present in four ponds for a year and in two ponds for two years (2014 data).
- In the ponds in the town of Saint-Saud-Lacoussière, no bullfrogs were detected in 2014. In 2015, the environmental DNA technique detected American bullfrogs in only one of the ponds.



3. Capturing tadpoles using hoop nets.  
 4. Shooting American bullfrogs at night.  
 5. Proceeding of a symposium on American bullfrogs in 2012.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Juveniles	1 170	358	381	36	859	1690	11	769	1 084	456	26
Sub-adults	264	190	86	68	75	46	78	1	64	31	5
Males	111	104	71	45	29	20	18	27	15	9	1
Females	28	39	15	2	14	12	2	4	16	1	1
Total	1 573	691	553	150	1 101	1 768	110	801	1 179	497	33
Hours spent	159	141	134	85	10	55	50	34	47	62	50

Number of American bullfrogs eliminated in the Piégut-Pluvier / Saint-Estèphe and Saint-Laud-Lacoussière / Champs-Romain sectors.



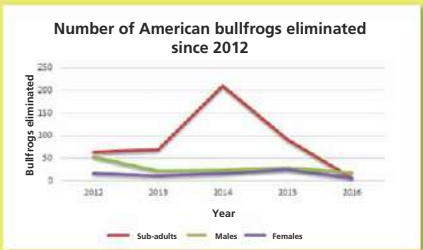
Number and development stage of American bullfrogs eliminated each year in the Piégut-Pluvier / Saint-Estèphe and Saint-Laud-Lacoussière / Champs-Romain sectors.

### ■ Thiviers / Saint-Romain sector

- Management work in this sector started only in 2012, with the involvement of the Thiviers intermunicipal association.
- A slight reduction in the number of eliminated males was noted from 2012 to 2013.
- The number of eliminated females remained stable over the three years of the programme, with an average number systematically lower than that for males.
- The number of eliminated sub-adults rose sharply in 2014, which may be due to a large number of juveniles not eliminated in 2013.

	2012	2013	2014	2015
Juveniles	4 343	1 237	220	738
Sub-adults	64	69	210	92
Males	54	22	23	29
Females	16	12	17	25
Total	4 477	1 340	470	884
Hours spent	62	50	40	39

Number of American bullfrogs eliminated in the Thiviers / Saint-Romain sector.



Number and development stage of American bullfrogs eliminated each year in the Thiviers / Saint-Romain sector.

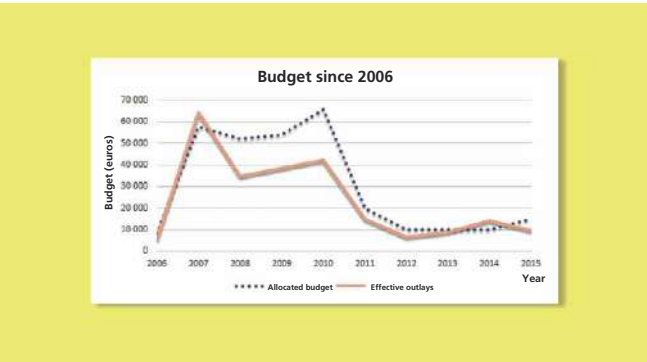


■ **Financial aspects**

- The budget for the programme varies from year to year, which hinders implementation of long-term activities.
- The sources of funding are the Aquitaine region (40%), the EU (Aquitaine ERDF, 40%) and the park 20% (these data are valid for the year 2016).

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Allocated budget (euros)	8 250	57 700	52 000	54 000	66 000	20 000	10 000	10 000	10 000	15 000
Effective outlays (euros)	5 447,89	64 174	34 603,11	38 451,92	42 126,88	14 857,85	6 632,82	8 927,46	14 119,70	9 667,27

Budgets allocated and effective outlays for the management programme since 2006.  
Source: Périgord Limousin regional nature park.



Budget allocated for the American bullfrog programme by the Périgord-Limousin regional nature park.

**Information on the project**

- A symposium on “Eliminating the American bullfrog and establishing a study method for biodiversity” was organised in June 2012.
- The proceedings of the symposium may be downloaded from the IBMA site (<http://www.gt-ibma.eu/wp-content/uploads/2014/05/Actess%C3%A9minaireGrenouilletaureauPnrPL.pdf>).

**Outlook**

- New management techniques are being developed:
  - light traps for tadpoles (LEDs in waterproof boxes placed in the hoop nets);
  - “frog calls” (a recording of an adult reproducer).
- A sampling project and a new inventory are planned:
  - the inventory procedure will be standardised with inspections of ponds colonised in the years n-1 and n-2 and of all ponds in the vicinity of the latter (within a radius of one kilometre). Non-colonised ponds will be inspected every three years;
  - a complete inventory will be carried out by creating a grid system with sectors measuring 5 km x 5 km. Two points in each sector will be visited to listen for calls. The sectors where bullfrogs are heard will be inspected again, this time is smaller sectors measuring 2.5 km x 2.5 km.
- Samples will be drawn and analysed using the environmental DNA technique.

- Indicators will be developed to assess the effectiveness of the eradication project:
  - number of adults eliminated per hour of shooting;
  - changes in abundance indices for adults on each site;
  - average weight of adults;
  - number of colonised sites discovered each year;
  - number of native species (amphibian and invertebrates) on the managed sites.
- The work done by the Périgord-Limousin regional nature park will contribute to the Life CROAA (Control strategies of Alien Invasive Amphibians in France) programme. The objectives are to update the range data, monitor the invasion front and eradicate the populations of invasive alien amphibians.

Authors: Emmanuelle Sarat, IUCN French committee, and Frédéric Dupuy, Périgord-Limousin regional nature park. May 2016.

#### For more information

- Internet site of the Périgord-Limousin regional nature park:  
<http://www.pnr-perigord-limousin.fr/Le-Parc/Les-actions/Patrimoine-naturel/La-lutte-contre-la-Grenouille-taureau>
- Proceedings of the symposium organised by the Périgord-Limousin regional nature park in June 2012. "Eliminating the American bullfrog and establishing a study method for biodiversity".  
<http://www.gtibma.eu/wpcontent/uploads/2014/05/Actess%C3%A9minaireGrenouilletaureauPnrPL.pdf>
- Mandin M. 2015. Bilan du programme d'éradication de la Grenouille taureau (2006-2015) sur le territoire du Parc naturel régional Périgord-Limousin. 39 pp.  
<http://www.gtibma.eu/wpcontent/uploads/2015/12/Bilan-programme-2006-2015.pdf>

2018 edition





# Chinese stripe-necked turtle

(*Mauremys sinensis*)

Originated in southern China, in northern and central Vietnam and Laos. First observed in the natural environment of Réunion Island in 2003.

## Description

- Aquatic turtle reaching up to 24 to 25 cm in length, but 20 to 22 cm on average
- The head, legs and tail range from olive green to grey in colour, with narrow stripes (pale yellow to pale green)
- The iris is cream-coloured or pale yellow, with a dark slash
- In juvenile turtles, the carapace has three ridges that fade with age
- Sexual dimorphism where males have a concave plastron, a longer, thicker tail and the cloaca is located closer to the end of the tail

## Ecology and reproduction in its original environment

- Habitats are located exclusively in freshwater environments, in swamps, canals with muddy bottoms, rivers with slow currents, marshes, lowland lakes and muddy ponds
- The animals are particularly found in water bodies with large amounts of vegetation
- Sexual maturity is achieved at the age of 5 to 7 years, at a size of approximately 15 to 18 cm
- Mating takes place primarily in the spring in its original environment
- From 3 to 10 elliptical eggs are laid over two months following mating, twice per year on average
- Incubation for 60 to 150 days
- The newborn measure between 30 and 35 mm in length

## Documentation

- Sanchez M. et Probst J.-M., 2013. L'Émyde de Chine *Mauremys sinensis* dans la rivière des Galets (île de La Réunion) : compte-rendu des actions de lutte précoce. Rapport Nature Océan Indien. 22 pp + annexes.  
<http://www.especesinvasives.re/especes-invasives/les-portraits/article/emyde-de-chine>
- Bonin F., Devaux B. et Dupré A., 2006. Toutes les tortues du monde. Les encyclopédies du Naturaliste. Delachaux et Nieslé SA. Paris, France. 416 pp.
- Kraus F., 2009. Alien Reptiles and Amphibians. A Scientific Compendium and Analysis. Series: Invading Nature – Springer. Series in Invasion Ecology, Vol. 4. 564 pp.

Authors: Emmanuelle Sarat, UICN France, and Mickaël Sanchez, Nature Océan Indien

Classification	
Order	Testudines
Family	Geoemydidae
Genus	Mauremys
Species	<i>M. sinensis</i> (Gray, 1834)







# Chinese stripe-necked turtle (*Mauremys sinensis*)

## Early preventive work against Chinese stripe-necked turtles on Réunion Island

### Nature Océan Indien

■ NOI is a non-profit for the protection of nature and the environment, founded in 2007. Its main objective is to contribute to gaining knowledge on and to conserving the species and environments of Réunion Island. The association is involved in protecting endemic reptiles and their habitats, notably through efforts to raise awareness.

■ NOI maintains a monitoring group for invasive alien reptiles that aims to:

- detect new introductions to the island and to rapidly set up projects to prevent their spread;
- avoid the spread of invasive alien species already established ;
- gather information on the distribution of certain species about which little is known.

■ The association employs two scientific officers. Contact: Mickaël Sanchez - mickael.sancheznoi@gmail.com

### Group for invasive species on Réunion (GEIR)

■ The work group for invasive species is managed by the regional environmental directorate. Its members include an array of institutions, agencies, associations, professionals and contact persons working on invasive species that threaten the natural heritage of the island, the local economy and human health. GEIR works to coordinate local stakeholders, to plan projects and to implement the strategy against invasive species on Réunion in the framework of the operational programme against invasive species.

■ Internet site: <http://www.especesinvasives.re>

### Intervention site

■ Réunion Island is a French overseas department in the Indian Ocean. Together with Maurice and Rodrigues, it forms the Mascarenhas Archipelago.

■ The Chinese stripe-necked turtle was first observed in 2003 in the natural environment of Réunion in the Galets River, downstream of the hydroelectric dam, at the place called Deux-Bras, in the NW section of the island, in the towns of La Possession and Saint-Paul.

■ The Galets River is 35.3 kilometres long, originates in the Mafate natural amphitheatre and forms a border for the towns of Le Port, La Possession and Saint-Paul.

■ In 2013, six juvenile turtles were observed along the river,



1. The study site.

2. Map of the study sectors and sites where turtles have been observed since 2003.

approximately ten kilometres downstream from the point of the initial observation, just upstream of a pool. In that the species has been widely sold as a pet on Réunion, it is probable that at least two adult turtles escaped from a farm and laid eggs at least once in the natural environment.

■ The work presented in this management report was carried out on an 18-km reach of the river, split into nine sectors, each two kilometres long (see Figure 2). The upstream sections of the reach are located in the central zone of the Réunion national park.

### Disturbances and issues involved

■ The diversity of natural environments on Réunion is exceptional, with a high level of endemism and fairly well conserved environments, e.g. native vegetation covers 30% of the island surface on average. The island is part of the biodiversity hotspot among the islands in the SW Indian

Ocean. Since its discovery between 900 and 1200, the combined effects of overuse, hunting, opening of land and the introduction of species has resulted in the extinction of many native and endemic species. Réunion is number six worldwide on the list of islands having suffered the greatest number of extinctions.

■ The invasion of natural environments on Réunion by introduced species is seen as the main cause of biodiversity loss. A total of 16 herpetofaunal species out of 19 (12 lizards, 2 ophidians and 2 amphibians, representing 80% of the species on the island) were introduced and subsequently naturalised. One-third of these species were introduced intentionally and 56% accidentally (mainly via maritime channels).

■ The impacts of Chinese stripe-necked turtles have not been documented. The species may compete for habitats and resources with native species (<https://www.business.qld.gov.au/industry/agriculture/species/invasive-animals/prohibited/chinese-stripe-necked-turtle>, Queensland government, 2016). The omnivorous turtles may have an impact on native species in the Galets River, notably on aquatic molluscs, the insect larvae and pupae, crustaceans and fish.



3. A Chinese stripe-necked turtle along the Galets River.

## Interventions

### ■ Observations and initial captures

■ Chinese stripe-necked turtles were first observed on Réunion in 2003 in the Galets Rivers near Deux-Bras. On 15 January 2013, the same observer (E. Hoarau) reported six juvenile turtles upstream from a pool in the Galets River. Surveys, lasting one to three hours, were carried out five times (17 and 24 May, 7, 21 and 28 June 2013), on different tributaries in the same sector, but no turtles were observed.

■ On 13 July 2013, a turtle was glimpsed near a bed of aquatic grass. One week later, the first five juveniles were captured. On 25 July, a new outing was organised and several tributaries along a 3-km stretch were inspected. Six juvenile turtles were captured. On 31 August, two more juvenile turtles were captured.

■ In total, 13 juvenile turtles were captured, measured (length of shell and plastron) and weighed. They were all approximately the same size and weight (36 mm long and 9 g). They were then placed under the custody of an authorised holder. Three turtles died following the captures and were recorded at the National museum of natural history (MNHN-RA 2016.0031 and 2016.0032) and the Museum of natural history in Saint-Denis on Réunion (MHN 2015.7.16).

### ■ Objective of the interventions

■ The discovery of the juvenile turtles in the natural environment raised numerous questions concerning their origin, species dynamics and distribution on Réunion. The objectives of the early work to prevent their spread were to:

- determine the distribution of the species in the Galets River;
- capture all the observed specimens in order to stop the possible invasion process;
- assess the feasibility of completely removing the species from the river;
- learn where the species came from.

### ■ Discussions with other stakeholders and partners

■ A planning meeting was held with the regional environmental directorate (a member of GEIR), the Réunion national park and the departmental fishing federation. NOI requested assistance for the work in the field and three official personnel were provided by the national park for one day of surveys. The capture of turtles in the central zone of the park was authorised.



## ■ Review of the literature prior to the surveys

■ Prior to the field work at the end of the year and to guide the searches for the animals, a review of the literature looked into the biology, ecology and ethology of the species, its sale and its use. Experts were also consulted from the University of Taiwan and the Centre for the observation and protection of turtles and their environments, in France.

## ■ Field surveys

■ Sectors 3 to 9 were deemed the most important and surveys were carried out in them (see Map 6). Due to a lack of time and resources, sectors 1 and 2 were seen as of secondary importance and were not surveyed. One to six people inspected the left bank tributaries, i.e. those furthest to the south and most exposed to sunlight where the sunbathing sites of the turtles were most likely.

■ At the end of 2013, the sectors were surveyed on 19 and 26 October, 12, 13, 14 and 15 November, and 4 December, for a total of seven days. A careful search was made for the turtles and any indications concerning their presence (partially consumed leaves and plants). The muddy areas with ample vegetation (grass beds, side channels, canals, isolated pools, etc.) were inspected by hand. All observation sites were identified by GPS. To avoid any risk of leptospirosis, the teams wore gloves when searching in muddy areas.

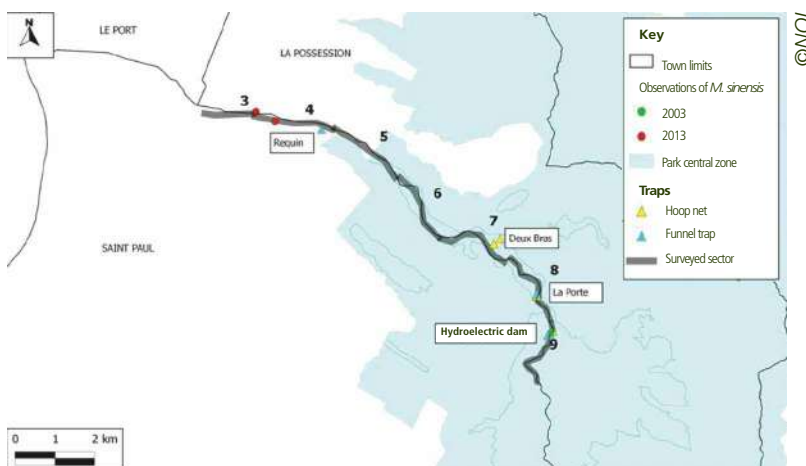
## ■ Trapping

■ Two types of traps were set up in areas conducive to the species:

- funnel traps;
- hoop nets (Grauvell-type nets, 30 x 60 cm).

■ The traps were laid on 12, 13 and 14 November, near the hydroelectric dam and in three places called “la Porte”, “Deux-Bras” and “Gueule Requins”. Sardines were used as bait.

■ The minimum time during which the traps were left open was 15 hours. On all sites taken together, the hoop nets were open a total of 122 hours and the funnel traps a total of 90 hours.



Map showing the surveyed sectors and the position of traps.



Sites conducive to *M. sinensis* that were investigated.

4 - A riverbed with aquatic grasses.

5 - A stagnant section with a mud bottom.

6 - A swampy area.

7 - A pool located upstream of the hydroelectric dam.



## Results and costs

### ■ Results

- No turtles were captured during the time the traps were open. None were observed and no indications of their presence were noted during the surveys.
- The 13 turtles captured in July 2013 probably came from a single nest hatched in the natural environment. That would imply that there are at least two adult turtles that were not detected. Given the behavioural traits of the species and the large area surveyed, it is possible that a number of turtles were not seen or that they were outside the surveyed area (notably upstream). Turtles may also have been captured by local residents (who reported finding turtles) and poaching is also frequent in the area.
- The work done did not produce results enabling an assessment of the risks of a long-term establishment of the species on Réunion. The Chinese stripe-necked turtle may be considered an introduced species, but it is not sure that it will become naturalised. Its definitive establishment remains a possibility and long-term monitoring would appear necessary.

### ■ Assessment

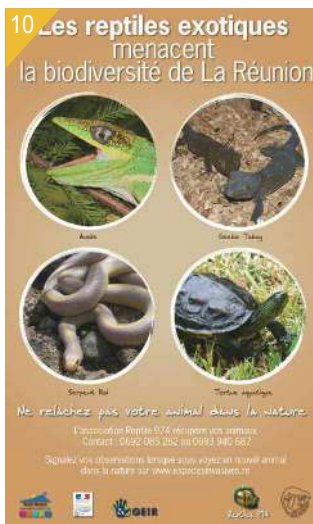
- Approximately 13 kilometres of river were inspected during the surveys. Depending on the day, between one and six people participated in the work. A total of 26 hours were put into the surveys, including 12 hours for sectors 3 to 5 and 14 hours for sectors 6 to 9. Given the number of people involved, that represented 96 man-hours.
- The entire operation was funded by the Réunion regional environmental directorate. An NOI employee participated in the surveys, the other participants were volunteers. The volunteers worked for a total of 17 man-days representing an equivalent cost of 2 213 euros (17 days x 130.20 euros). The cost of the work by the three park agents who participated in the surveys for one day is not known and not included in the final budget calculation of the project.

## Information on the project

- Article reporting on the observations on Réunion in the Bulletin Phaethon (published by the local Nature & Patrimoine association).
- Information on the GEIR internet site:  
<http://www.especesinvasives.re/especes-invasives/les-portraits/article/emyde-de-chine>.
- Newspaper articles and information bulletins.
- Efforts to raise awareness concerning reptiles introduced to Réunion targeting pet shops and the main association of reptile breeders on the island (publication of a poster).

## Outlook

- The employees of the fishing federation and of the national park keep an eye out for the turtles during their routine inspections of the river. An adult turtle was observed in 2016 in a remote basin (climbing equipment required) located further upstream than the capture sites in 2013. Surveys will be carried out in 2017.



8. A team in the field.

9. Traps used to capture the turtles.

a) Funnel trap.

b) Hoop net.

10. Poster to raise awareness concerning invasive alien reptiles on Réunion.



Table listing project costs.

Item	Item details	Quantity	Unit cost (euros)	Total cost (euros)
Equipment				
Equipment	Bag and field clothing	1	95.60	95.60
	Hoop net	2	—	36.55
	Plastic gloves	8	9.70	100.50
	Scale and field equipment	1	167.40	167.40
Study				
Review of the literature	Rev. of lit. and discussions with experts	3	130.20*	390.60
Field work	Initial visits	6	130.20*	781.20
Data processing	Data processing and analysis	1	130.20*	130.20
Report and publication	Drafting of report	6	130.20*	781.20
GEIR presentation	Presentation to GEIR	1	130.20*	130.20
Project coordination	Project & admin. coordination	2	130.20*	260.40
Mission and overhead costs				
Meals	1 meal per day per person in the field	10	6.00	60.00
Travel costs	Meetings (500 km / week in the field)	531	0.332	176.29
Overhead costs	Overhead costs, 8.5%	—	—	—
Miscellaneous	Printing, etc.	1	79.78	79.78

Summary of costs	
Equipment	400.05
Payroll	2 473.80
Mission and overhead costs	316.07
Subtotal	3 189.92
Volunteer work	2 213.40*
Park agents	NA
TOTAL	5 402.92

\* Costs estimated as equivalent to payroll costs for a day of survey work (collective agreement for the sector, coefficient 380).

Regulations

■ No particular prohibitions concern the species on Réunion Island. It is sold in local pet shops (juvenile turtles are sold for 10 to 20 euros).

Authors: Emmanuelle Sarat, IUCN French committee, and Mickaël Sanchez, Nature Océan Indien. February 2017.

For more information

- NOI internet site:  
<http://www.nature-ocean-indien.org/>
- GEIR internet site:  
<http://www.especiesinvasives.re/geir/>
- Probst J.-M. & Sanchez M., 2013. L'Émyde de Chine *Mauremys sinensis* (Gray, 1834) (Testudines : *Geoemydidae*), une tortue aquatique naturalisée à La Réunion ? Bulletin Phaethon, 33 : 55-56.
- Sanchez M. et Probst J.-M., 2016. L'herpétofaune alloctone de l'île de La Réunion (Océan Indien) : état des connaissances en 2015. Bull. Soc. Herp. Fr. (2016) : 49-78.
- Sanchez M. et Probst J.-M., 2013. L'Émyde de Chine *Mauremys sinensis* dans la rivière des Galets (île de La Réunion) : compte-rendu des actions de lutte précoce. Rapport Nature Océan Indien. 22 pp + annexes.
- Soubeyran Y., 2008. Espèces exotiques envahissantes dans les collectivités françaises d'outre-mer. État des lieux et recommandations. Collection Planète Nature. Comité français de l'IUCN, Paris, France.



# Red-eared slider turtle

(*Trachemys scripta elegans*)

Originated in North and Central America. Imported in France up to 1997 as a pet.

## Description

- Yellowish stripes along the head and neck
- Characteristic red “ears” posterior to the eyes
- Shell up to 24 cm (males) and 29 cm (females) long in adults:
  - black carapace (yellow and light-green stripes in juveniles)
  - yellow plastron with dark-green spots
- Average adult weight is 3.2 kilograms
- Sexual dimorphism in adults with, for males:
  - a longer and thicker tail
  - larger claws on the front feet
- Maximum life span approximately 30 years

## Ecology and reproduction

- Habitats in many types of aquatic environments, primarily in stagnant water
- Carnivorous diet for juveniles and omnivorous for adults
- Reproductive activity starting at an age between 3 and 8 years
- Mating in the spring and/or fall
- Females lay eggs once or twice per year, approximately a dozen eggs in nests dug into banks
- Incubation for 70 to 90 days
- Newborn vary in size between 23 and 35 mm

## Documentation

- Sarat E. (coord.) 2012. Vertébrés exotiques envahissants du bassin de la Loire (hors poissons) : connaissances et expériences de gestion. Office national de la chasse et de la faune sauvage, Plan Loire Grandeur Nature, 128 pp.
- Nepveu C. 2002. Les espèces animales et végétales susceptibles de proliférer dans les milieux aquatiques et subaquatiques - Fiches espèces animales (Les espèces exotiques). Agence de l'eau Artois-Picardie. 98 pp.
- Pascal M., Lorvelec O. et Vigne J.-D. 2006. Invasions biologiques et extinctions: 11 000 ans d'histoire des vertébrés en France. Quae éditions. 350 pp.

Author: Emilie Mazaubert, Irstea

Classification	
Order	Testudines
Family	Emydidae
Genus	Trachemys
Species	Trachemys scripta elegans (Wied, 1839)



© Matthieu Berroneau



© CEN Corse



© CEN Corse



© CEN Corse







# Red-eared slider turtle

(*Trachemys scripta elegans*)

## Testing management methods for red-eared slider turtles on the Courpain site (Loiret department)

### Maison de Loire du Loiret (MLL)

■ The non-profit organisation, founded in 1987, aims to raise awareness and inform on environmental issues (hikes along the Loire, teaching projects, exhibitions, etc.) and to run studies and monitoring programmes on the plants and animals in the Loire ecosystem.

■ Contact: Cyril Maurer, director - [cyril.maurer@maisondeloire45.org](mailto:cyril.maurer@maisondeloire45.org)

### Intervention site

■ The Courpain site is a former gravel quarry (17 hectares), located in the town of Ouvrouer-les-Champs, between the Loire River and its dike.

■ When the quarry ceased operation in 2007, the redevelopment project for the site that was awarded to the Institut d'Écologie Appliquée in Saint-Jean-de-Braye and MLL was brought into the project. MLL was assigned the task of organising naturalist monitoring of the site.

■ The Courpain site comprises numerous habitats capable of supporting rich biodiversity, including reed beds, meadows, woods, briars, etc. It is a wintering and nesting site for many bird species (163 species have been observed, including ospreys [*Pandion haliaetus*], reed buntings [*Emberiza schoeniclus*] and the Eurasian hoopoe [*Upupa epops*]).

■ In 2012, MLL signed a three-year Natura 2000 contract with the French State to restore the site and manage it. The organisation set up a programme to restore the environment, including work on the river banks, cutting of poplars, removal of sand dunes, etc.

■ In 2016, the site was purchased by the Loiret Departmental council. A long-term (20-year) administrative lease was granted to MLL. The site is now managed in the framework of the river-basin contract with the Val Dhuy Loiret SBMP.

### Disturbances and issues involved

■ Red-eared slider (RES) turtles were imported massively to France as pets in the 1980s and 1990s. Numerous persons subsequently released the adult turtles to the natural environment.



1. Map showing the Courpain quarry.

■ The species can have a major, adverse impact by competing with protected, native turtle populations (the area is highly favourable for European pond turtles [*Emys orbicularis*]).

■ The omnivorous species can also affect invertebrate populations when it is present in high densities (Prévot-Julliard *et al.*, 2007).

■ Its reproductive capacity is currently considered fairly low in France, however its life span is very long.

■ On the Courpain site, RES turtles have been regularly observed since 2007 during ornithological monitoring visits.

### Intervention

■ On 20 August 2014, during a visit to monitor odonata, a juvenile turtle was found dead on the banks of the pond. The probability that the species had reproduced on the site was discussed.

- A meeting was organised in March 2015 with the National agency for hunting and wildlife (ONCFS) and the Departmental territorial directorate (DDT) to set up an experiment to capture and study the population of RES turtles on the site.
- Prefectoral authorisation to shoot the turtles was granted on 7 April 2015.

### ■ Trapping in 2015

- Two different types of traps were laid on 15 April 2015:
  - two semi-floating hoop nets, installed two metres from the bank, in the area where RES turtles had most frequently been seen on the site. Bait (a dead fish) was placed inside each trap;
  - two cage traps, installed on the bank in the area where RES turtles had most frequently been seen on the site. A dead fish was again placed inside each trap.
- The traps turned out to be ineffective (no captures) and were removed after eight weeks.
- Two new traps were laid on 5 August 2015. The first was a floating, cage trap and the second a sundeck trap.
- The traps, checked on 19 August, were again empty. The sundeck trap was moved to a different place and the cage trap had its flotation system and stability improved, but they still did not produce a single capture.
- The two traps were removed from the site on 30 September.

### ■ Shooting operations

- On an experimental basis and in compliance with the conditions laid out in the prefectoral authorisation, ONCFS ran shooting trials on the site.
- Seven sequences were organised over the spring and summer of 2015, from May to August.
- Each sequence lasted about one hour and involved two technicians, one with a .222 rifle equipped with a scope and the other serving as an observer for safety reasons. The turtles were located using binoculars.
- Two RES turtles were shot and killed, one on 6 May and the second on 15 May.

### ■ Monitoring a nest

- On 4 June 2015, during an ornithological monitoring visit, a RES turtle was observed while laying its eggs. The turtle was removed and placed under the custody of an authorised holder, but the eleven eggs were left on site to see if they were viable.
- After a few days, some of the eggs contained dead fetuses and some others appeared not to have been fecundated, but five living turtles finally hatched in mid-August, confirming that RES turtles could reproduce on the site (the young turtles were removed and transferred to the authorised holder).

### ■ Trapping in 2016

- A new type of trap was tested in 2016, the Fesquet cage trap. Results using this type of trap were positive on the Or Pond (Hérault department) and its wide entry, flat on the ground, is thought to facilitate captures.
- Two cages were set up near the pond in the spring of 2016.
- Unfortunately, they turned out not to be suitable for the site given that two juvenile Eurasian beavers were captured two weeks later (without injury). They were immediately released.
- Prior to their capture, no turtles were captured using the Fesquet cage traps.



2. Aerial view of the quarry.  
3. The quarry in May 2007, prior to the rehabilitation.  
4. The quarry in June 2014.  
5. The juvenile turtle found on 20 August 2015.  
6, 7. Setting up the floating trap.



## Results and assessment

### ■ Results

■ Five trapping techniques were tested, but did not result in any captures. Two turtles were shot and killed during the shooting project run by ONCFS.

### ■ Assessment

■ Most of the time spent monitoring the cages occurred during ornithological monitoring visits to the site. Consequently, it is difficult to estimate the cost. A number of visits were also made by volunteers.

■ The estimated cost to build the cages was approximately 150 euros for the materials, plus a half-day to build the cages and place them on site.

■ The number of man-days has been estimated at twelve in 2015 and eight in 2016.

■ With the exception of the ONCFS shooting campaign, this operation was entirely financed by MLL.

## Information on the project

■ An article was published in the *Chéloniens* journal.

■ An article will be published in the *Recherches Naturalistes* journal.

■ Articles have been published in the press.

■ A management report on the project was presented to the ONCFS invasive alien species group at the Centre Val de Loire environmental directorate on 17 December 2015.

## Outlook

■ It would appear that sundeck and floating traps are the best suited to the site because the devices must be capable of adapting to the changing water level of the Loire River. However, a larger number of traps is required and they must be set up in the beginning of the season (end of March, early April).

■ A new, larger floating sundeck (2 x 2 metres), equipped with netting rather than a grid, will be tested in 2017.

■ The shooting campaign will not be repeated given the small number of turtles shot with respect to the time spent.

## Regulations

■ The decree dated 30 July 2010 prohibits the release of the species to the natural environment in France.

■ The species may not be imported into the European Union (EC 349, 25 February 2003) and it is also listed as an invasive alien species of Union concern (European regulation 1143/2014).

Author: Doriane Blottière, IUCN French committee. January 2018.



8. Shell of a shot turtle.

9, 10. Eggs of a RES turtle laid on the site.

### For more information

■ Maurer, C. 2015. Projet expérimental de capture et d'étude d'une population de « Tortues de Floride » - Trachémydes à tempes rouges. Maison de Loire du Loiret, 13 pp.

■ Maurer C. 2015. La reproduction *in natura* de la Trachémyde à tempes rouges, *Trachemys scripta elegans*. Cheloniens n°39.





# Red-eared slider turtle

(*Trachemys scripta elegans*)

## Managing a population of red-eared slider turtles on the Vieux Salins site in Hyères (Var department)

### Toulon Provence Méditerranée urban board

- The board manages the Vieux Salins site in Hyères with scientific and technical support from the Port-Cros national park, the town of Hyères and the Conservatory for the coast and lakes (CELRL), the site owner.
- Contact: Matthieu Lascève, Natura 2000 policy officer - [mlasceve@tpmed.org](mailto:mlasceve@tpmed.org)

### Intervention site

- The Vieux Salins are a unit of the former salt ponds in Hyères. With the Pesquiers salt ponds, they produced salt until 1995. Subsequently, the site was purchased by the CELRL in 2001. The site was initially managed by the Port-Cros national park, then in 2004 by the Toulon Provence Méditerranée urban board.
- Listed as a Ramsar and Natura 2000 site, it covers a total surface area of 350 hectares.

### Disturbances and issues involved

- Young red-eared slider (RES) turtles were imported massively to France as pets in the 1980s and 1990s. Numerous persons subsequently released the adult turtles to the natural environment.
- The European pond turtle (*Emys orbicularis*) is known to inhabit the Vieux Salins site. This turtle population is weakened by its isolated geographic situation, given that the site is placed between the sea to the south and a high-speed road and houses to the north. The population number has been estimated at 197 in 2005 (Joyeux, 2005), then 175 in 2011 (Joyeux, 2011) and finally 232 in 2015 (Perrot et al., 2016). The statistical tools and the degree of observation differed from one survey to another, making it difficult to identify a significant trend in the population and to determine the influence of the RES turtles on that trend.
- The RES turtles may be a limiting factor in the development of the population of the European pond turtles due to the probable competition, notably for sunning spots (Cadi & Joly, 2003).
- Observations of RES turtles laying eggs and the capture of juveniles and large females (25 cm and 2.5 kg) confirmed that the species has reproduced on the site.



1. Map showing the Vieux Salins site.

- Limiting the alien population would make it easier for the European pond turtles to use the local resources (food, nesting and sunning sites).

### Interventions

- A test to limit the alien population was launched by the managing entity in 2003. A shooting campaign eliminated a total of 117 RES turtles.

### Surveys of turtle populations

- Capture-mark-recapture (CMR) campaigns were run in 2005 and 2011 to estimate the population of European pond turtles, in the framework of the herpetological survey of the site.
- In 2005, four RES turtles were captured in the hoop nets used to capture the European pond turtles and two were captured while laying their eggs. In 2011, only one RES turtle was captured in the hoop nets.
- On the basis of visual sightings, the RES turtles were estimated to represent 32% of the total turtle population on the site.
- They would seem to be concentrated mainly on the eastern side of the site, whereas the European pond turtles are located primarily on the western side (see the graph below). The RES turtle population would appear to be growing and spreading to the west, while at the same time driving the European pond turtles from the eastern side.

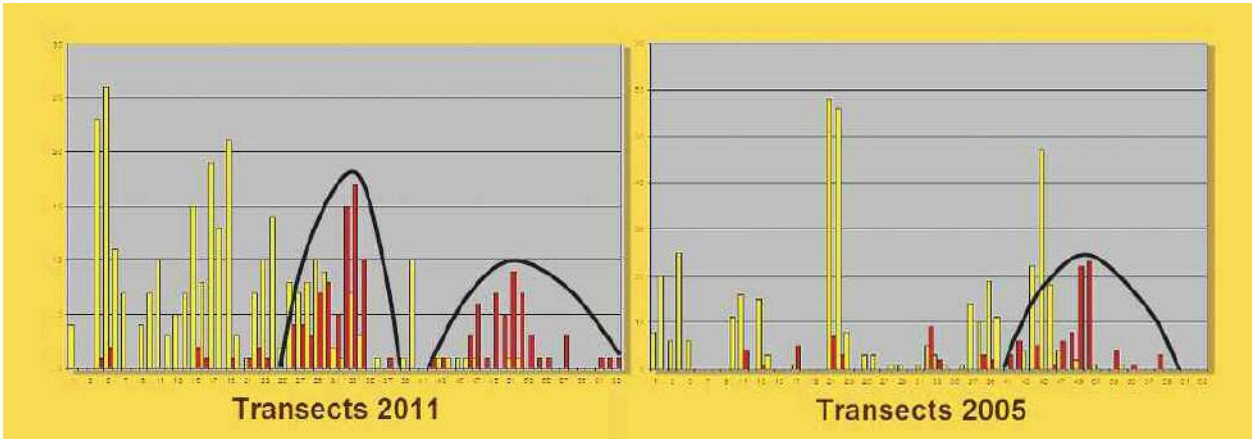


■ **Trapping**

- To facilitate the development of the European pond turtle population on the site, it was decided in 2013 to reduce the number of RES turtles.
- Contacts were made with the local stakeholders involved in conserving the European pond turtle, namely the Mediterranean lagoon centre, CEN PACA (in charge of the national action plan for European pond turtles), the Tour du Valat biological centre, the Or River board, the Port-Cros national park and local naturalists. The purpose of the contacts was to gather information on management methods for RES turtles.
- Hoop nets were not used given the lack of results in capturing RES turtles during the CMR campaign for European pond turtles in 2005 and 2011.
- Fyke nets were preferred because they seemed better suited to the layout of the site, i.e. a straight canal with steep banks and a maximum water depth of 60 centimetres.
- The system consisted of a seine net across the canal, rising from the canal bed to above the water level, and the Fyke net with several netted funnels leading in (60 cm diameter at the entry point) and a system hindering an exit once the turtles had entered. The Fyke nets were installed along the bank and the system as a whole was held in place with wooden stakes. The rear ends of the Fyke nets were strung up above the water level so that the captured turtles could breathe. Floaters were also installed in the Fyke nets, again to avoid drowning the turtles.
- In May 2013, during a first test run, two Fyke nets were installed. Over the course of the operation, they were installed in five different spots.
- Bait was not placed in the nets. Any fish captured were released, with the exception of pumpkinseeds (*Lepomis gibbosus*), an invasive alien species that was eliminated.
- The traps installed on Monday were inspected daily in the morning until Friday, when they were “deactivated”. From 4 to 31 May 2013, the traps were in operation for 23 nights.
- In 2015, the trapping campaign was carried out in parallel with the monitoring programme for European pond turtles. Trapping was done in sessions of four consecutive days each week, for a total of six sessions, using ten Fyke nets as per the recommendations of the national action plan for European pond turtles, i.e. three to four nets per kilometre of bank.
- The RES turtles captured in 2013 were sent to the Turtle observation and protection station (SOPTOM) in Gonfaron. In 2015, they were eliminated on site.



2. Ring canal around the Vieux Salins site.  
3, 4. Setting up the Fyke nets.



Visual sightings of European pond turtles (in yellow) and RES turtles (in red) along east-west transects in 2005 and 2011.

Results and costs

■ Results

- During the trapping campaign in May 2013, 73 RES turtles were captured.
- In 2015, 159 RES turtles were captured, including 81 adults, 59 juveniles and 19 of undetermined age.
- The trapping technique was clearly suited to the terrain, i.e. a canal with steep banks and shallow water.

■ Assessment

- The work in 2013 was considered a test phase during which the equipment and human resources were adjusted as needed, consequently a precise assessment is not available.
- The work in 2015 was carried out in the framework of the updating procedure for the document listing objectives for the Rade d'Hyères Natura 2000 site that is managed by the Port-Cros national park with State funding. The technical supervision of an intern and the purchase of part of the equipment was funded by the Toulon Provence Méditerranée urban board. The results are the following:
  - the preparatory work for the trapping campaign took approximately one week (contacts with the various partners, reconnaissance of the site, decisions on work techniques);
  - the trapping work required two technicians over six weeks, working two full days per week (setting up and taking down the traps on Monday and Friday) and three half-days (checking the traps on Tuesday, Wednesday and Thursday), for a total of 42 man days;
  - the end-of-project work required a further week (cleaning and repairing the material, drafting various articles, both scientific and for the general public);
  - the Toulon Provence Méditerranée urban board made available a technician for the field work and provided equipment for the trapping campaign (vehicles, wooden stakes, etc.);
  - the unit price for a Fyke net ranges from 100 to 175 euros, depending on the supplier.

Table listing the human resources used in 2015.

Work	Number of man-days
Preparatory work	5
Trapping	42
End-of-project work	5
Additional technical support	21
TOTAL	73

Information on the project

- Articles were published in the local press (Var Matin, TPM Mag, etc.).
- Scientific articles were published in the scientific journal of the Port-Cros national park.
- A university student drafted a report in the framework of his Masters-2 studies (Perrot, 2015).



5, 6. RES turtles captured during the trapping campaign.  
7. Article published in the Var Matin newspaper on 2 June 2013.



## Outlook

■ In 2017, a transect study was run, similar to those in 2005 and 2011, to detect any changes in the distribution of the two species. The initial results confirmed the continued presence of the two species along different sections of the canal, signalling that they both still co-exist on the site. Further analysis of the study results should provide more information on the conditions of the co-existence and on any trends.

■ The geographic isolation of the two turtle populations on this rather particular site, the success of the previous trapping campaigns and the ever-present need to protect the native species led to the decision to plan a new trapping campaign in 2018 in order to continue reducing the population of RES turtles.

■ Similar trapping projects will be carried out in the ponds of a tree nursery next to the Vieux Salins site where RES turtles have also been observed. Other trapping methods may be used in the ponds, e.g. sundeck traps or Fesquet cage traps (see the management report on the Mauguio Pond: <http://www.gt-ibma.eu/wp-content/uploads/2016/10/Trachemys-scripta-elegans4.pdf>).

■ If in the future further efforts are required, shooting may be tested in order to remove the last RES turtles from the site.

## Regulations

■ RES turtles may not be introduced into the natural environment (ministerial decree dated 30 July 2010). The species may not be imported into the European Union (EC 349, 25 February 2003) and it is also listed as an invasive alien species of Union concern (European regulation 1143/2014).

■ The European pond turtle is a protected species (decree dated 19 November 2007). Its capture and handling require an authorisation granted to a specific person by the Departmental territorial and maritime agency (DDTM). For the studies and work mentioned here, Matthieu Lascève (Toulon Provence Méditerranée urban board) was authorised to capture-mark-recapture living European pond turtles and to euthanise the captured RES turtles.

Authors: Doriane Blottière, IUCN French committee, and Matthieu Lascève, Toulon Provence Méditerranée urban board. January 2018.

### For more information

- Lascève, M. 2014. Premiers résultats de l'opération de limitation de la population de Tortue de Floride sur le site des Vieux Salins, Hyères (Var, France). Sci. Rep. Port-Cros natl. Park. 28 : 195-201.
- Perrot, K. 2015. Estimation de la population et localisation des sites de ponte de la Cistude d'Europe (*FF*) sur les Anciens Salins d'Hyères. Université de Bourgogne, PNPC, TPM. 55 pp.
- Perrot, K., Lascève, M., Gomez, M-C. 2016. Estimation de la population et localisation des sites de ponte de la Cistude d'Europe (*Emys orbicularis*) sur les Vieux Salins d'Hyères (Var, France). Sci. Rep. Port-Cros natl. Park, 30 : 179-194.
- Joyeux, A. 2011. Suivi de la population de Cistude d'Europe des Vieux Salins d'Hyères. 56 pp.
- Joyeux, A. 2005. Expertise herpétologique des anciens Salins d'Hyères. 67 pp.
- Cadi, A. & Joly P., 2003. Competition for basking places between the endangered European pond turtle (*Emys orbicularis galloitalica*) and the introduced red-eared slider (*Trachemys scripta elegans*). Canadian Journal of Zoology, 81: 1392-1398.
- Thienpont, S. 2011. Agir pour la Cistude d'Europe. Plan National d'Action. Ministère de l'Écologie, du Développement, des Transports et du Logement. 20 pp.
- Syndicat mixte du Bassin de l'or – CEN LR, 2013. - La cage-Fesquet : enfin un piège efficace sur les tortues de Floride !



# Northern raccoon

(*Procyon lotor*)

Originated in North and Central America, introduced in continental France to be bred for its fur in the 1920s and as a mascot of U.S. NATO troops. Introduced to Guadeloupe in the early 1800s and was considered a native species until recently.

## Description

- Round, squat silhouette, raised hind quarters
- Up to 90 centimetres long (without the tail), average weight 5 to 6 kilogrammes
- Wide head, short snout, with a mask stretching from the eyes to the muzzle, large, clearly visible ears
- Bushy tail 20 to 40 cm long, with 5 to 7 brown to black rings, interspersed with lighter coloured fur
- Grey brown dorsal fur, less dark ventral fur
- They may be confused with the raccoon dog (*Nyctereutes procyonides*), however the mask of the latter does not cover the muzzle and there are no rings on the tail
- They can live from 6 to 16 years

## Ecology and reproduction in its original environment

- The preferred habitat is a wooded region with slow-moving rivers, ponds and pools
- Raccoons often occupy hollow trees or the burrows of other mammals (foxes, badgers)
- They are sexually mature at 10 to 15 months and bear 3 to 5 young after a gestation period of 63 days
- Activity is essentially nocturnal or at dusk, often solitary
- Omnivorous, including fish, amphibians, birds, eggs, insects, fruit, seeds, etc.

## Documentation

- Sarat E. (ed.), 2012. Vertébrés exotiques envahissants du bassin de la Loire (hors poissons) : connaissances et expériences de gestion. National agency for hunting and wildlife (ONCFS), *Loire Grandeur Nature* plan (PLGN). 128 pp.
- Lamand F. (ed.), 2015. Espèces exotiques envahissantes des milieux aquatiques et associés en France métropolitaine. Recueil de fiches d'identification. Onema North-East. 168 pp.
- Léger F. and Ruette S., 2014. Raton laveur et Chien viverrin : le point sur leur répartition en France. *Faune Sauvage*. 302 : 9-16.

Authors: Doriane Blottière, IUCN French committee.

Classification	
Order	Carnivora
Family	Procyonidae
Genus	Procyon
Species	<i>P. lotor</i> (Linnaeus, 1758)





# Northern raccoon

(*Procyon lotor*)

## Management of Northern raccoons by the Association of certified trappers in the Gironde department

### Association of certified trappers in the Gironde department (ADPAG)

- The non-profit organisation was founded in 1997 and is certified for environmental protection.
- Its main missions include:
  - representing the certified trappers in the Gironde department in their dealings with the administrative, professional and hunting authorities;
  - managing and informing the certified trappers concerning regulations and safety;
  - organising the capture of species classified as pests.
- Contact: Fabien Egal, policy officer – [fegal.adpag@gmail.com](mailto:fegal.adpag@gmail.com)

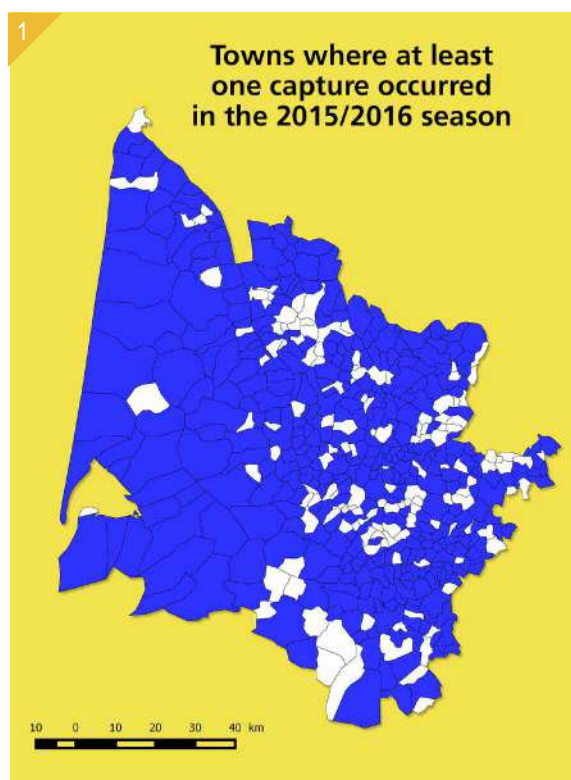
### Intervention site

- ADPAG represents the volunteer, certified trappers that operate in the towns of the Gironde department.
- The association coordinates coypu and muskrat trapping by signing agreements with various entities (towns, intermunicipal boards, river boards, farmers, Bordeaux Métropole (urban area), etc.). Trapping of raccoons was progressively included in these agreements.
- The first captures of raccoons occurred in 2008 in two towns of the department. Between 2008 and 2016, raccoons were captured in 27 towns.
- The first raccoons were captured accidentally in cages set for coypus. The trapping system is the same, but some trappers have since specialised in trapping raccoons.
- The traps are generally positioned near aquatic environments (rivers, wetlands), on the banks, in compliance with the applicable regulations.

### Disturbances and issues involved

#### ■ Impacts on biodiversity

- In France, the effects of the presence of raccoons on native species are not known. However, the species is suspected of hunting reptiles, amphibians and the young of birds nesting on the ground. It is also thought to compete with other, small carnivores.



© ADPAG

1. Map showing towns in blue where the ADPAG is active (all species).

#### ■ Impacts on health

- Raccoons are potential carriers of rabies and of raccoon roundworm (*Baylisascaris procyonis*), which can cause lethal encephalitis in humans.
- They are not fearful and approach homes to look for food (kibble). They may act aggressively toward household pets (dogs, cats), can inflict wounds and transmit diseases (zoo-noses).

#### ■ Impacts on agriculture

- A number of land owners in the area have noted significant damage to fruit trees (fig trees, prune trees, etc.).



## Interventions

- ADPAG coordinates trapping by the certified trappers in the Gironde department and draws up an annual report on raccoon trapping on the basis of the data supplied by the trappers. Trapping activities are reported to the administrative authorities in each town.
- Operations are conducted throughout the year and the results are assessed at the end of June.
- The traps are supplied by ADPAG with funding by the Departmental council. The cages have a single entry and are equipped with a 5 x 5 cm opening for mink, in compliance with prefectural regulations on trapping. The holes allow female European mink to escape during the time that they feed their young (April to July). For cages manufactured after 1 July 2013, the mink hole must be located in the top panel of the cage.
- Bait consists of apples, carrots or kibble, the latter being an excellent bait for raccoons.
- In compliance with the applicable regulations, the cages are inspected daily.
- When a raccoon has been captured, the ADPAG policy officer is immediately contacted and, whenever possible, travels to the site to check for a microchip implant that would enable identification of the animal. To date, none of the trapped animals has had an implant.
- In compliance with the regulation, the captured animals are killed on site. If a storage system for the corpses has been set up by the certified organisation, they are stored until they can be picked up by the rendering service (free of cost if requested by the town for loads of at least 40 kilogrammes).
- Report cards on animal captures are sent in June to the trappers, who fill them out and send them back to ADPAG for inclusion in the annual summary report.

## Results and costs

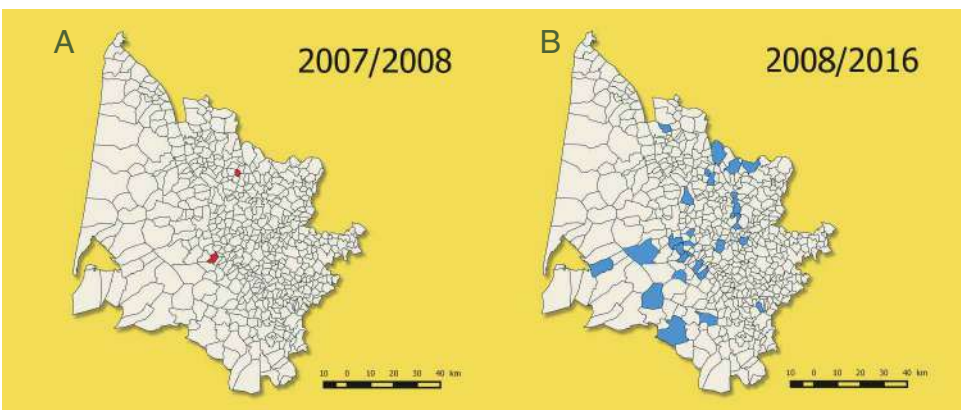
### ■ Results

- From 2008 to 2016, a total of 131 raccoons were captured in 27 different towns by 28 trappers.
- To put that into context, for the 2015-2016 season, 22 raccoons were captured in seven towns, based on the data contained in the 1 288 report cards sent back by trappers. Seven trappers made those captures, with a maximum of nine by one of the trappers.
- In 2016-2017, the number of captures increased sharply with 91 raccoons captured by seven trappers in seven towns. One of the trappers succeeded in capturing 68 raccoons.



2. Cage trap used for raccoons with an opening for European mink.

3, 4. A raccoon captured in a cage trap.



A. Towns in the Gironde department where the first captures were made in 2008.

B. Towns in the Gironde department where at least one raccoon was captured from 2008 to 2016.

© ADPAG

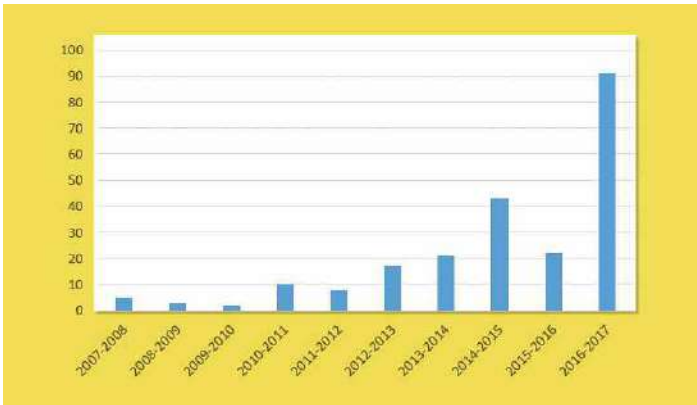


■ A mapping application was developed by the Poitou-Charentes Regional environmental observatory to illustrate the trapping results. It may be found at [adpag.fr/cartographie/](http://adpag.fr/cartographie/).

Yearly trapping results.

Season (July to June)*	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	TOTAL
Number of raccoons captured	5	3	2	10	8	17	21	43	22	91	222
Average number per trapper	2.5	1	1	2	2.67	2.83	3.5	5.38	3.14	13	-
Number of towns	2	3	2	5	3	6	6	8	7	7	27

\* The trapping season runs from 1 July to 30 June.



Number of raccoons trapped per season.

■ **Assessment**

- There is clearly an increase in the number of raccoons captured, probably due to the rise in the number of trappers, to the fact that some have specialised in trapping raccoons, and to the successful reproduction and dispersal of the species over the territory.
- It is difficult to distinguish any differences in the cost of trapping raccoons compared to coypus and muskrats given that the equipment used is the same. Starting in the 2015-2016 season, the bounty for the capture of a raccoon was five euros, compared to three euros for a coypu (only in the towns having signed an agreement with ADPAG).
- The major difficulties are the theft of and damage to the traps. Between 20 and 30 traps are declared stolen each year (out of 1 200 traps made available), a discouraging situation for the trappers affected by the thefts. The traps are replaced by ADPAG if the trapper presents the papers declaring the theft to the *Gendarmerie*.
- In addition, the species has a positive image in the population, which can result in the reaction of people opposed to trapping who send emails to the town hall, distribute leaflets, etc. An example of a leaflet is shown in Figure 5.

**Information on the project**

- Training courses are regularly run for the certified trappers who must go through a mandatory course on regulations at least once every five years. Optional courses on trapping techniques are also offered.
- The annual report on trapping in the Gironde department is published on the ADPAG site.

■ Presentations on the work are regularly made during conferences and symposia on invasive alien species, e.g. at the 38th SFEPM Mammalogy conference in October 2015.

## Outlook

■ A genetic study is now being run by the National agency for hunting and wildlife (ONCFS) to identify the different populations and determine the origin of individual animals (populations originating in Germany, newly escaped animals, etc.).

■ To that end, samples are drawn from trapped animals or those found dead (e.g. roadkill). A piece of ear (0.5 square cm) is placed in a tube filled with alcohol and sent to ONCFS, with a note indicating the place of capture, the date and the name of the trapper.

■ ADPAG intends to include the species in a maximum number of agreements with towns in the department in order to increase the trapping pressure on the species. The trappers are regularly informed of the need to transmit all available information on raccoons.

## Note on applicable regulations

■ The species has been declared a pest for all of continental France (the decree dated 02 September 2016 on controlling non-native species through hunting, in application of article R. 427-6 of the Environmental code, lists the periods and conditions under which non-native species of animals deemed harmful shall be destroyed in continental France). Raccoons may be trapped year round and may be shot outside of the hunting season by persons having received individual authorisation from the prefecture.

■ The species is also listed as an invasive alien species of Union concern (European regulation 1143/2014). It is prohibited to release the species to the natural environment (ministerial decree, 30 July 2010).

Authors: Doriane Blottière, IUCN French committee, and Fabien Egal, ADPAG. January 2018.



5. An anonymous leaflet distributed in the town of Villenave d'Ornon.

### For more information

- ADPAG internet site:  
<http://www.adpag.fr/>
- ADPAG 2017. Synthèse du piégeage en Gironde – Saison 2015/2016. Rapport, 49 p.
- Egal F. 2015. Les espèces de mammifères invasives en Gironde : récolte et traitement des données. Actes du XXXVIII<sup>e</sup> Colloque francophone de mammalogie. 110-113.  
<http://www.gt-ibma.eu/wpcontent/uploads/2015/11/Diapo-colloque-SFEPM-PDF.pdf>
- Léger F. 2017. Petits carnivores exotiques introduits : un point de la situation. ONCFS. Présentation lors du séminaire espèces exotiques envahissantes « de la réglementation à la gestion : comment agir ? », Parc naturel régional de la Montagne de Reims, 27 avril 2017.  
[http://www.gt-ibma.eu/wpcontent/uploads/2017/07/4b\\_petits-carnivores\\_oncfs-f-leger-seminaire-pnrmr.pdf](http://www.gt-ibma.eu/wpcontent/uploads/2017/07/4b_petits-carnivores_oncfs-f-leger-seminaire-pnrmr.pdf)
- Ruys T & Léger F. 2015. Situation du Raton laveur en France et zoom sur l'Aquitaine. Actes du XXXVIII<sup>e</sup> Colloque Francophone de Mammalogie. 114-119.

2018 edition





