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.

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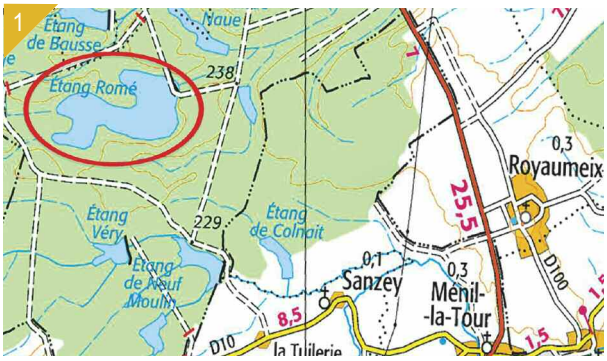
Intervention site

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



1. Map showing the intervention site.

■ 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.

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 Schweyer, Lorraine CEN, Doriane Blottière, IUCN French committee, and Jean-Nicolas Beisel, University of Strasbourg – ENGEES. January 2018.

For more information

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2018 edition