Box elder

(*Acer negundo*)

Project to eliminate box elder by the Biogeco joint research unit (2008-2011)

Biodiversity, genes and communities joint research unit (BIOGECO)

- The joint research unit comprises three teams from the Ecology of forests, prairies and aquatic environments department at INRA and a team from the University of Bordeaux 1.
- The research focusses on analysis of the mechanisms governing the evolution of diversity on different hierarchical levels (communities, species, populations, genes) in order to achieve sustainable management of resources and environments.
- Contact: Annabel Porté - annabel.porte@u-bordeaux1.fr, head of the Functional ecology and genomics team.

Study on the invasion of box elder in the riparian vegetation of South-western France

- Information on the invasion speed and the impacts on biodiversity.
- Identification of the mechanisms involved in the proliferation.
- Study of control methods and dissemination of the information.
- Steps:

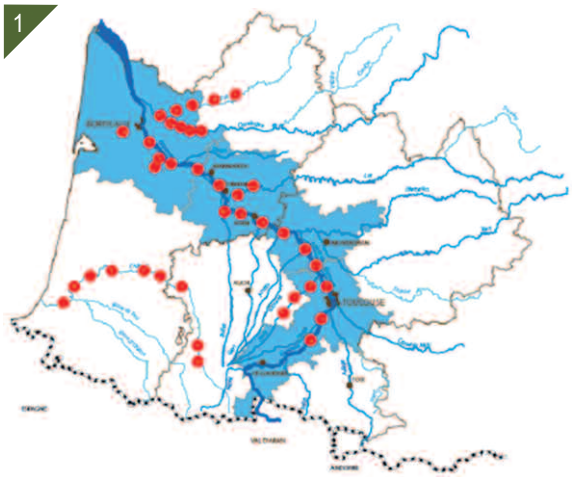
- 2008, review of the literature on the various control methods;
- 2009, launch of the experiment on control methods (year n);
- 2010, assessment of the results of the control methods (year n+1);
- 2011, assessment of the results of the control methods (year n+2);

Intervention site

- 70 sites along 10 rivers in South-western France were inspected.
- The presence/absence of box elder and the degree of colonisation were observed on each site.
- Three study sites were selected in light of their high concentrations of box elder and the large areas covered:

- the Bruges marshes natural reserve contained a coppice that had started to age with an increase in the number of fairly large-diameter trees, though smaller trees continued to represent a majority of the population;

1



© BIOGECO

2

© Google maps

1. Map showing the inspected sites.
2. Study sites.

- the riparian vegetation along the Leyre River in the town of Salles, in the Landes-de-Gascogne regional nature park, included a larger number of small trees and sprouts, i.e. a typical, young coppice;
- the riparian vegetation along the Save River in the town of Marestaing, where mid-sized trees represented a relative majority, indicating a fairly old population probably the result of long-standing occupation of the site by box elder.

Disturbances and issues involved

■ Box elder can impact alluvial communities in different ways:
- possible modification of the structure and composition of fauna and flora;
- superficial root system that does not stabilise river banks.

■ The study on the potential methods for box-elder management was launched at the request of the departmental councils of the Aquitaine region following an alert issued by the river technicians of the River and wetland management groups (CATERZH) concerning the development of box elder.

3. Box elder.

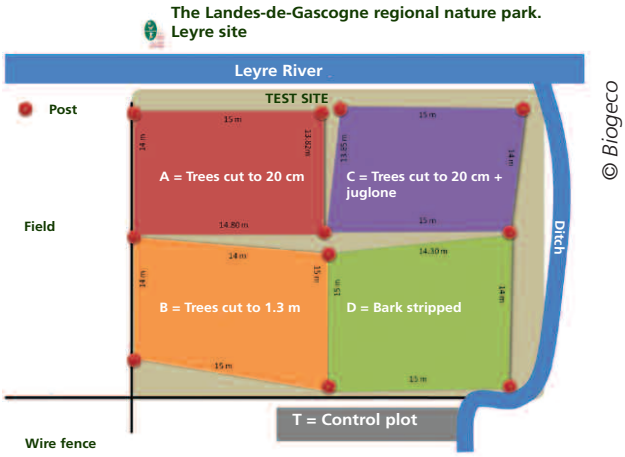
Interventions

■ Selection of different treatments following a review of the literature:
- treatment C, where all the trees are cut using a chainsaw to a height of 10 to 20 centimetres above ground level. This is the standard treatment used by river technicians and served as the reference for the others;
- treatment H, where all the trees are cut using a chainsaw to a height of 1.3 metres above ground level;
- treatment E, where a ring of bark 20 to 30 centimetres wide is stripped off all the trees, down to the xylem, at a height of approximately 1 metre above ground level. The bark is removed using an axe or a chainsaw. Care must be taken to remove all the living tissue between the bark and the hardwood in order to starve the trunk by blocking the transit of sugars coming from the leaves;
- treatment J, using juglone, an allelopathic substance produced by walnut trees and a known herbicide. All the trees are cut to a height of 10 to 20 centimetres above ground level and notches 2 cm wide are cut into the trunk using a chainsaw or machete to hold the paste made of walnut leaves. The trunks are then covered with cut paste.

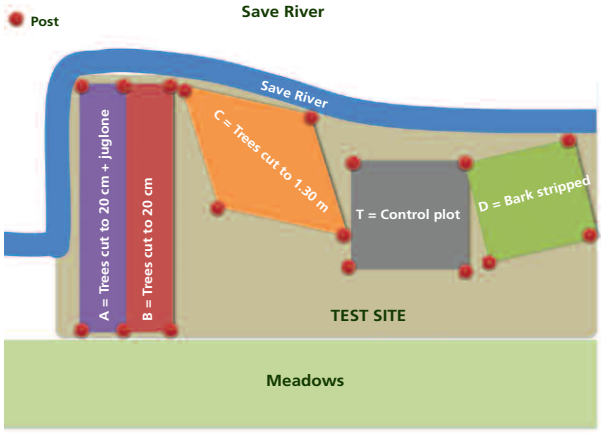
■ Between March and June 2009, five plots, approximately 200 square metres each, were laid out on each of the three study sites:
- one plot was reserved as a control plot;
- the other plots were each subjected to a different treatment.

■ Plots were randomly assigned a treatment and any seedlings and waste (trees, bark) were removed from the site. All native species remained untouched.

■ The treatments were carried out after the rising of the sap, when the leaves were well developed (in May).

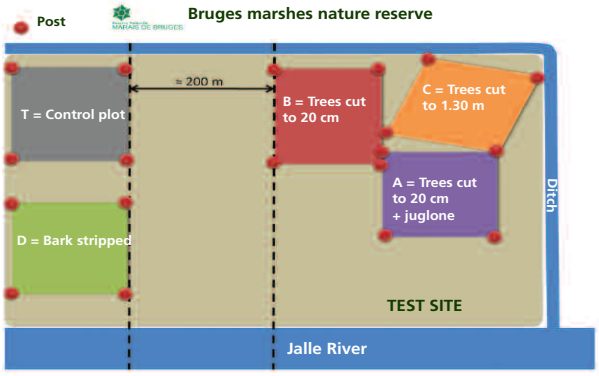


Plots on the Leyre site.



© Biogeco

Plots on the Marestaing site.



© Biogeco

Plots on the Bruges site.

Results and assessment

■ Results

■ Different parameters were used to assess the effectiveness of the different treatments on the plots:

- mortality
- total number of new shoots;
- diameter and length of the five largest new shoots.

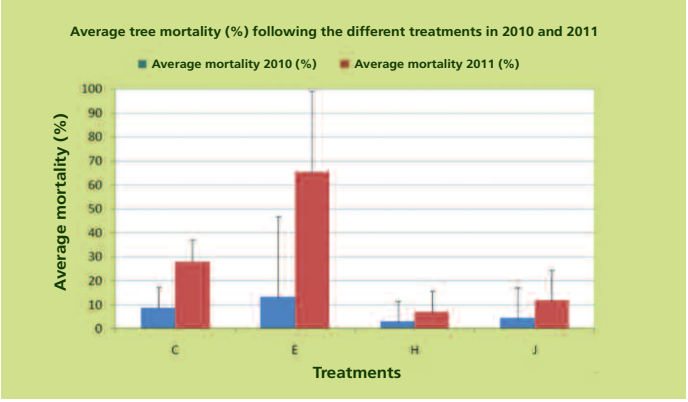
■ Mortality:

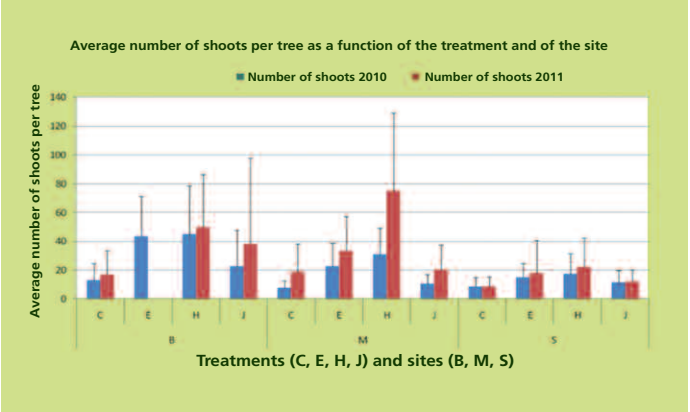
- mortality increased after two years of treatment;
- average mortality rates varied significantly for a given treatment depending on the site due to the influence of abiotic (environmental conditions) and genetic (origin of the trees) parameters;
- stripping of the bark was the most effective in spite of the healing process (exsudat) observed on certain sites that slowed the decline of the trees.

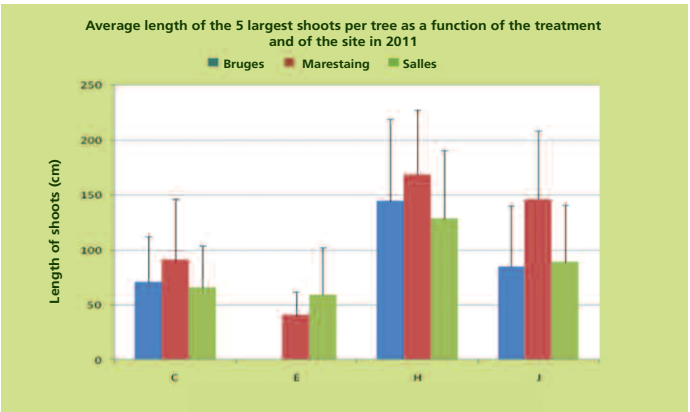
■ New shoots:

- high growth potential, some shoots reaching a high diameter to length ratio;
- the number of shoots per tree increased significantly in 2011;
- the shoots were more vigorous on the trees cut to a height of 1.3 metres;
- the juglone-based treatment (J) was not effective, which may be due to the low concentration (walnut leaves were used and not pure juglone);
- the five largest shoots were smaller in size when the bark was stripped from the trees (treatment E), a treatment that tired the trees.

4. Treatment C.
5. Treatment H.
6. Treatment E.
7. Treatment J.







Results of the different treatments.

Results of the treatments.
8. Treatment C.
9. Treatment E.
10. Treatment H.
11. Treatment J.

■ Assessment of the study

■ The experiments in the framework of the three-part study programme on the invasion of box elder were launched in 2008.

■ 2008:

- review of the literature on invasive species;
- preparation of the field experiments under controlled conditions.

■ 2009:

- end of the study on colonisation patterns;
- start of the study on invasion mechanisms;
- preparation of the experiments on control methods.

■ 2010 and 2011:

- end of the comparative study on box elder and native species in riparian vegetation (Porté *et al.*, 2011);
- continuation of the study on the invasion mechanisms of box elder;
- assessment of the control methods tested in the field;
- dissemination of study results.

■ Assessment of the experiments on control methods

■ The treatments were undertaken in the spring of 2009.

■ The following years, new shoots were cut and the trees were restripped (if a healing process was observed).

■ On the site level, the most effective method was stripping of the bark down to the xylem for at least two or three consecutive years.

■ Monitoring is required to avoid the return of box elder in the treated areas (due to the seed banks present in the invaded areas).

■ When fully exposed to sunlight, box elder grow more rapidly than native species. To avoid a situation where an undergrowth of box elder comes to dominate a stand, it is necessary to counteract the possible opening up of an environment by removing the box elder and encouraging the native species.

Outlook

■ An analysis of the genetic variability of maple populations in France and Europe would be useful.

■ This study could be expanded to include other species of invasive trees in South-western France (*Baccharis halimiifolia, Prunus serotina, Robinia pseudoaccacia, Ailanthus altissima*).

■ What is the impact of climate change on invasion dynamics?

■ It would be useful to develop a model to calculate invasion risks in riparian vegetation, based on the bark-stripping method and result monitoring, to improve the techniques used for the method, to determine the costs, to test the support methods (replanting) and avoid the return and dominance of box elder in the treated areas.

Information on the project

■ Field trips are organised in the areas invaded by box elder.

■ Field personnel are trained to monitor populations.

■ Informational meetings are organised and results are disseminated.

■ Scientific articles have been published.

■ The study and its results have been presented at a number of different events.

■ Study results are available on the BIOGECO site.

Author: Emilie Mazaubert, Irstea

For more information

■ BIOGECO internet site: http://www4.bordeauxaquitaine.inra.fr/biogeco/Personnel/MP/Porte-Annabel/Arbres-invasifs

■ Moreau A. 2010. Évaluation de l'efficacité de méthodes de lutte contre l'espèce invasive *Acer negundo* L. Master Écologie fonctionnelle comportementale évolutive, Université de Rennes 1, 23 pp.

■ Porté A., Lamarque L., Lortie C., Michalet R. et Delzon S. 2011. *Invasive Acer negundo outperforms native species in non-limiting resource environments due to its higher phenotypic plasticity. BMC Ecology,* 11(1) : 28.

B i o G e C o
Biodiversité, gènes & communautés