Habitat preference of a new invasive species in Wallonia: the bullfrog (*Lithobates catesbeianus*)

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Introduction

The Bullfrog *Lithobates catesbeianus* has been recorded in Wallonia (S-Belgium) since 1992 (de Wavrin, 2007). We report on the first study in this region designed to characterise its distribution and habitat use. IUCN considers *L. catesbeianus* as one of the 100 worst invasive species in the world (Lowe et al., 2000). It negatively affects native amphibians through competition and predation. Moreover, this frog is known to be frequent carrier of a fungus (*Batrachochytridum dendrobatidis)* that causes the amphibian disease chytridiomycosis. This disease significantly contributes to the global amphibian decline throughout the world.

Our study focused on bullfrog habitat use in Wallonia to better understand environmental factors that influence the presence and the invasiveness of the species in this region. It provides basic information that may help us to prevent, predict and chose management measures to respond against settlement and spread. Distribution and habitat preference were studied in Wallonia during the summer of 2008. We focused on the surroundings of the two known populations at Ransart (Charleroi) and in the Dyle valley (Brabant Wallon).

Rana catesbeiana - American bullfrog

ISSG DAISIE

Synonym:	*Lithobates catesbeianus*	**Group:**	Amphibians and reptiles
French name:	Grenouille taureau	**Origin:**	North America
Dutch name:	Stierkikker	**Habitat:**	freshwater
Family:	Ranidae	**Introduction:**	aquariums and ponds

A1 species

ISEIA Score : ***12***

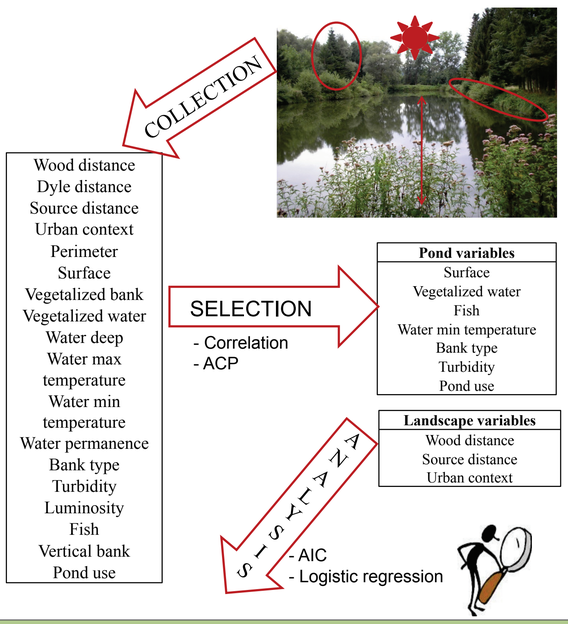
Figure 1. ISEIA index. (Branquart, E. et al., 2009)

Materials and methods

Adult presence was determined by call surveys during the night (June-July). Tadpole presence was studied by visual inspection and netting during the day (July-August). Sites within both zones (Dyle valley: 22.6 km², Ransart 8.5 km²) were visited at least 3 times.

Habitat of the 22 potential sites closest to the cores populations of Ransart and Dyle valley were characterized using 19 habitat variables (14 pond variables and 5 landscape variables).

The significant relationships between habitat variables and adult presence were analyzed by logistic regression. We built 2 models, for the pond and for the landscape variables, and we compute each by logistic regression with backward elimination and AIC test. PCA and Pearson correlation were used to study the structure among variables.



Areas of study

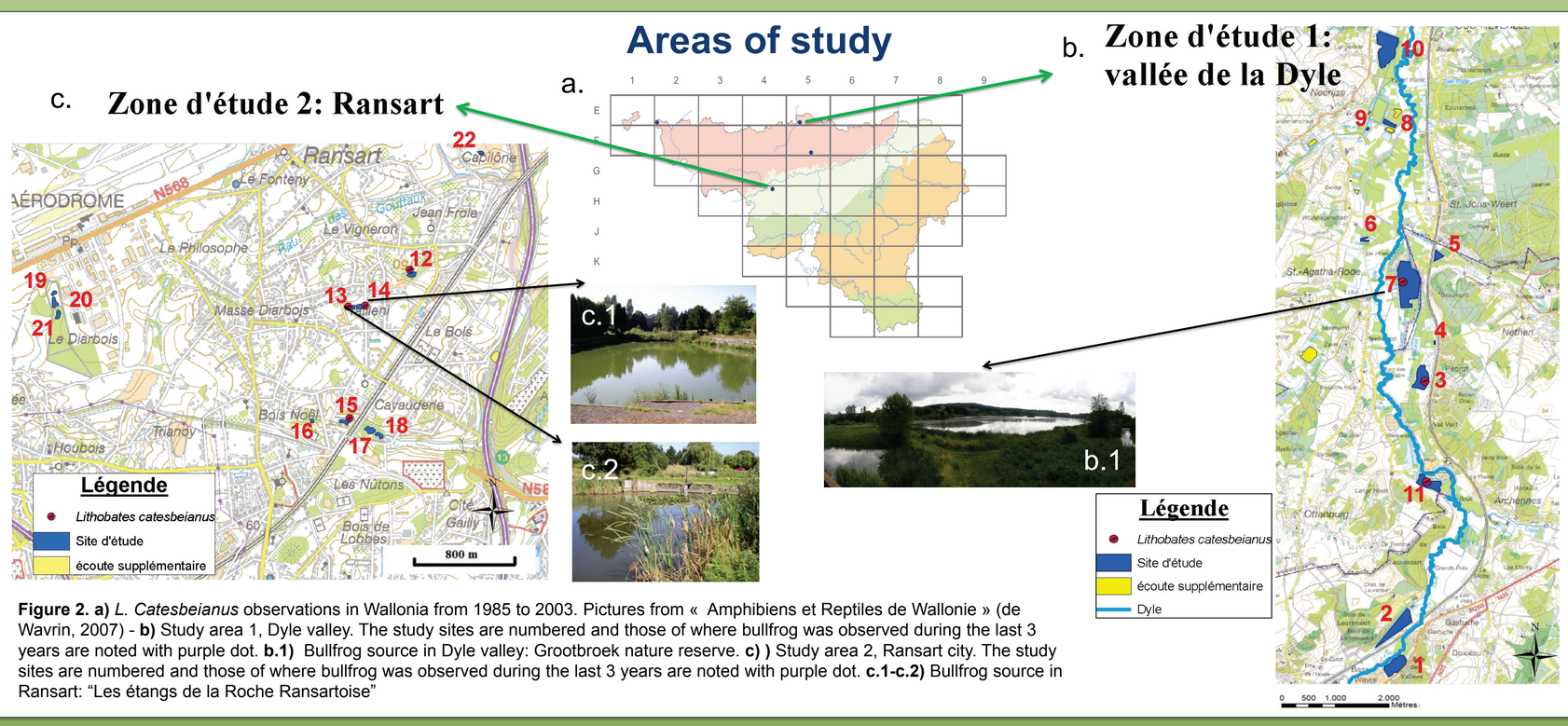


Figure 2. a) *L. Catesbeianus* observations in Wallonia from 1985 to 2003. Pictures from « Amphibiens et Reptiles de Wallonie » (de Wavrin, 2007) - **b)** Study area 1, Dyle valley. The study sites are numbered and those of where bullfrog was observed during the last 3 years are noted with purple dot. **b.1)** Bullfrog source in Dyle valley: Grootbroek nature reserve. **c))** Study area 2, Ransart city. The study sites are numbered and those of where bullfrog was observed during the last 3 years are noted with purple dot. **c.1-c.2)** Bullfrog source in Ransart: "Les étangs de la Roche Ransartoise"

Results

L. catesbeianus was observed in a very limited number of water bodies (4/22) close to introduction sites; reproduction only occurred in 3 ponds (Fig. 2).

Logistic regression with backward elimination and AIC models both showed the same results for the landscape and pond variables model.

Bullfrog presence was significantly explained by the distance from the known source population (source distance), the turbidity of the water, the minimal water temperature and water plant coverage of the water surface. Presence of fish was not retained as a factor in the best model.

Landscape model	K	Δ*AIC*	Δ*AICc*	W (*AICc*)
dist_source	**2**	**0**	**0**	**0.37**
dist_sb +dist_source	3	1.06	1.76	0.15
/	1	2.96	2.53	0.10
zone_etude +dist_source	3	1.96	2.66	0.10
contexte+dist_source	4	1.44	0.12	0.08

	W
dist_source	0.775
dist_sb	0.257
zone_etude	0.216
contexte	0.171

Pond model	K	Δ*AIC*	Δ*AICc*	W (*AICc*)
pourc_eau_veg +turb +tempmin	**4**	**0.07**	**0.00**	**0.16**
turb +poissons +pourc_eau_veg +tempmin	5	0.02	1.45	0.08
turb +poissons +pourc_eau_veg	4	2.80	2.58	0.04
poissons +pourc_eau_veg	3	3.83	2.59	0.04
turb +pourc_eau_veg	3	4.3	3.07	0.03

	W
turb	0.690
pourc_eau_veg	0.641
tempmin	0.529
poissons	0.434
surf	0.236
zone_etude	0.219
berge	0.113

Table 1. AIC table for landscape and pond models. Best explicative models are bolded. K= model parameters, W (*AICc*)= Akaike weight (probability to be the best model), W= Akeike weight for each variables. Adults is predicted by the logistic model. The constant model (/) was also tested.

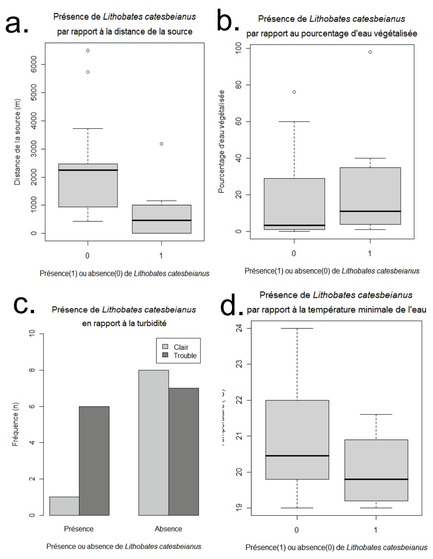


Figure 3. Bullfrog presence in relation to a)the bullfrog initial place, b) the percentage of vegetalized water, c) the water turbidity and d) the minimal water temperature.

75% of occupied sites were at a distance of < 1000 m from the known source population (Fig. 3). The occupied sites also showed on average 3 x higher water plant coverage and clearly more turbid water than empty sites. Sites with Bullfrogs were slightly cooler during the summer (water temperature +/- 1 degree less).

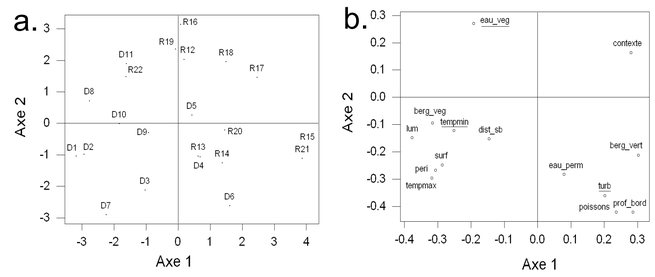


Figure 4. PCA for a) study sites and b) habitat variables. Axe 1: 30%, axe 2 : 20% of explained variability.

PCA did not help explaining the presence of *L. catesbeianus*, but did show how habitat variables and sites are structured among them. We see that the occupied sites (7,3,11,13,14,15,12) are distributed along the 4 quadrants. It illustrates that bullfrog use a broad range of habitat types.

Conclusions

- We are only at the early stage of the bullfrog invasion in Wallonia. Even if the bullfrog is present in Ransart since more than 15 years; the species remains highly localized. Probably, this can be attributed to the urban context of Ransart. However, there is some spreading in the rural wet landscape of the along the Dyle basin since 2005.
- *L. catesbeianus* is able to use a broad range of habitat types (from natural to highly artificial); there is some indication for a preference of eutrophic and turbid waters that are usually with a high cover of helophytes and somewhat warmer water temperature. This rich ecosystem provides sufficient food and vegetation cover for development of the long larval stage and for adults which are confined to water during the entire year (Clarkson and deVos, 1986, Détaint and Coïc, 2001, Graves and Anderson, 1987).
- Moreover, other studies have demonstrated that invasion of bullfrogs is facilitated by the presence of fish. They do not eat tadpoles and increase their survival by reducing predatory macroinvertebrate densities and facilitate bullfrog competition with other native amphibians (Adams et al., 2003, Smith et al., 1999, Kiesecker and Blaustein, 1998, Hecnar and M'Closkey, 1997). However, all the current bullfrog breeding sites are colonized by fish in Wallonia.
- It is important to prevent further harm (as documented for other regions) and, hence, take management measures (Adams and Pearl, 2007) on the short term to control or even rapidly eradicate the Bullfrog.

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For further information

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More information on this and related projects can be view in the thesis report: Martin,Y. (2009) *Lithobates catesbeianus*, une nouvelle espèce invasive en Wallonie: distribution, habitat et régime alimentaire. *Mémoire de l'Université Catholique de Louvain*, pp. 81.