Alien macro-crustaceans in freshwater ecosystems in Flanders

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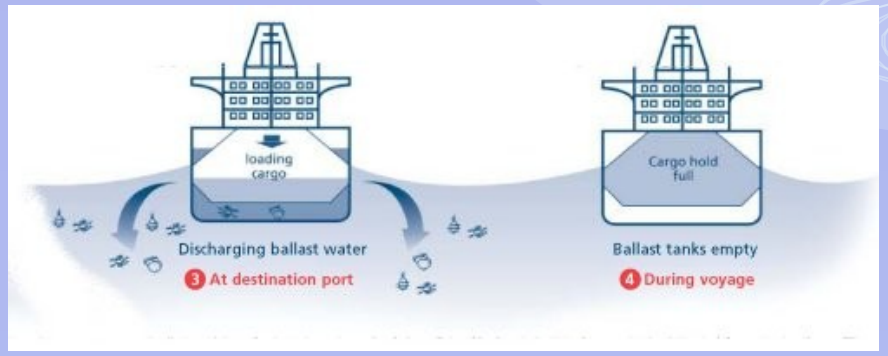
Introduction

Why are aquatic ecosystems vulnerable to invasions ?



- Ballast water
- Attachment to ships
- Interconnection of canals
- Vacant niches as consequence of pollution

Impact of invasive macroinvertebrat

- Ecological: decrease of diversity
  destabilization of ecosystem
- Economical: high costs for eradication
  decrease of yield in aquaculture

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Introduction pathways

Deliberatly introduced + aquaculture
Shipping (long distance)
Shipping (short distance) + interconnection of canals

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The process of invasion

Potential donor region

Transport (e.g. through ballast water of ships)

Introduction

Biotic and abiotic factors

Establishment & reproduction

Interactions between species (competition, predation, ...)

Dispersal & dominant behavior

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Overview of freshwater macrocrustaceans in Flanders

Family	Species	Origin	First occurence in Flanders
Gammaridae	*Gammarus pulex*		
	Gammarus fossarum	Southern Europe	1910
	Gammarus roeseli	Eastern Europe	1993
	Gammarus tigrinus	USA	1925
	Dikerogammarus haemobaphes	Ponto-Caspian	1997
	Dikerogammarus villosus	Ponto-Caspian	1927
	Echinogammarus berilloni	Iberian Peninsula	1992
	Echinogammarus ischnus	Ponto-Caspian	1990
Talitridae	*Orchestia cavimana*	Southern Europe	1992
Crangonyctidae	*Crangonyx pseudogracilis*	USA	?
Corophidae	*Chelicorophium curvispinum*	Ponto-Caspian	1895
Asellidae	*Asellus aquaticus*	Southern Europe	
	Proasellus coxalis	Southern Europe	2000
	Proasellus meridianus	Southern Europe	1999
Atyidae	*Atyaephyra desmaresti*	Europe	2005
Janiridae	*Jaera istri*	Ponto-Caspian	1970
Mysidae	*Hemimysis anomala* *	Ponto-Caspian	1980
	Limnomysis benedeni	Ponto-Caspian	2007
Astacidae	*Astacus astacus* *		
	Astacus leptodactylus *	Ponto-Caspian	1977
Cambaridae	*Procambarus clarkii*	USA	1933
	Orconectes limosus	USA	
Grapsidae	*Eriocheir sinensis*	Southeast Asia	

red colour = alien species * = not recorded during recent

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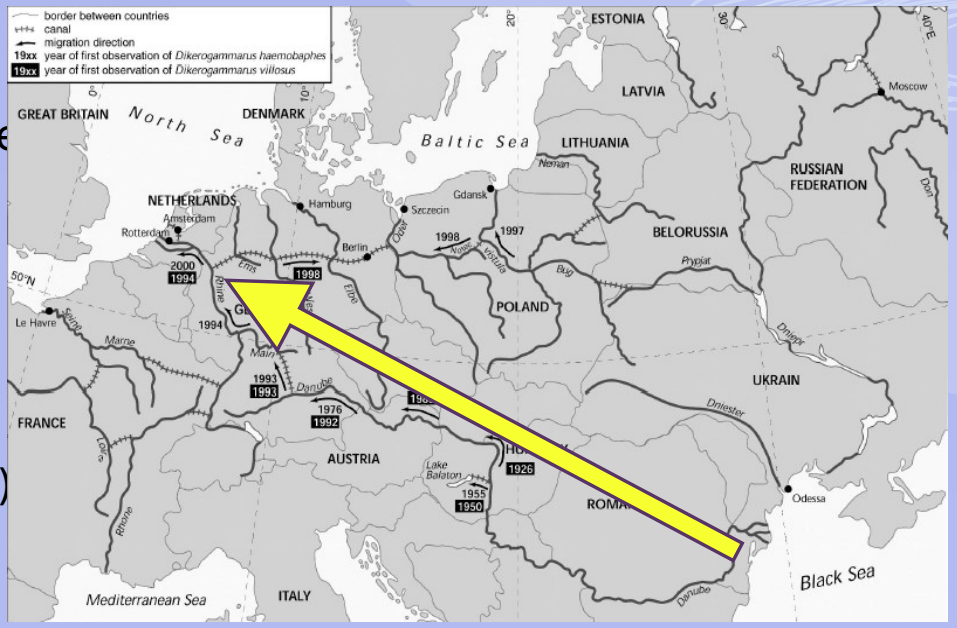
‘Killer shrimp’ - *Dikerogammarus villosus*

- Presence

- Native in Ponto-Caspian area

- Dispersal through Europe (also Flande



Dispersal of *D. villosus* in Europe *(Bij de Vaate et al. 2002)*

- Life characteristics

- Strong competitor

- Unequal sex-ratio (m♀re th♂n)

- Early sexual maturity

- High reproduction rate

- Diet

- Omnivore: filterfeeder, carnivore, detrivore

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Aims of the study

- Predation of several prey by *D. villosus* based on lab experiments

- Different substrates

- Different prey

- Substrate preference of *D. villosus* based on lab experiments

- Single species experiments

- In the presence of the native *Gammarus pulex*

- Use of decision trees to model the presence of *D. villosus* based on field observations

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Material & methods

Predator-prey interactions:

- Sand, gravel or no substrate
- *D. villosus* and five types of prey (experiment 1)
- *D. villosus* and one single type of prey (experiment 2-6)

Substrate preference:

- Sand, gravel, leaf surrogate or no substrate
- *D. villosus*, *G. pulex*, combination of both sp

Model (decision tree):

- WEKA software (J48 algorithm)
- Model reliability evaluation based on Correctly Classified Instances (>70 %) & *Kappa* (>0.4)

Material & methods

Predator and prey

Predator: *Dikerogammarus villosus*

Prey:

- *Asellus aquaticus*
- *Chironomus sp.*
- *Cloeon dipterum*
- *Gammarus pulex*
- *Crangonyx pseudogracilis*
- *Gammarus tigrinus*

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Predator: *Dikerogammarus villosus*

Prey: ***Asellus aquaticus***

Chironomus sp.

Cloeon dipterum

Gammarus pulex

Crangonyx pseudogracilis

Gammarus tigrinus

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Material & methods

Predator and prey

Predator: *Dikerogammarus villosus*

Prey: *Asellus aquaticus*

Chironomus species

Cloeon dipterum

Gammarus pulex

Crangonyx pseudogracilis

Gammarus tigrinus

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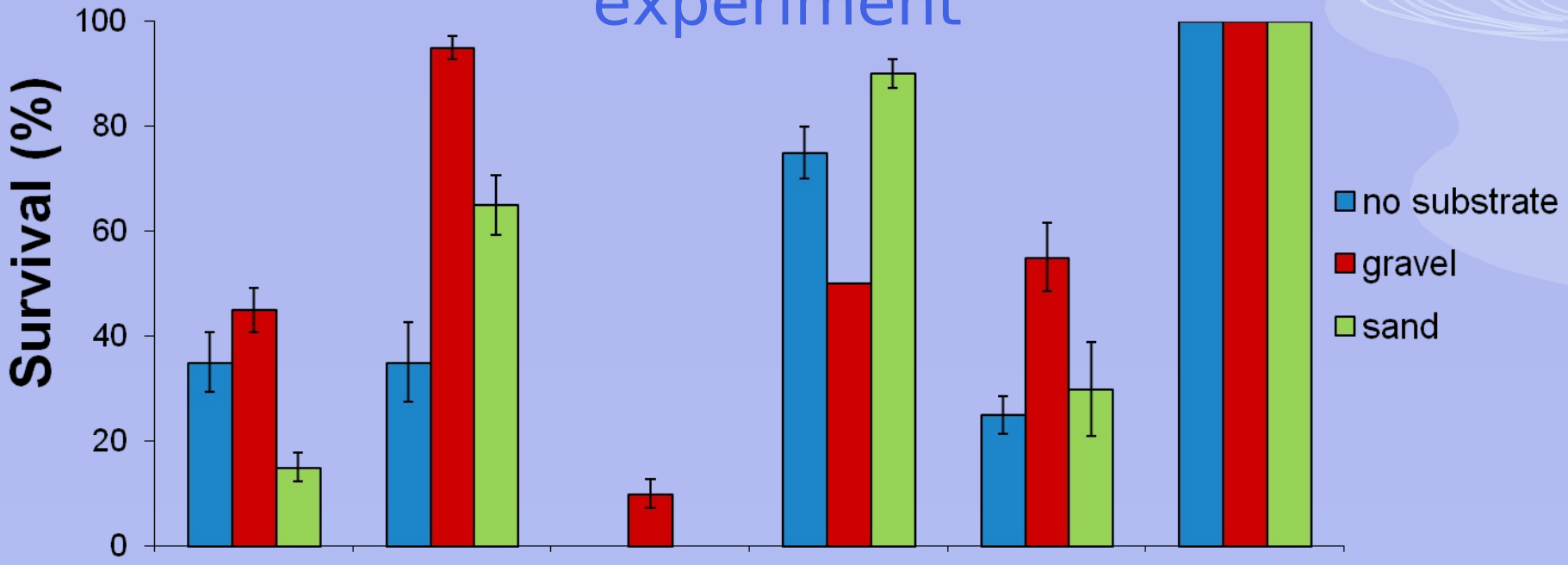
Results & discussion

Survival multiple prey experiment





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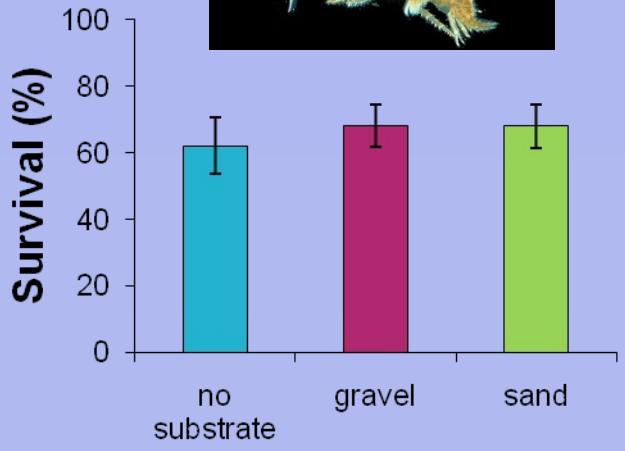
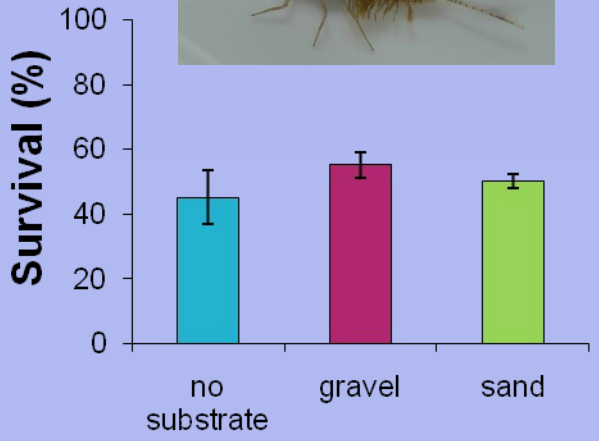
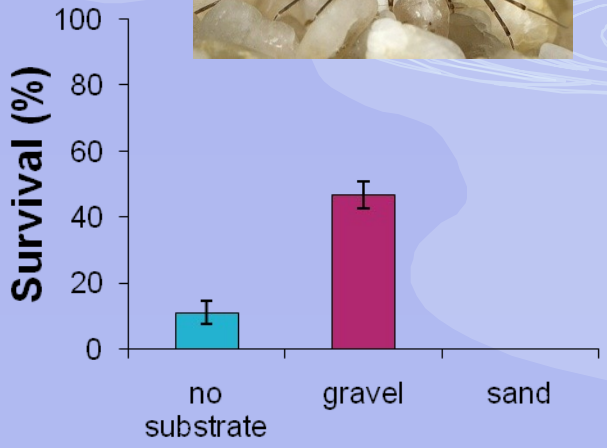
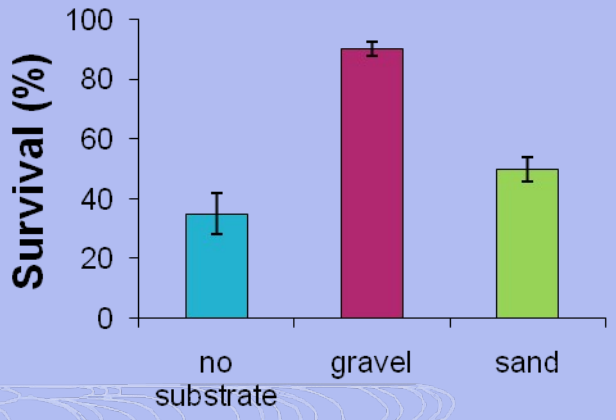
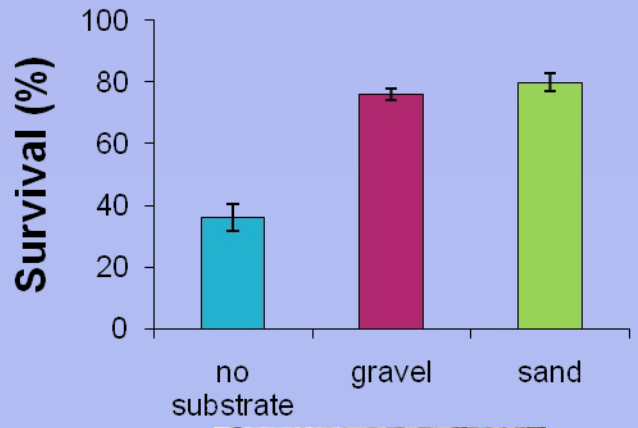
Survival single prey experiment











Species	*p*
G. pulex	0.68
C. dipterum	0.84
A. aquaticus	0.001
C. pseudogracilis	0.012
G. tigrinus	0.001

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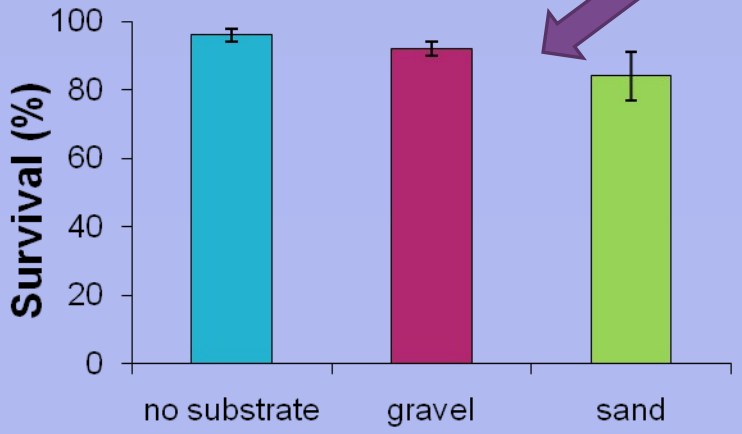
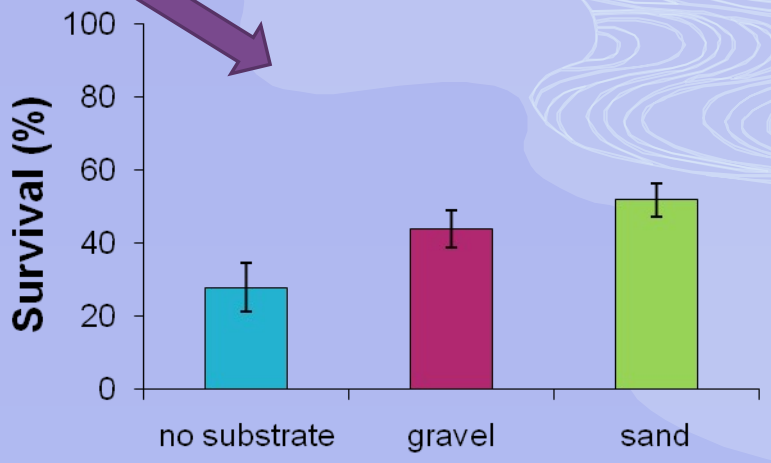
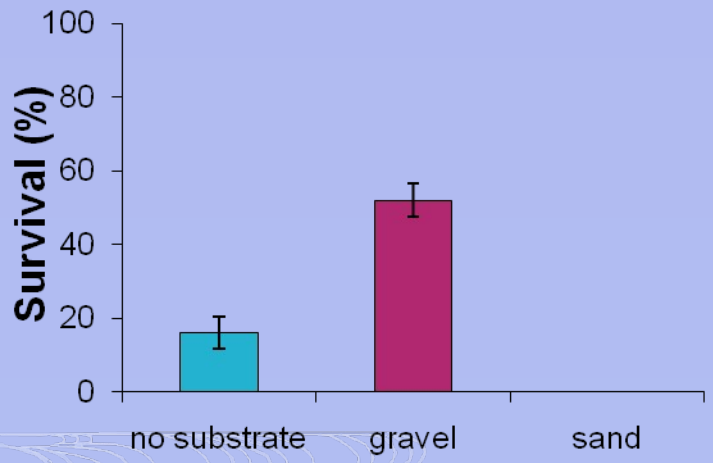
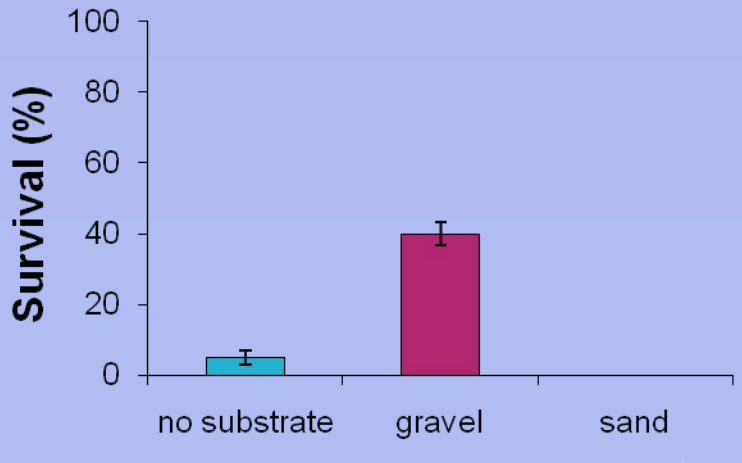
Survival large & small individuals









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Substrate preference: lab experiments

	Separate		Combination	
				
Sand (%)	0	0	0	0
Water (%)	30.0 ± 5.8	70.0 ± 8.8	16.7 ± 5.0	63.3 ± 8.4
Leaf surrogate (%)	6.7 ± 3.8	13.3 ± 1.9	13.3 ± 1.9	23.3 ± 6.9
Gravel (%)	63.3 ± 1.9	16.7 ± 1.9	70.0 ± 3.3	6.7 ± 1.9

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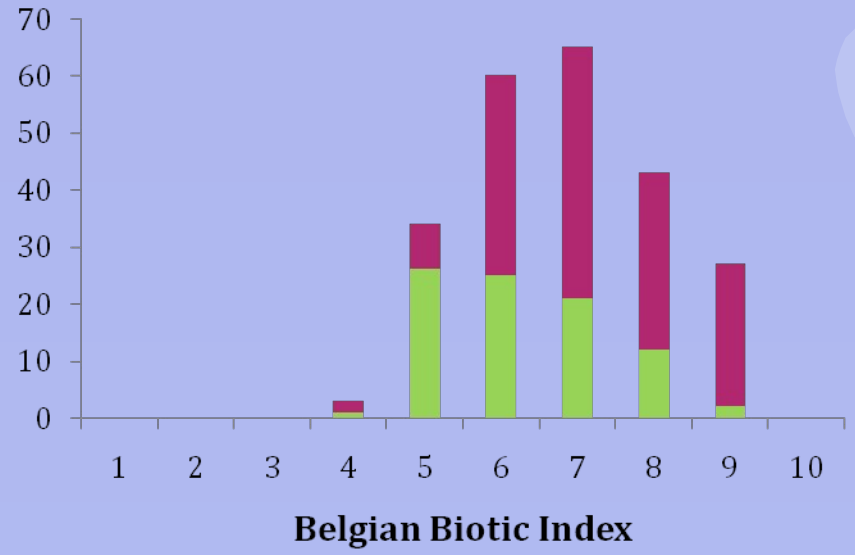
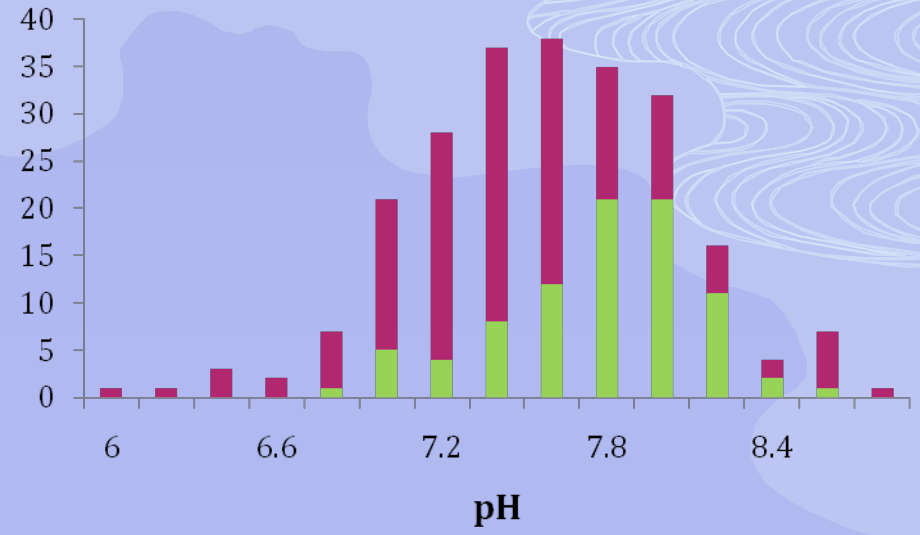
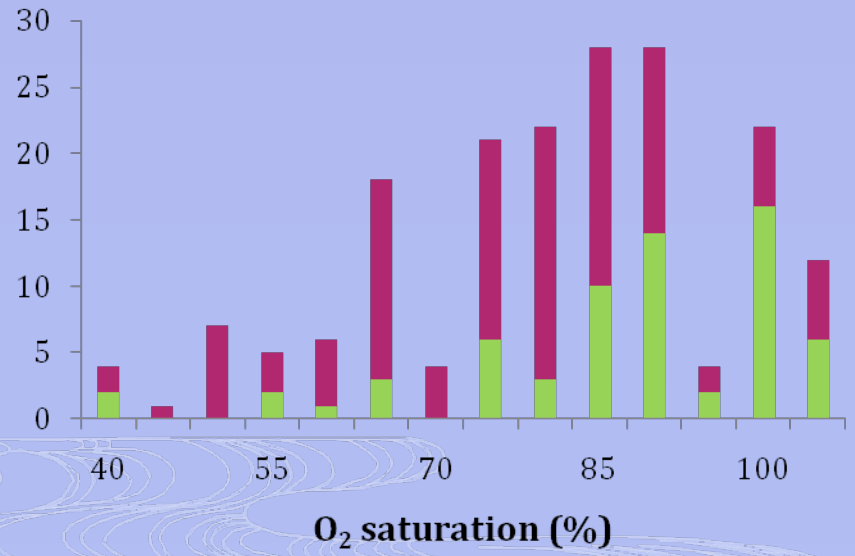
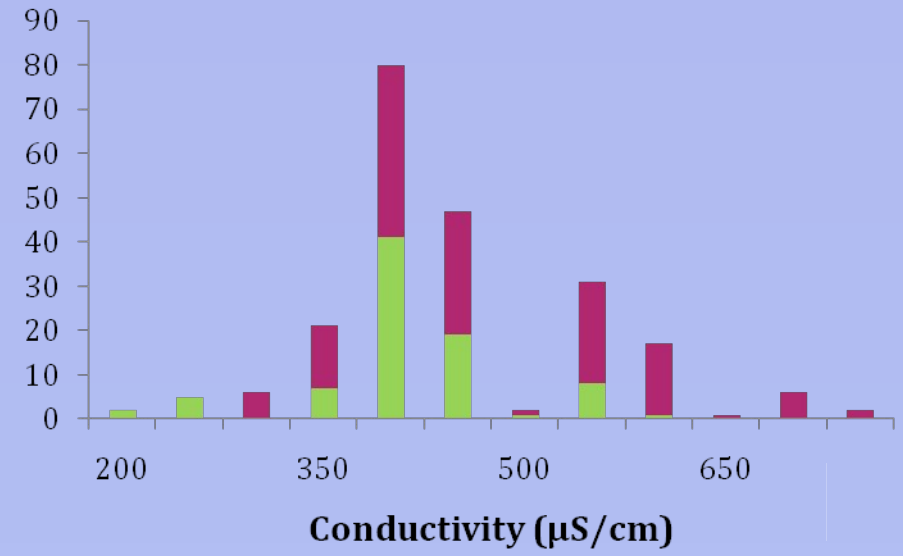
D. villosus ~ river characteristics





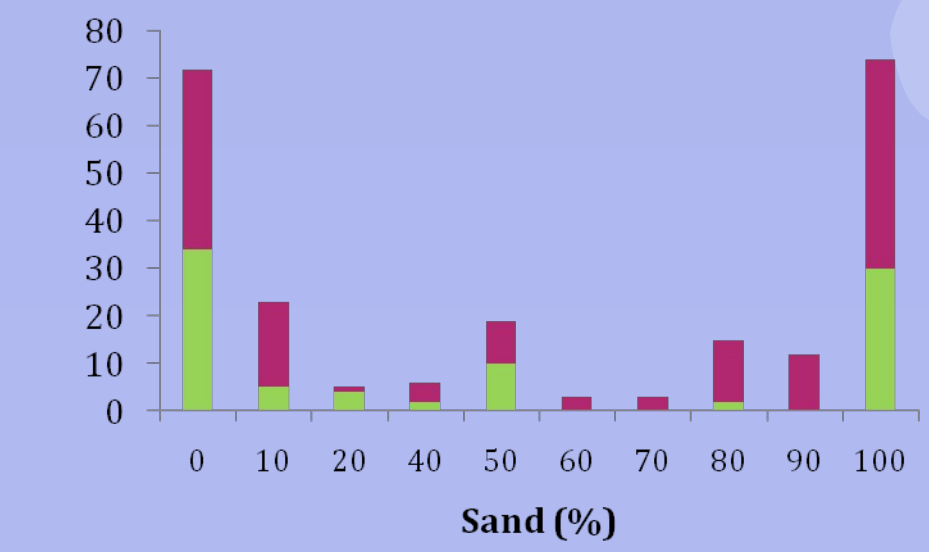


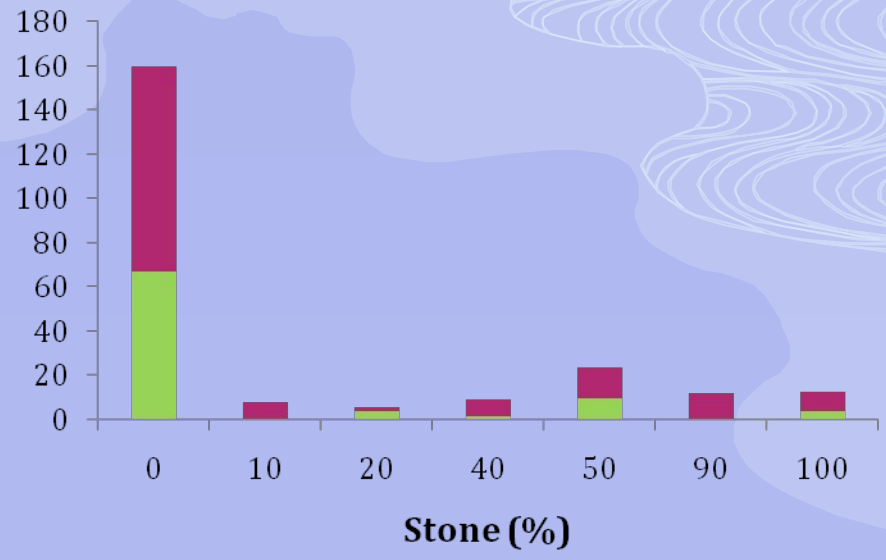


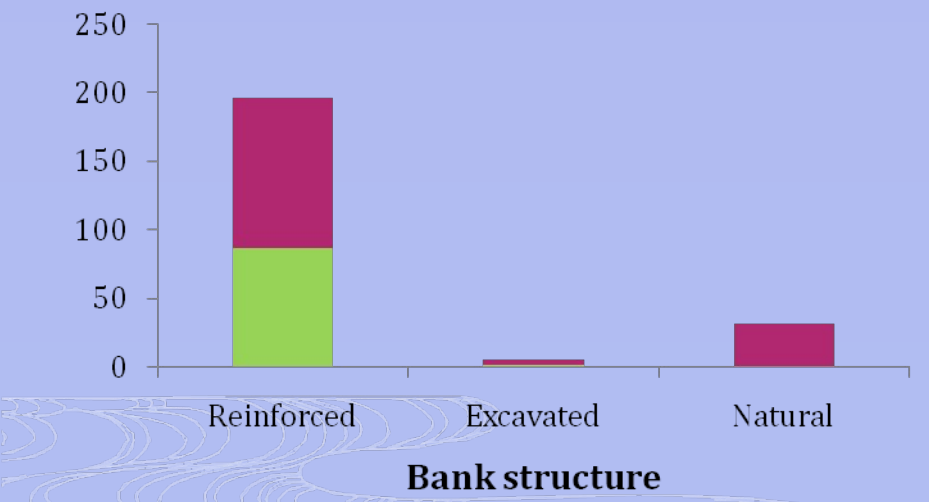
Present

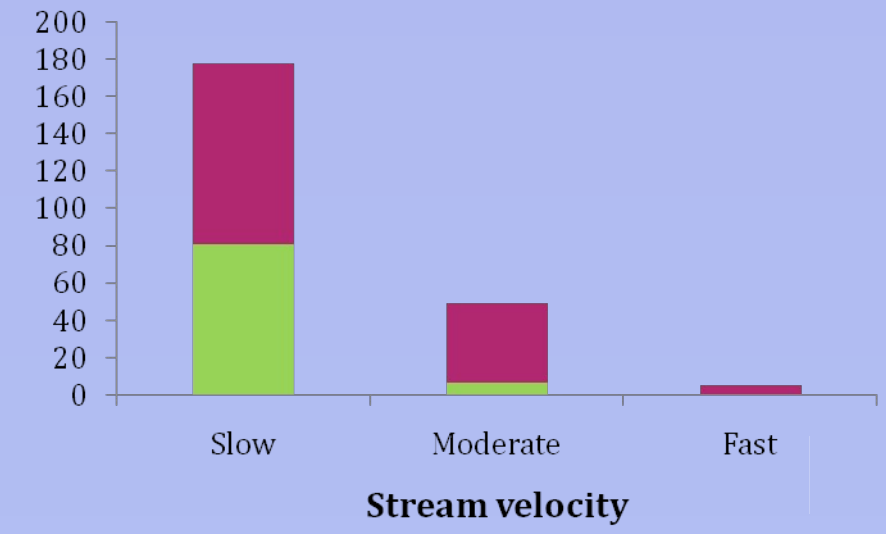
Absent

D. villosus ~ river characteristics









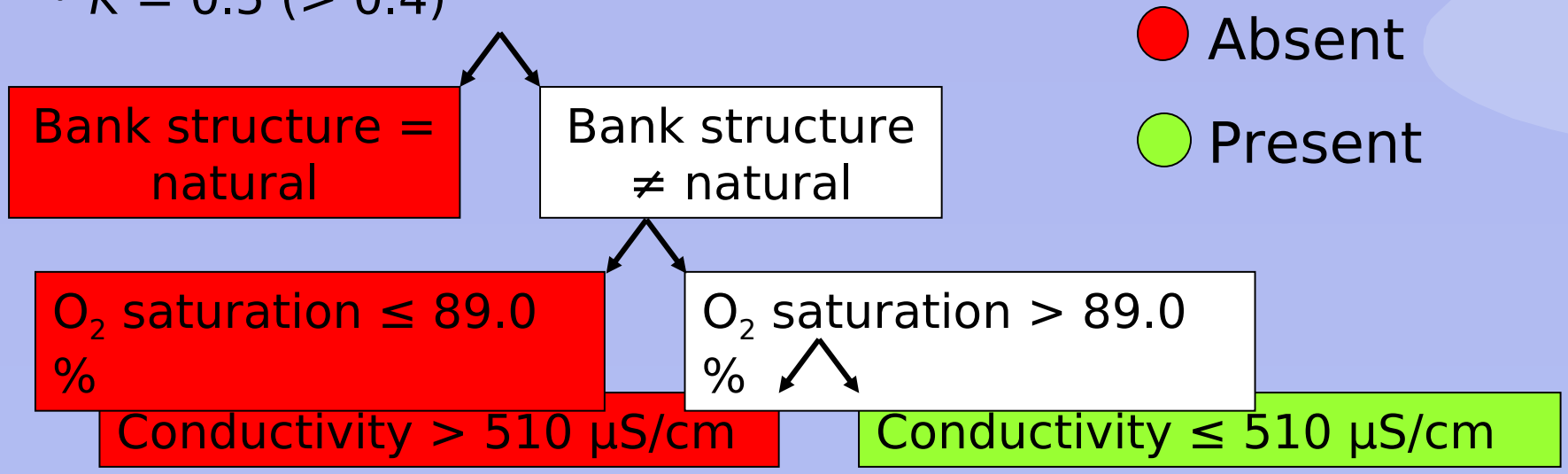
Present

Absent

Habitat suitability model *Dikerogammarus villosus*

Classification tree of *Dikerogammarus villosus* (PCF = 0.01)

- CCI = 77 % (> 70 %)
- K = 0.5 (> 0.4)



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Conclusions

- Predatory behavior towards native and exotic macroinvertebrates
- Wide range of prey of different size
- Competitively stronger than other macroinvertebrates
- Preference for stony substrates based on lab experiments
- Field observations and lab experiments can lead to different conclusions
- Heterogeneity, diversity and the interactions between species are crucial
- Based on the habitat suitability model, *D. villosus* can be found canals with a good chemical water quality

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Thank you for your attention !
Questions ?