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Using ecosystem resilience to enhance invasion resistance

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Background > effectiveness of response

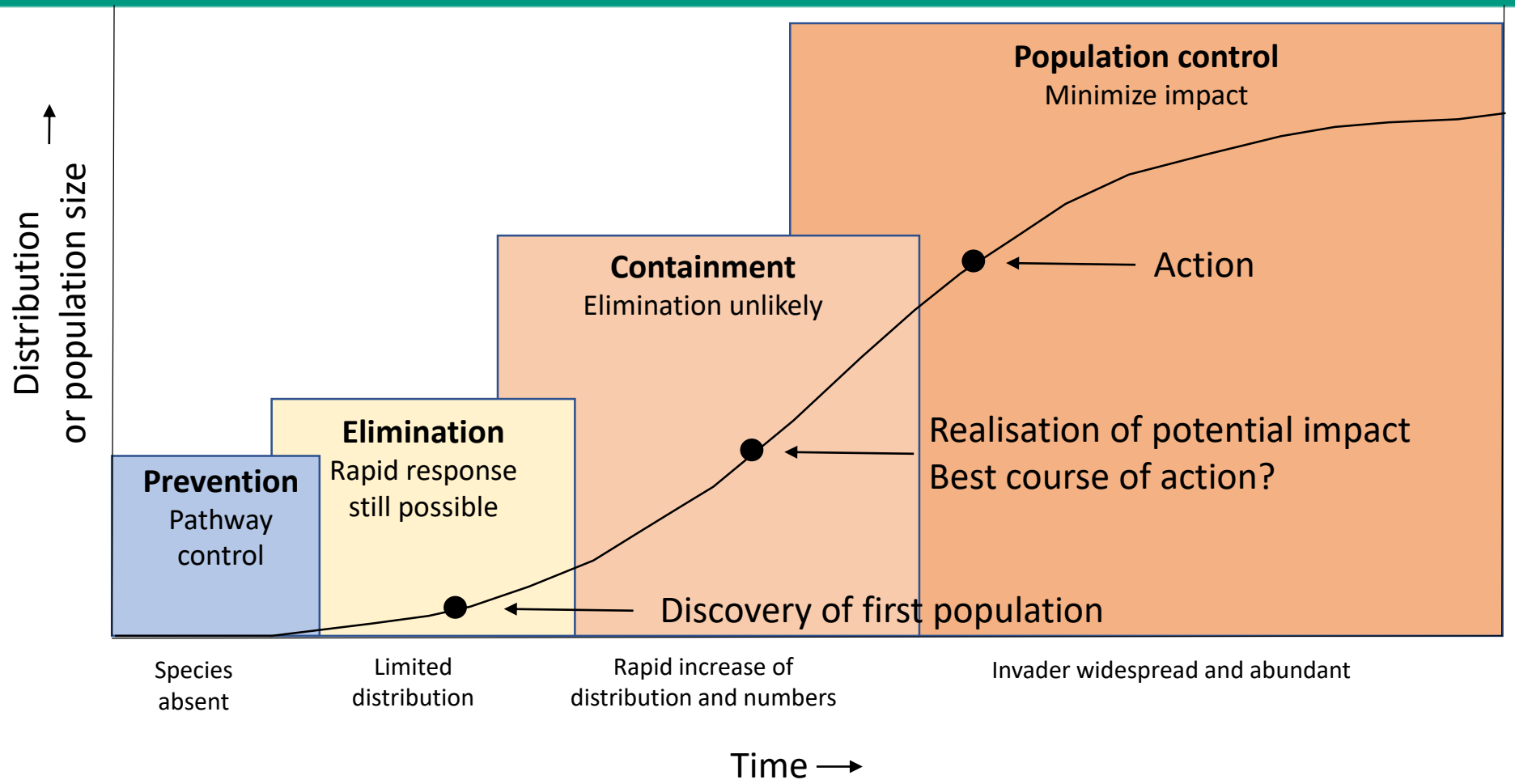



	Effectivity of measures for elimination		
	High	Moderate	Low
American Bullfrog	1	0	9
Yellow-legged Asian hornet	1 *	1	2
Various aquatic turtles	0	1	6
Chinese mitten crab	0	0	6
Various crayfish	3 ***	1	10
Kudzu	1	3	4
Topmouth gudgeon	2 *	0	5
African sacred ibis	1	3	1
Reeves's muntjac	2	1	0
Common raccoon	0	2	3
Siberian chipmunk	3 **	1	1

*: effective, but not legal

De Hoop et al. (2016) Maatregelen voor het elimineren en beheersen van invasieve exoten van EU-belang in Nederland

Background > increase in IAS

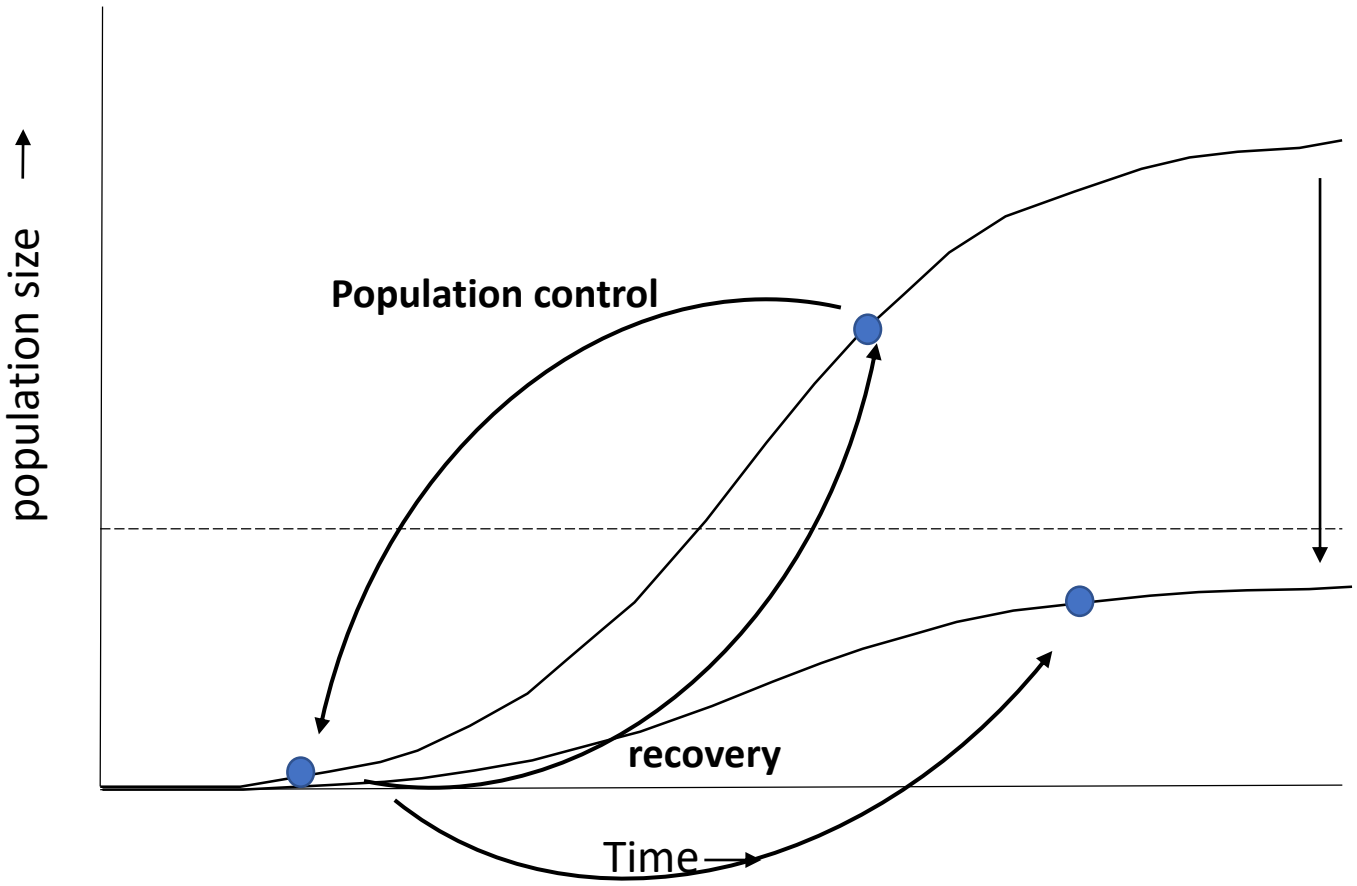


470 species with limited distribution (2012) > 134 abundant in 2022

Van Riel, M. C., H. Van Kleef, J. Van der Loop, L. Van Veenhuisen, B. Odé, P. Lemmers, R. Creemers, M. Schutter, K. Van Veen, A. Van Kleunen, M. Gilbert, and T. Van der Have. 2023. Horizonscan voor nieuwe invasieve uitheemse soorten in Nederland, update 2023. NEC-E.

Background > increase in IAS



Lower carrying capacity

lower recruitment, higher mortality > biotic resistance

Acceptable impact

Background > understanding invasiveness



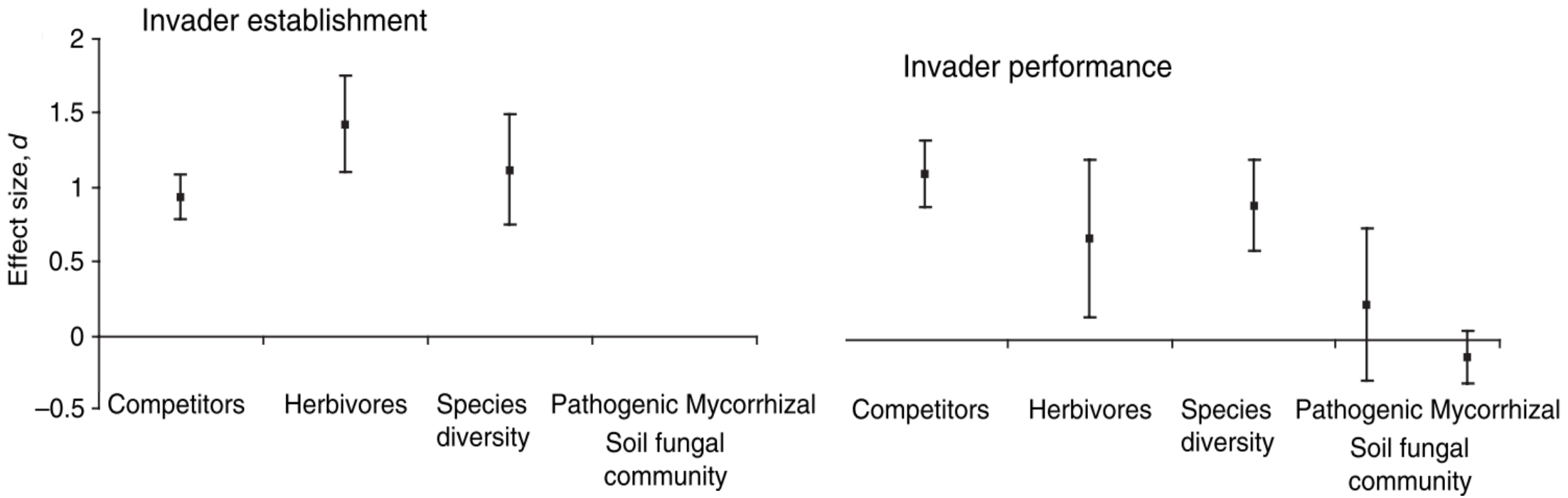

Vulnerability of disturbed ecosystems

Photos: Wikimedia commons, G. van Duinen, H. van Kleef

Background > understanding invasiveness



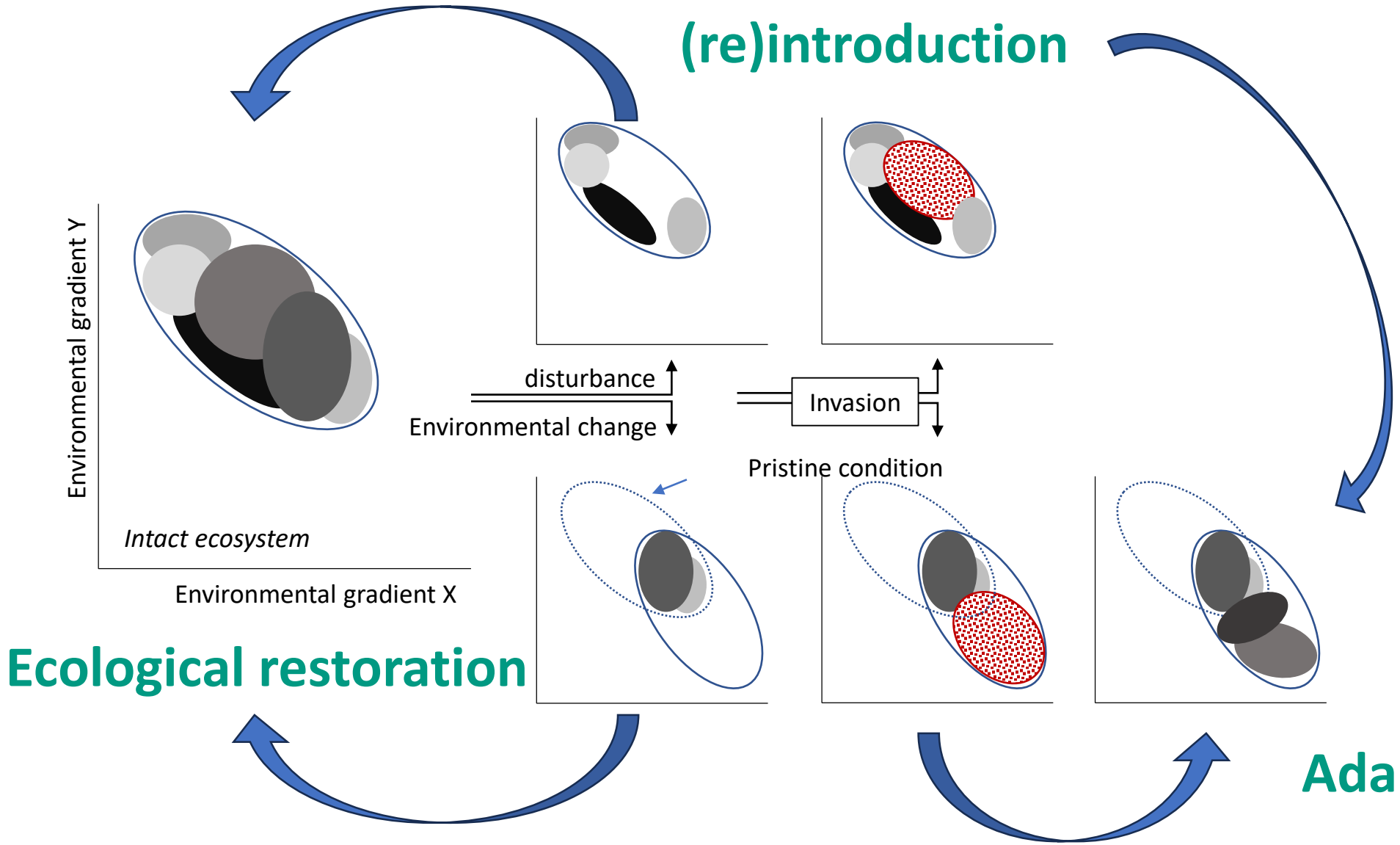

Lack of competition or predation



Levine et al. (2004). A meta-analysis of biotic resistance to exotic plant invasions. Ecology Letters 7: 975-989

Background > understanding invasiveness



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- demonstrate the effectiveness of invasive alien species (IAS) management based on improving ecosystem resilience
- promote and replicate the application of the IAS ecosystem resilience approach at ecosystem scale
- transfer of ecosystem resilience approach (ERA) to other invasive species and ecosystems

Duration: 2020 –2027

Partners: Bosgroep Zuid Nederland
Stichting Bargerveen

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Demonstration of ERA

Lepomis gibbosus	- 5 ha wetland
Crassula helmsii	- 3 ha wetland
Prunus serotina	- 156 ha forest
Reynoutria spp.	- 245 ha stream valley
	- 0,3 ha road verges

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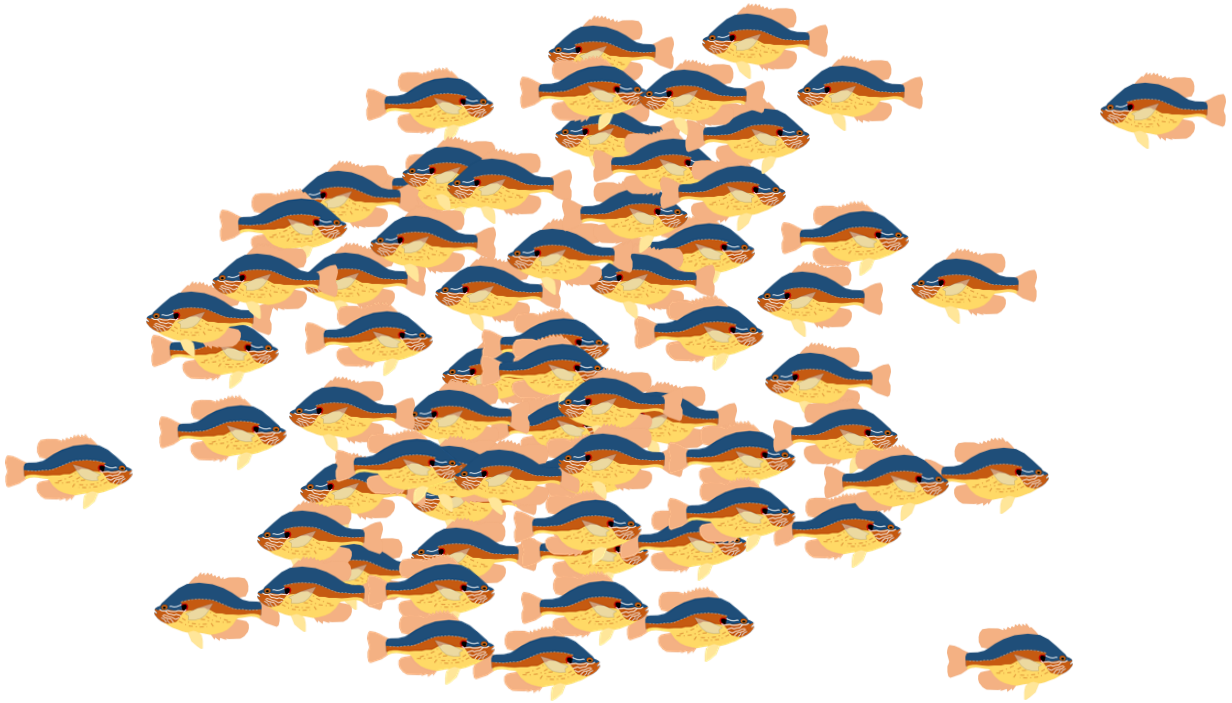
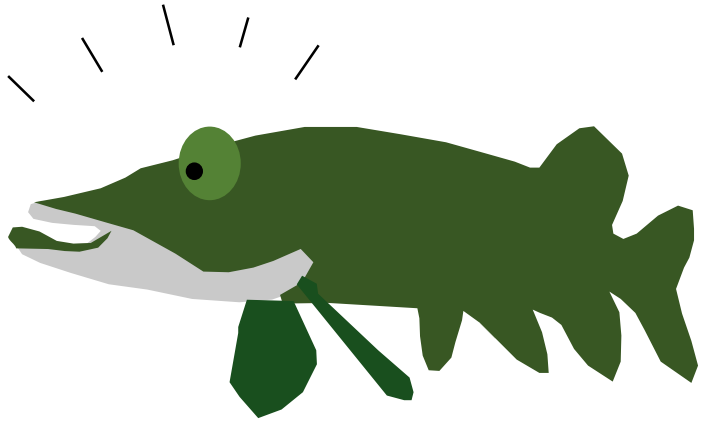
Practical concept




Step 1. reduce invader numbers (optional)





Step 2. restore abiotic conditions

Step 3. restore biotic conditions

Step 4. After care

Pumpkinseed sunfish in wetlands

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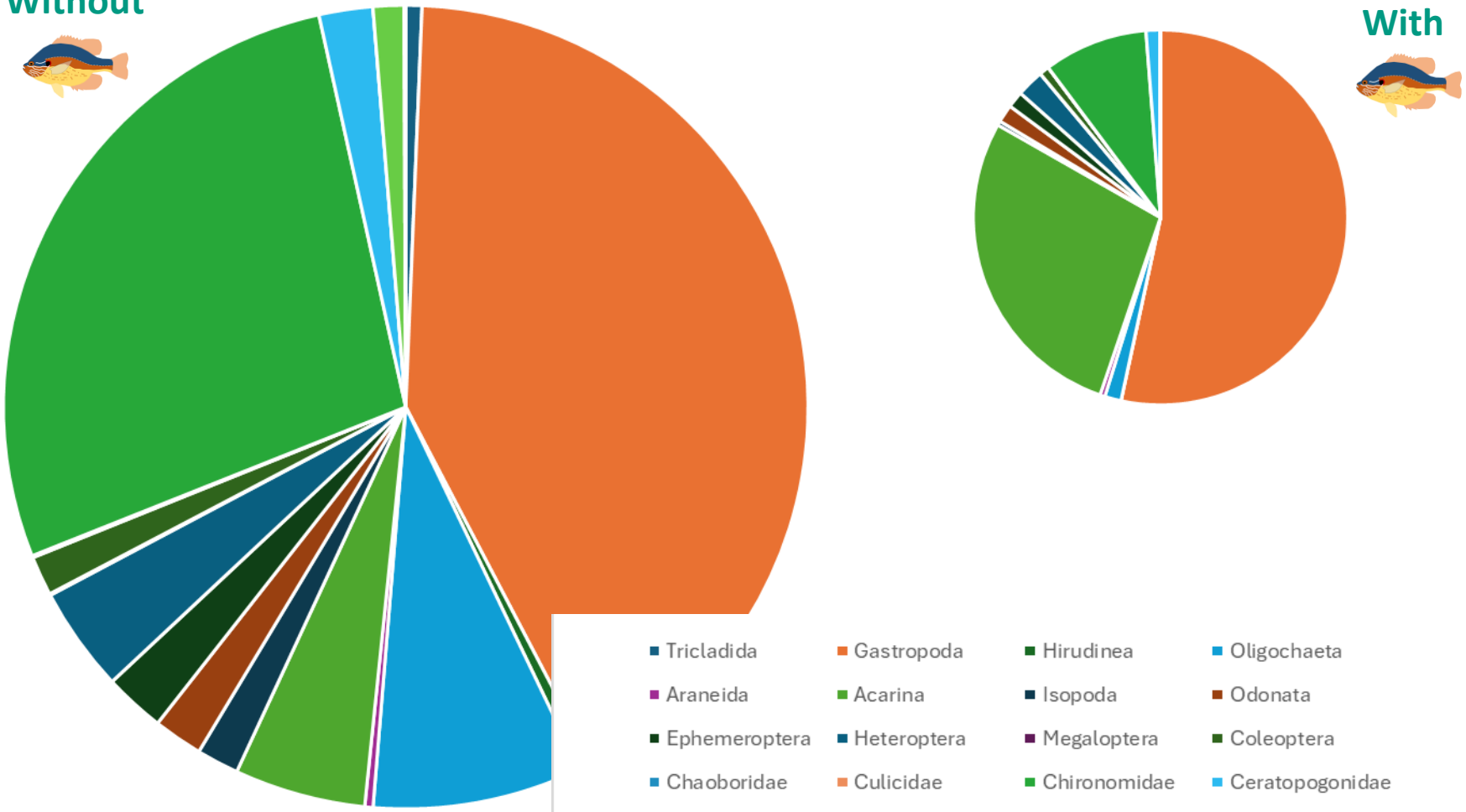
Without

With



Pumpkinseed sunfish in wetlands

	Removal Detritus	Newly created	Sod cutting of shore	No management
Abundant	100%	50%	25%	20%
Frequent		50%		
Rare			75%	80%
N	10	8	4	5

Van Kleef, H., G. Van der Velde, R. Leuven, and H. Esselink. 2008. Pumpkinseed sunfish (Lepomis gibbosus) invasions facilitated by introductions and nature management strongly reduce macroinvertebrate abundance in isolated water bodies. Biological Invasions **10:1481-1490.**

Pumpkinseed sunfish in wetlands

Photos: J. van Bussel; H. van Kleef

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Pumpkinseed sunfish in wetlands

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Difficulties

Very few

Warm summers > high PS recruitment

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Pumpkinseed sunfish in wetlands

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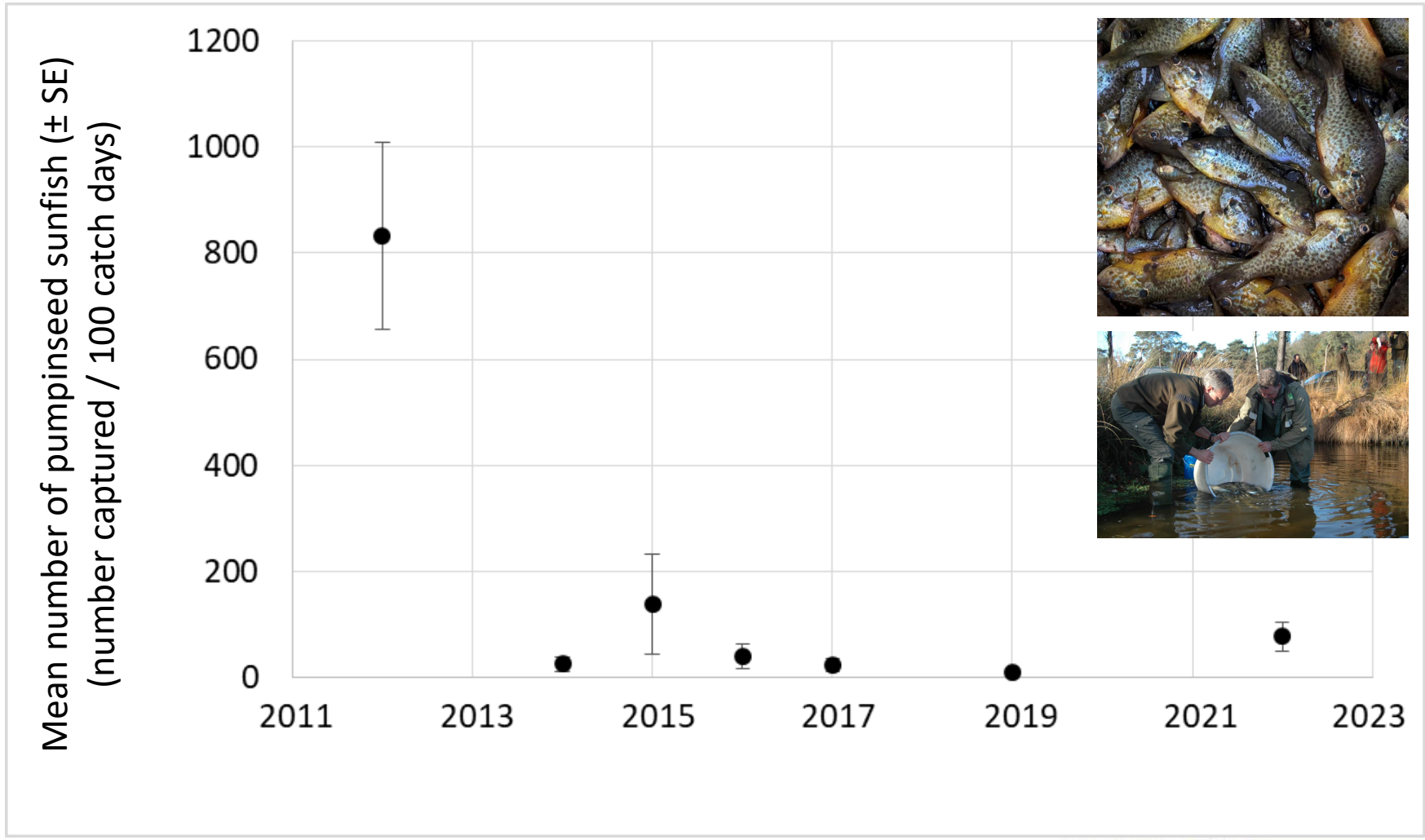

Pumpkinseed sunfish in wetlands

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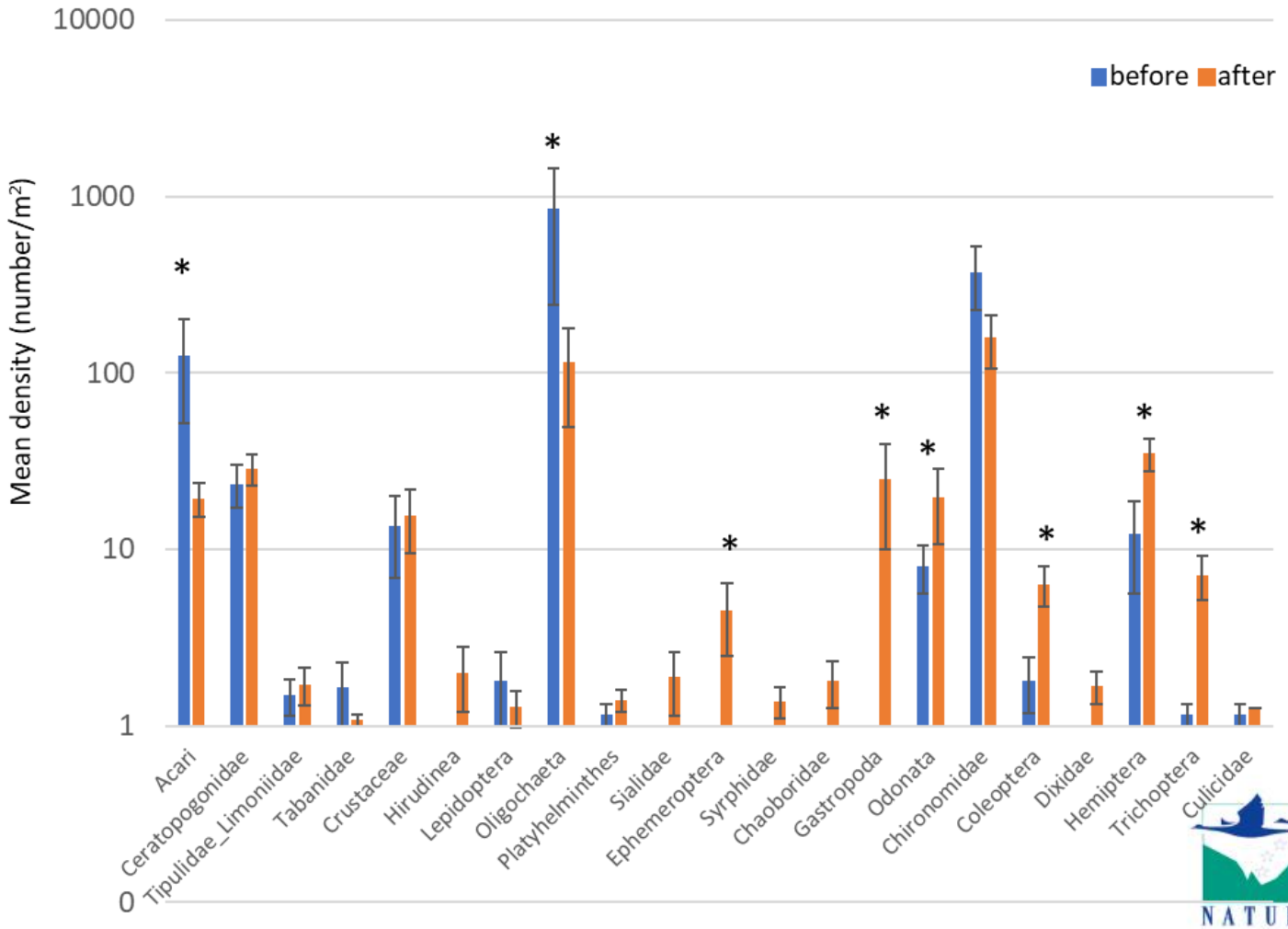

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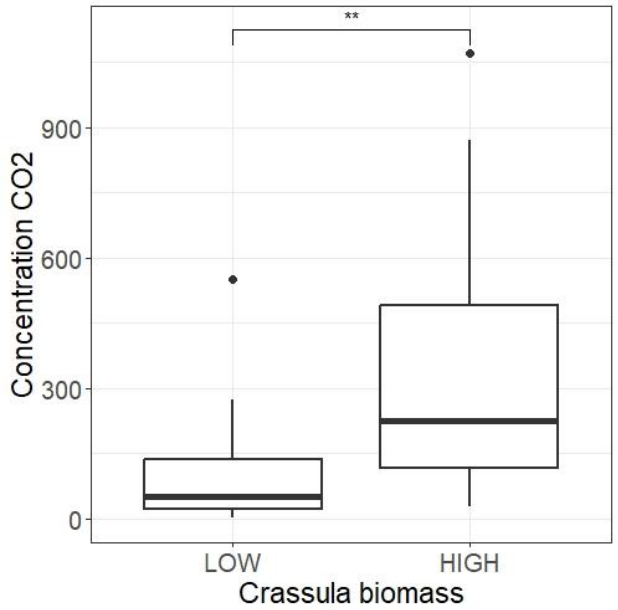
C. Helmsii in wetlands

Photo: H. van Kleef

C. Helmsii in wetlands



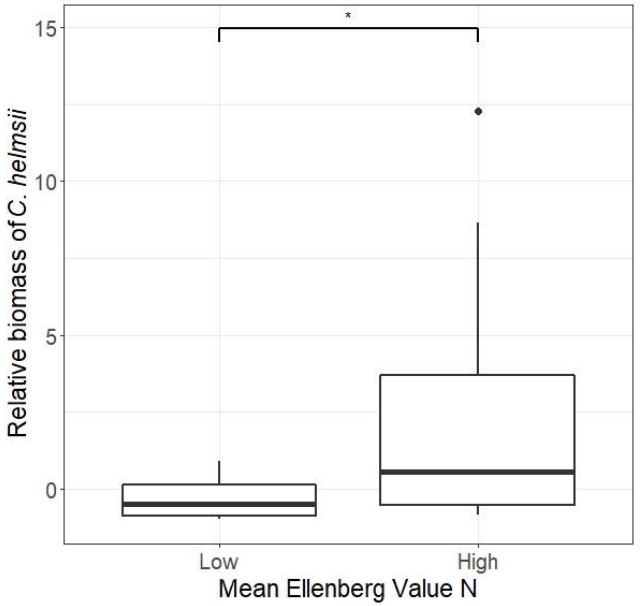


Photo: H. van Kleef

Van Kleef, H. H., J. M. M. Van der Loop, and L. Van Veenhuisen. 2024. Low Resource Competition, Availability of Nutrients and Water Level Fluctuations Facilitate Invasions of Australian Swamp Stonecrop (Crassula helmsii). Diversity **16:172.**

C. Helmsii in wetlands

Photos: J. van der Loop, M. van de Loo, H. van Kleef

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C. Helmsii in wetlands

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Difficulties

Acquire plants

Sufficient reduction of C. helmsii

Sufficient reduction of nutrients

Dry - wet summers

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C. Helmsii in wetlands

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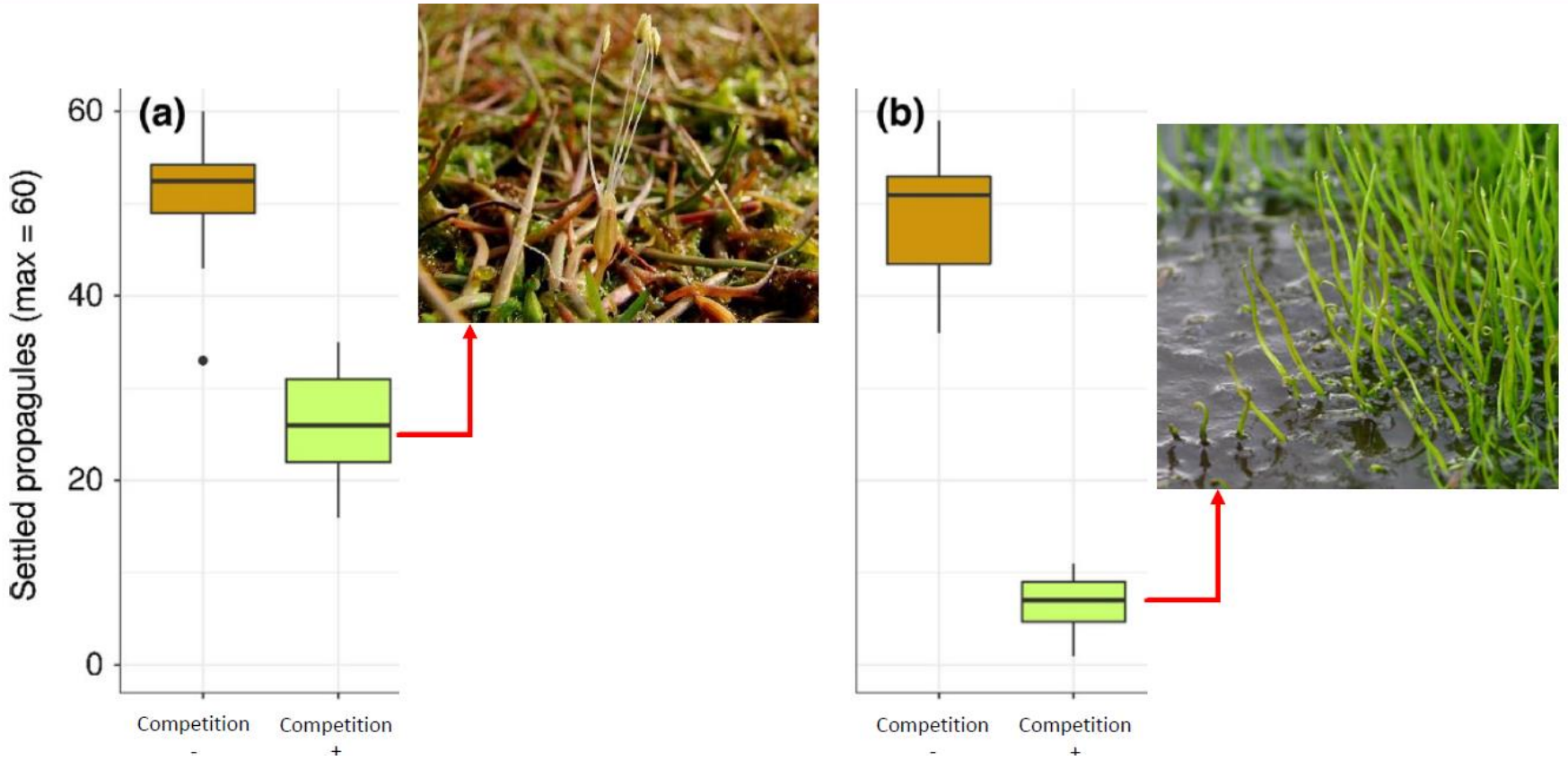

Bron: Van der Loop, J. M., Tjampens, J., Vogels, J. J., van Kleef, H. H., Lamers, L. P., & Leuven, R. S. (2020). Reducing nutrient availability and enhancing biotic resistance limits settlement and growth of the invasive Australian swamp stonecrop (Crassula helmsii). *Biological Invasions 22*(11): 3391-3402

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C. Helmsii in wetlands

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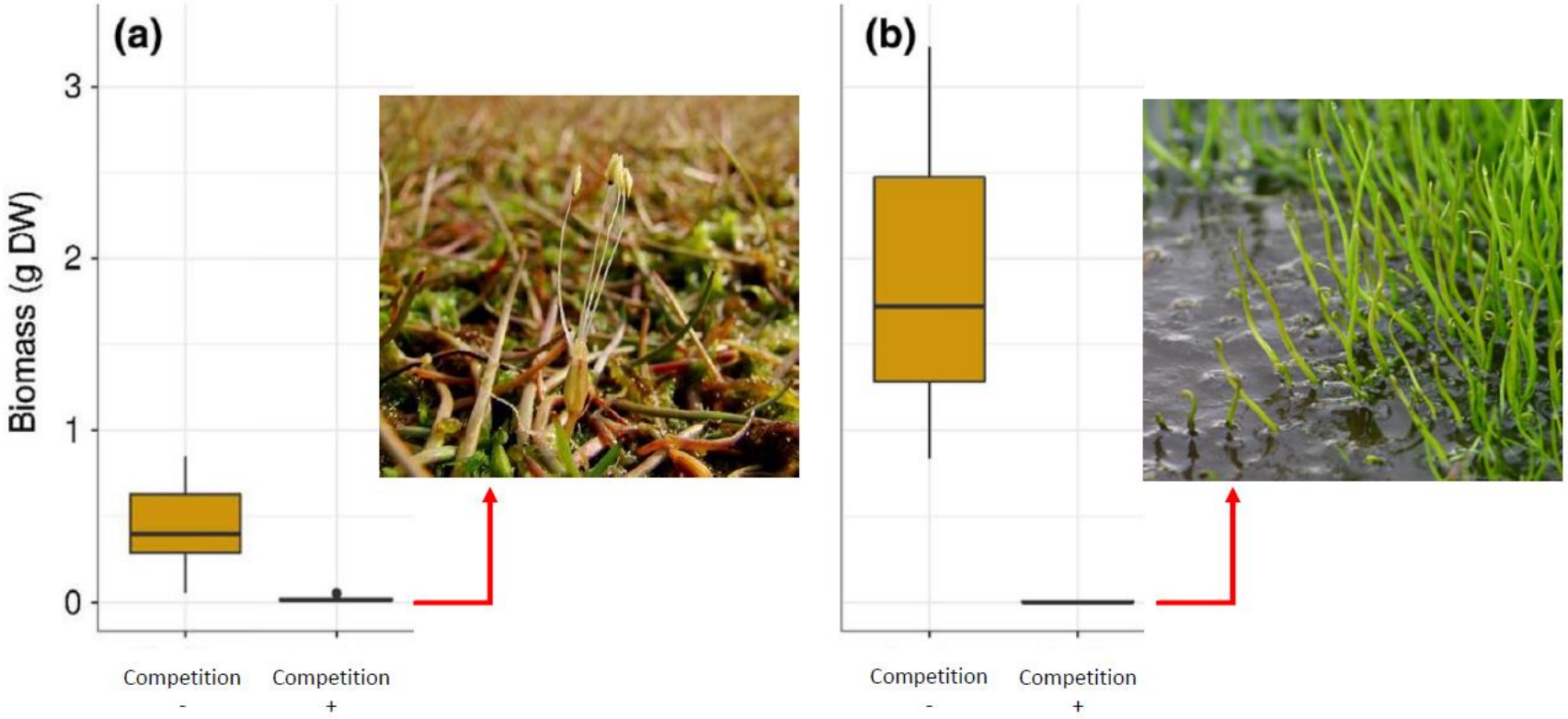

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Replication




Species	Ecosystem	Total area	Number of sites
Prunus serotina	forest	1921	13
Reynoutria	stream valleys	140	1
Reynoutria	road verges	3	1
Crassula	wetlands	20	9
Pumpkinseed	wetlands	1,7	1
Total		2085,7	25
Target	2025	500	
Target	2027	1740	

Transfer




		Design	Research	Application
Mosses				
Heath star moss	*Campylopus introflexus*	x	x	x
Trees				
Box elder	*Acer negundo*	x		x
Tree of heaven	*Ailanthus altissima*	x		x
Blue gum	*Eucalyptus globulus*	x		x
Eastern American black walnut	*Juglans nigra*	x		x
Monterey pine	*Pinus radiata*	x		x
Black locust	*Robinia pseudoacacia*	x		x
Northern red oak	*Quercus rubra*	x		x
Herbacious plants				
Floating marshpennywort	*Hydrocotyle ranunculoides*	x		
False pimpernel	*Lindernia dubia*	x	x	
Water primrose	*Ludwigia grandiflora*	x		
Garden lupine	*Lupinus polyphyllus*	x	x	
Narrow-leaved ragwort	*Senecio inaequidens*	x	x	
Fauna				
Virile crayfish	*Faxonius virilis*	x	x	x
Red Swamp Crayfish	*Procambarus clarkii*	x	x	x
Signal crayfish	*Pacifastacus leniusculus*	x	x	x

Photos: B. Nyssen

Key messages




- Eradication of invasive species only effective if combined with measures to restore or improving ecosystem resilience
- Restoring ecosystem resilience can be achieved by ecological restoration and (re)introduction of native species
- Invest in applied research on improving ecosystem resilience for management of invasive species

LIFE Resilias is financed by

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Provincie Noord-Brabant

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Ministerie van Infrastructuur en Waterstaat

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Evides waterbedrijf