The impact of aquatic alien plants and crayfish control methods on ecosystem services

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Biodiversity.be

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Gembloux
Agro-Bio Tech

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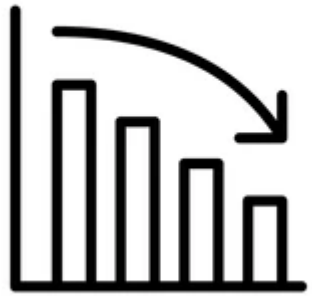
RIPARIAS

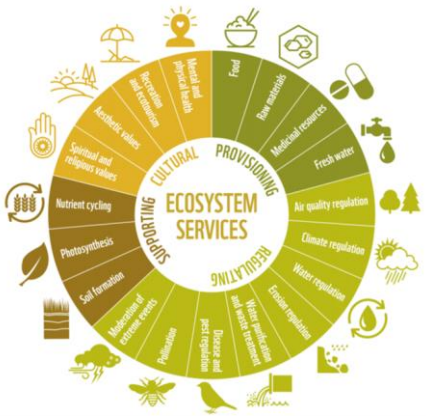
Reaching Integrated and Prompt Action in Response to Invasive Alien Species

Controlling invasive species: where and how ?

LIFE RIPARIAS aims at improving **priorization** in IAS control → where and how to manage?

Mainly targets **EU-listed species**




ECOSYSTEM SERVICES
PROVISIONING
REGULATING
CULTURAL
SUPPORTING
Food
Raw materials
Medicinal resources
Fresh water
Air quality regulation
Climate regulation
Water regulation
Erosion regulation
Water purification and waste treatment
Disease and pest regulation
Pollination
Moderation of extreme events
Soil formation
Photosynthesis
Nutrient cycling
Spiritual and religious values
Aesthetic values
Recreation and ecotourism
Mental and physical health

RIPARIAS

Assess the impacts of control methods on ecosystem services?

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Assess the impacts of control methods on ecosystem services?

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Assessing the impact of control methods on ecosystem services - Workflow

Assessing the impact of control methods on ecosystem services - Workflow

Selection of the control methods

Adaptation of the conceptual framework

Expert assessment

Analyses

Matrix

To include in a decision-support tool

Assessing the impact of control methods on ecosystem services - Workflow

Selection of the control methods

Scientific literature review (SCOPUS)

→ 358 record (species x technique) for plants and 181 for crayfish

“Grey literature” additional review (CABI, IUCN, LIFE, field guides, etc.)

→ 90+ records for plants and 55 for crayfish

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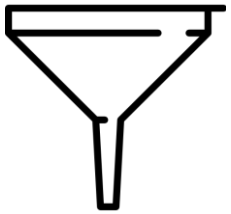

Synthesis
(eradication-control-ineffective)

Discussion with experts
→ Efficiency (eradication > control)
→ Actual feasibility
→ Acceptability

List of control methods

Selection of the control methods

Methods	Description	Duration	What's expected?	Species example	
Light deprivation : floating cover	Shades sheeting floating over the weed mass to prevent light reaching the target infestation, thereby limiting plant growth and preventing flower and seed production. Manual aftercare	4 month	Eradication	*Ludwigia spp., Cabomba caroliniana*	
Light deprivation : benthic cover	Benthic blankets sit over the substrate at the bottom of a water body, both compressing aquatic plants and blocking out sunlight. Manual aftercare.	4 month	Eradication	*Lagarosiphon major, Cabomba caroliniana, Myriophyllum aquaticum, M. heterophyllum*	
Manual removal: hand pulling	Manually pulling plants out by the roots	One operation or more	Eradication with small population otherwise control	*Ludwigia spp., Lagarosiphon major, Cabomba caroliniana, Myriophyllum heterophyllum, M. aquaticum, Hydrocotyle ranunculoides*	
Mechanical removal: aquatic/floating machines	Mechanical uprooting and collection of plants with floating machines. Manual aftercare	One operation and manual aftercare (3 to 4 years)	Eradication or good level of control	*Ludwigia spp., Hydrocotyle ranunculoides, Myriophyllum aquaticum, M. heterophyllum*	

Methods	Description	Duration	What's expected?	Species example	
Mechanical removal: terrestrial machines (aquatic species)	Mechanical uprooting and collection of plants with terrestrials machines from the banks. Manual aftercare	One operation and manual aftercare (3 to 4 years)	Eradication or good level of control	*Hydrocotyle ranunculoides, Ludwigia spp., Myriophyllum aquaticum, M. heterophyllum*	
Biological control agent: grass carp	Introduction of sterile fish into a closed and controlled environment to prevent fish from escaping	2 to 3 years and then fish removed from the pond	Control	*Cabomba caroliniana, Lagarosiphon major, Hydrocotyle ranunculoides*	
Substrate removal: mechanical dredging	To dredge the bottom sediments with roots, rhizomes or any other part of the invasive plant targeted. Often preceded by a drying out.	Twice a year for 2 to 3 years. Manual aftercare	Eradication or good level of control	*Ludwigia spp., Cabomba caroliniana, Myriophyllum aquaticum*	
Draining and filling a pond/ destruction of habitat	Filling carried out with a shovel or using machines	Permanent	Eradication	*Cabomba caroliniana, Lagarosiphon major, Hydrocotyle ranunculoides, Ludwigia spp., Myriophyllum aquaticum, Elodea spp.*	

Selection of the control methods

Methods	Description	Duration	What's expected?	Species example	
Baited and unbaited trapping	Pyramid traps, conical traps, mesh traps... baited or unbaited. Very few catches of other organisms (newts, fish, etc.)	Variable	Control	*Faxonius virilis, Procambarus virginalis, Procambarus clarkii*	
Seine fishing/ seining	Nylon seine net to catch crayfish during the day. All caught fish are released	One operation or more	Control	*Faxonius virilis, Procambarus virginalis, Procambarus clarkii*	
Temporary drainage	Ponds are drained allowing water to pour out of water systems or by active pumping; A barrier is installed around the drained ponds to avoid crayfish emigration and facilitate hand capture after drainage. Liming of crayfish galleries	2 years or more	Eradication	*Faxonius virilis, Procambarus virginalis, Procambarus clarkii*	
Biological control agent: indigenous predatory fish	Introduction of pike, perche, eels…	Permanent	Control or eradication (with trapping)	*Faxonius virilis, Procambarus virginalis, Procambarus clarkii*	

Assessing the impact of control methods on ecosystem services - Workflow

Adaptation of the conceptual framework

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Mapping ecosystem service supply, demand and budgets

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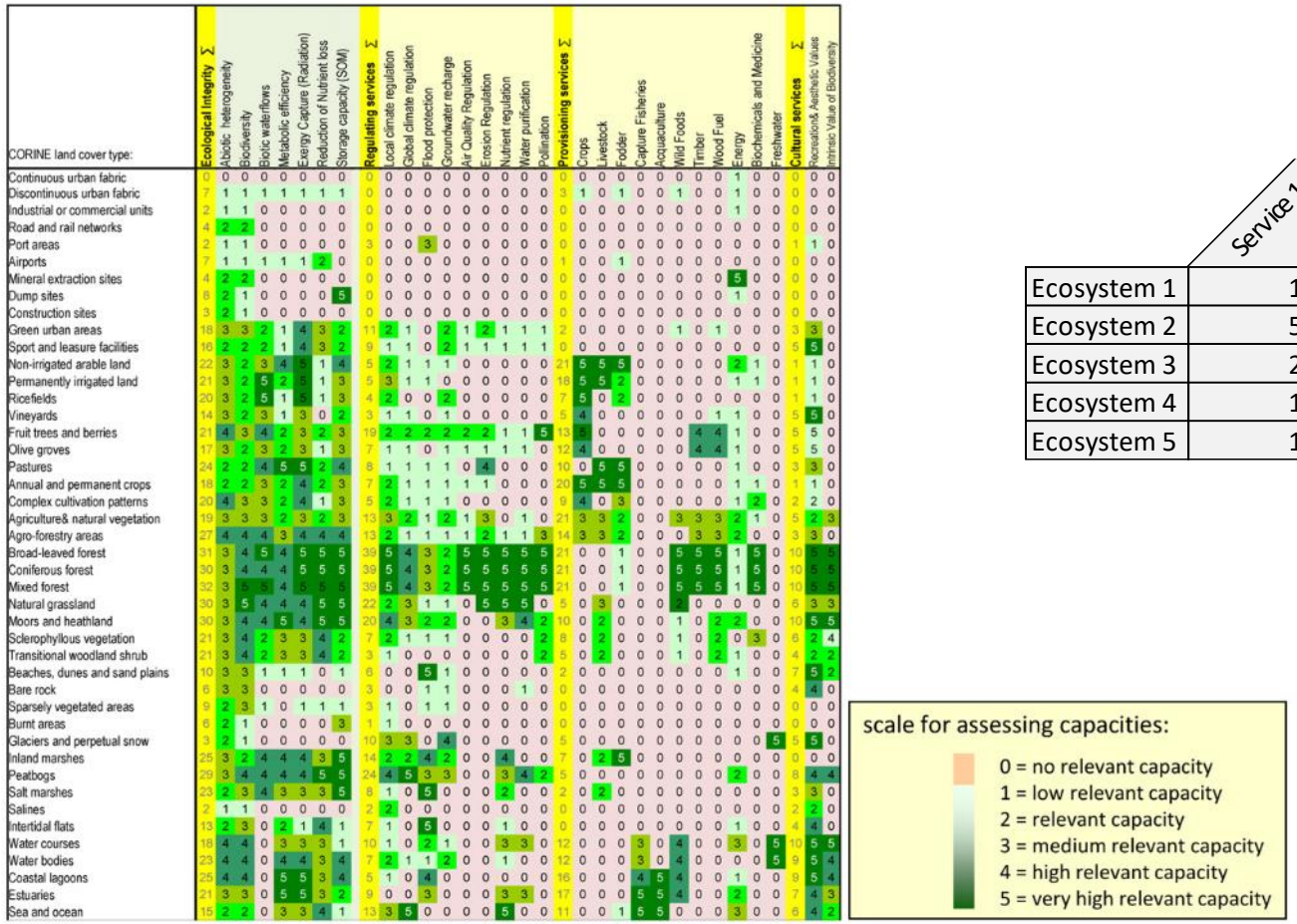

	Service 1	Service 2	Service 3	Service 4	Service 5
Ecosystem 1	1	2	1	0	5
Ecosystem 2	5	2	2	1	0
Ecosystem 3	2	2	1	3	0
Ecosystem 4	1	1	4	0	0
Ecosystem 5	1	1	2	2	0

Adaptation of the conceptual framework

Control methods?

Are all the services relevant?

Different species?

	Service 1	Service 2	Service 3	Service 4	Service 5
Ecosystem 1	1	2	1	0	5
Ecosystem 2	5	2	2	1	0
Ecosystem 3	2	2	1	3	0
Ecosystem 4	1	1	4	0	0
Ecosystem 5	1	1	2	2	0

Different ecosystems?

How to consider the temporal aspect?

Adaptation of the conceptual framework

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Control methods?

Are all the services relevant?

Different species?

	Service 1	Service 2	Service 3	Service 4	Service 5
Ecosystem 1	1	2	1	0	5
Ecosystem 2	5	2	2	1	0
Ecosystem 3	2	2	1	3	0
Ecosystem 4	1	1	4	0	0
Ecosystem 5	1	1	2	2	0

Different ecosystems?

How to consider the temporal aspect?

Adaptation of the conceptual framework

Control methods?

Are all the services relevant?

Different species?

	Service 1	Service 2	Service 3	Service 4	Service 5
Ecosystem 1	1	2	1	0	5
Ecosystem 2	5	2	2	1	0
Ecosystem 3	2	2	1	3	0
Ecosystem 4	1	1	4	0	0
Ecosystem 5	1	1	2	2	0

Different ecosystems?

How to consider the temporal aspect?

That's much too many cells !!!

Adaptation of the conceptual framework

Assumptions

→ A similar control method can be used (and evaluated) for several species

→ Control actions are undertaken in typical situations (*i.e.* in typically invaded ecosystems)

→ Not all the ecosystem services of the CICES are relevant

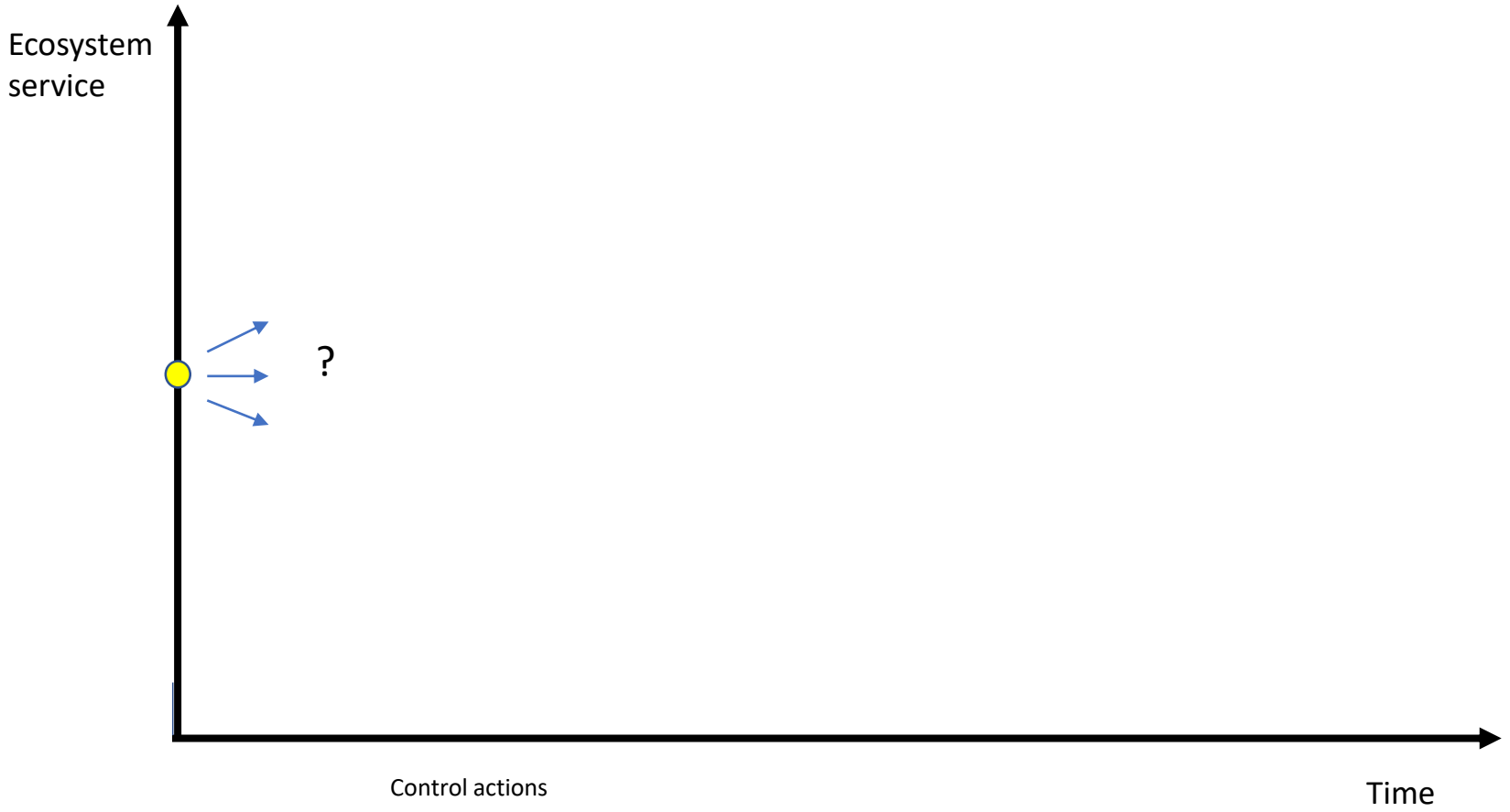
Adaptation of the conceptual framework

	Ecosystem service 1		Ecosystem service 2		Ecosystem service 3		Ecosystem service 4		…
	Over 1 year	Over 5 years	Over 1 year	Over 5 years	Over 1 year	Over 5 years	Over 1 year	Over 5 years	
Control method 1									
Control method 2									
Control method 3									
Control method 4									
…									

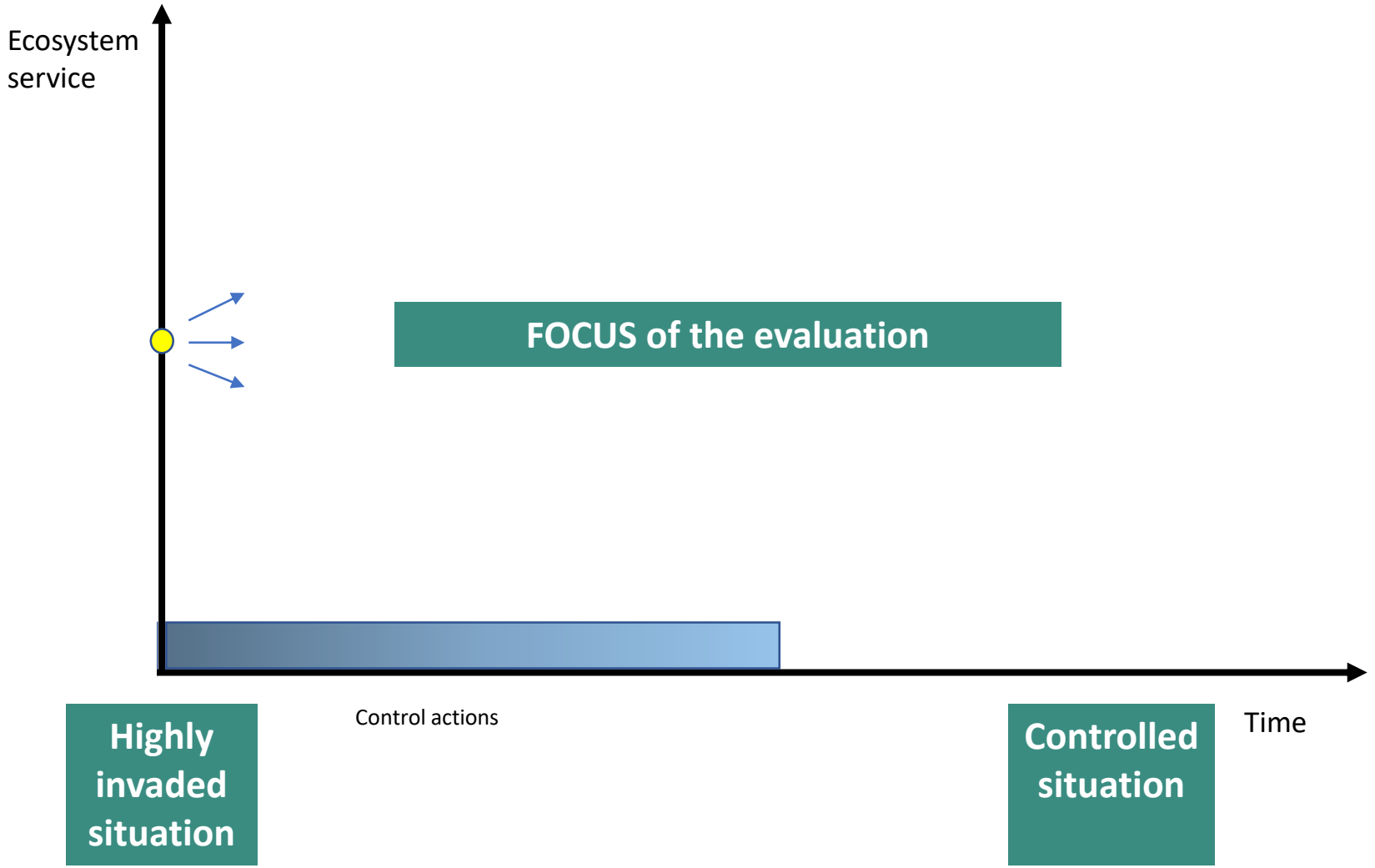
Adaptation of the conceptual framework

	Ecosystem service 1		Ecosystem service 2		Ecosystem service 3		Ecosystem service 4		…
	Over 1 year	Over 5 years	Over 1 year	Over 5 years	Over 1 year	Over 5 years	Over 1 year	Over 5 years	
Control method 1	?								
Control method 2									
Control method 3									
Control method 4									
…									

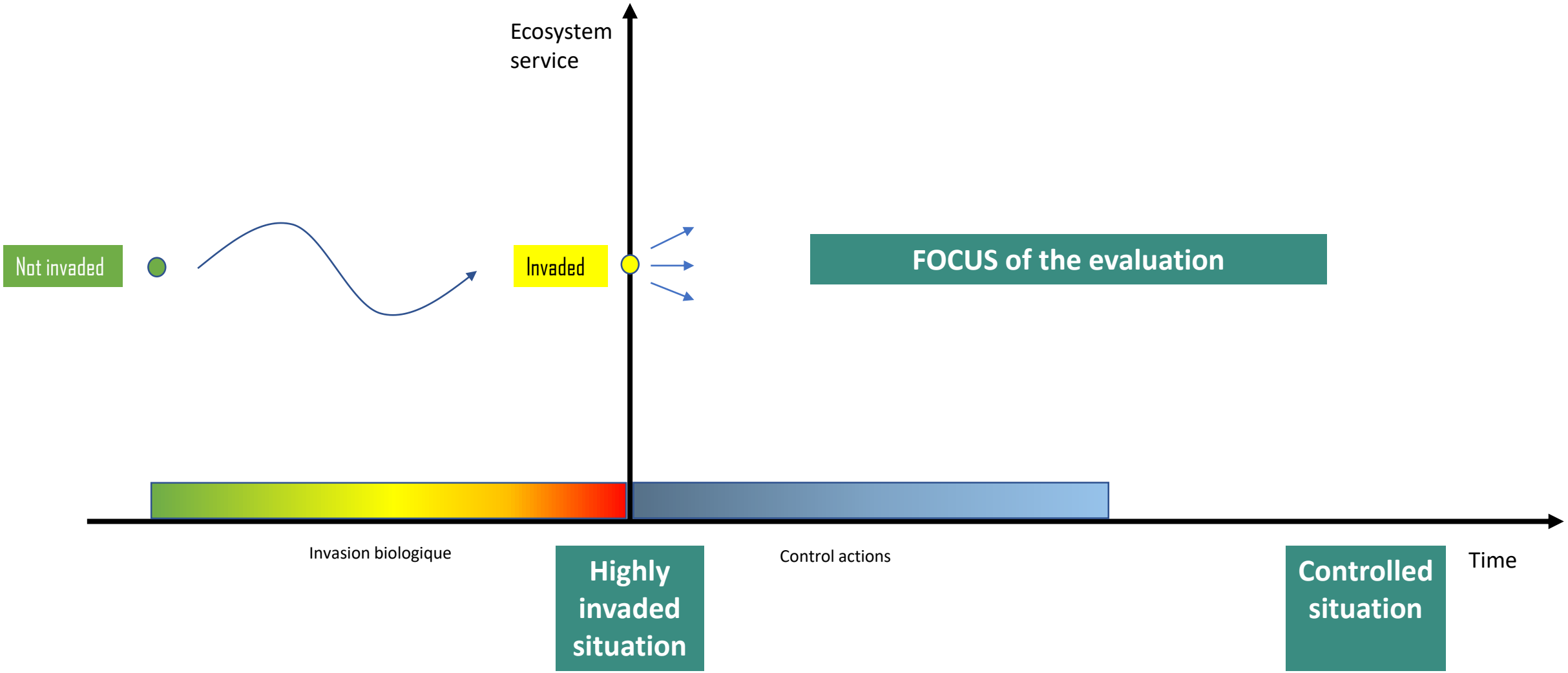
Adaptation of the conceptual framework



Adaptation of the conceptual framework



Adaptation of the conceptual framework



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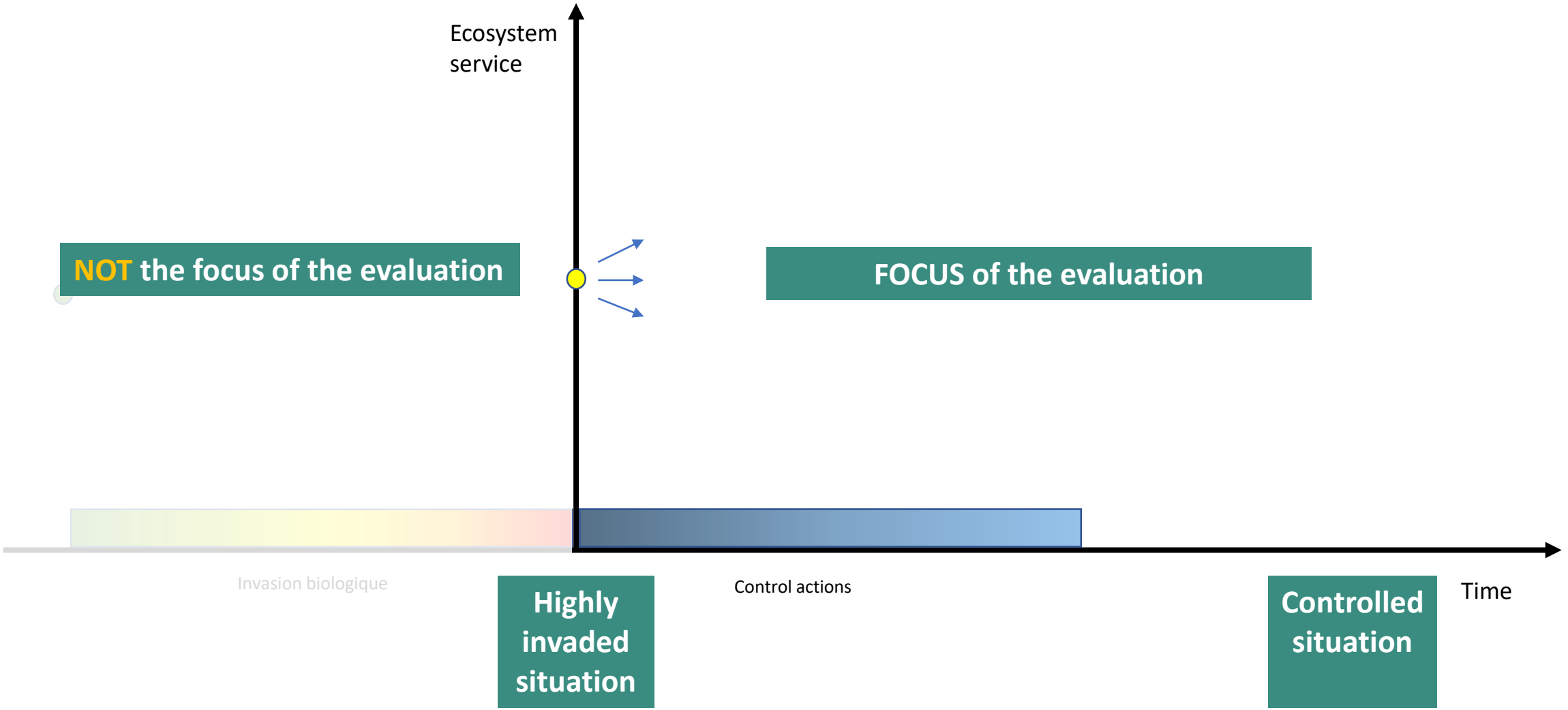

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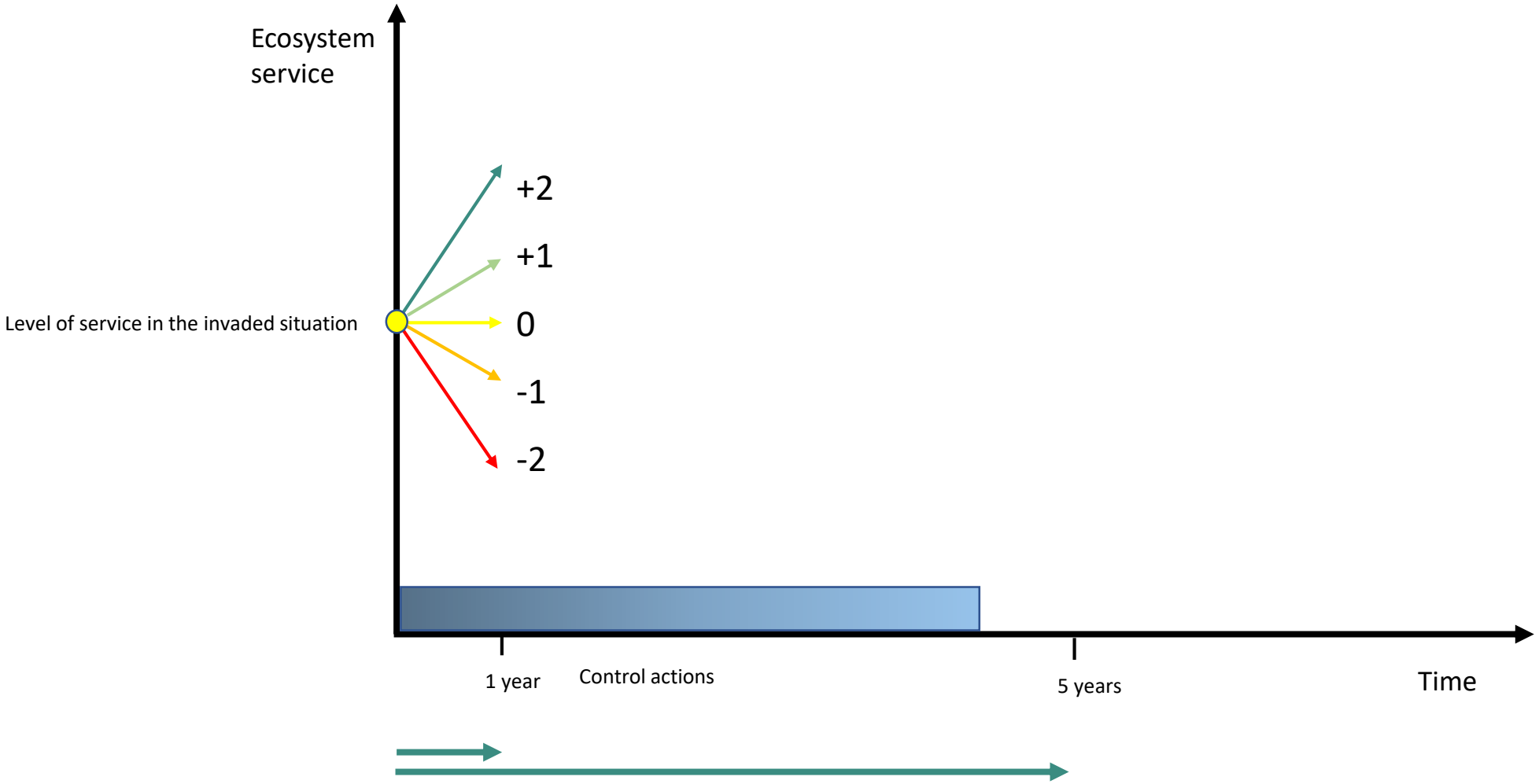

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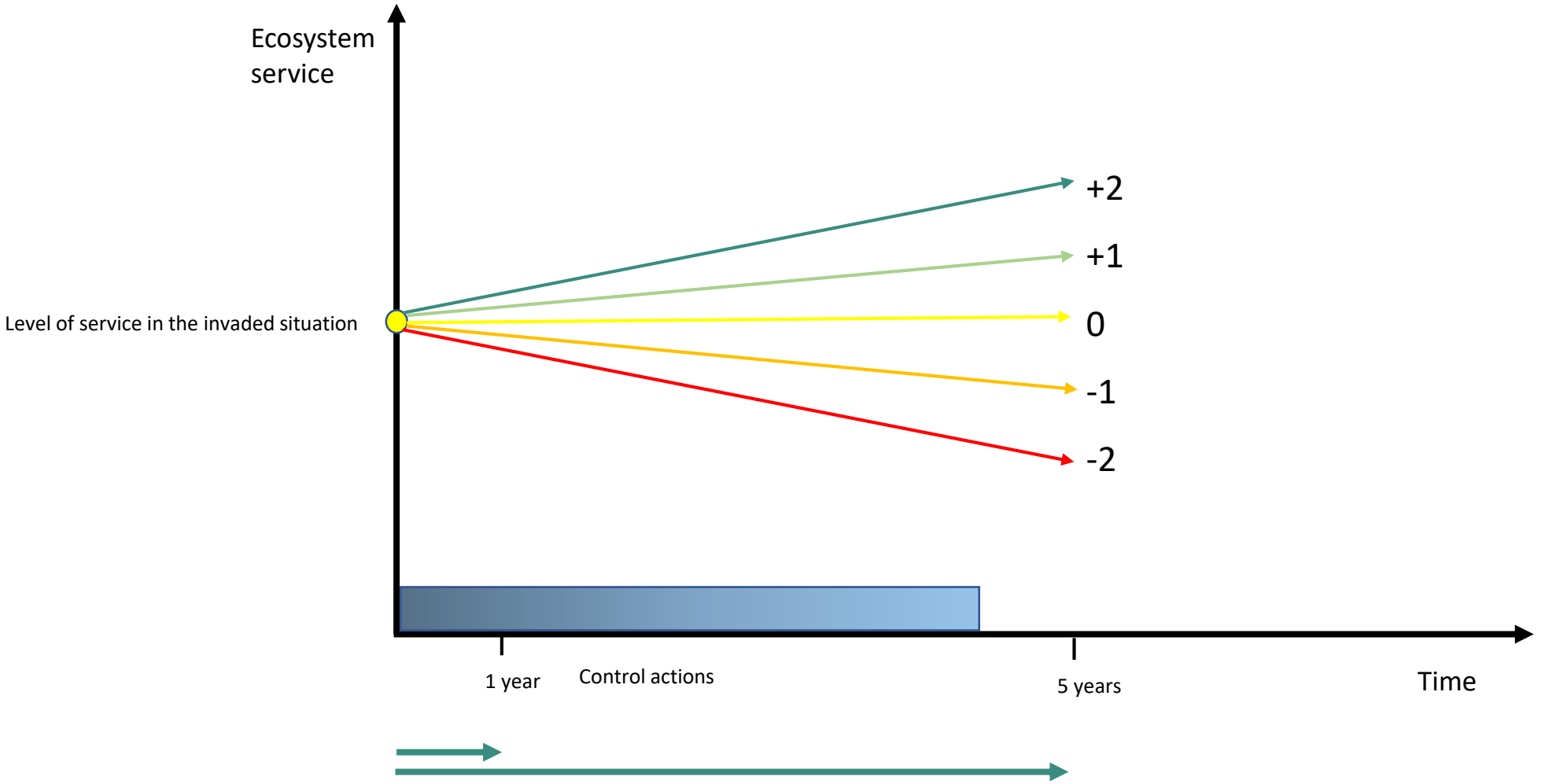

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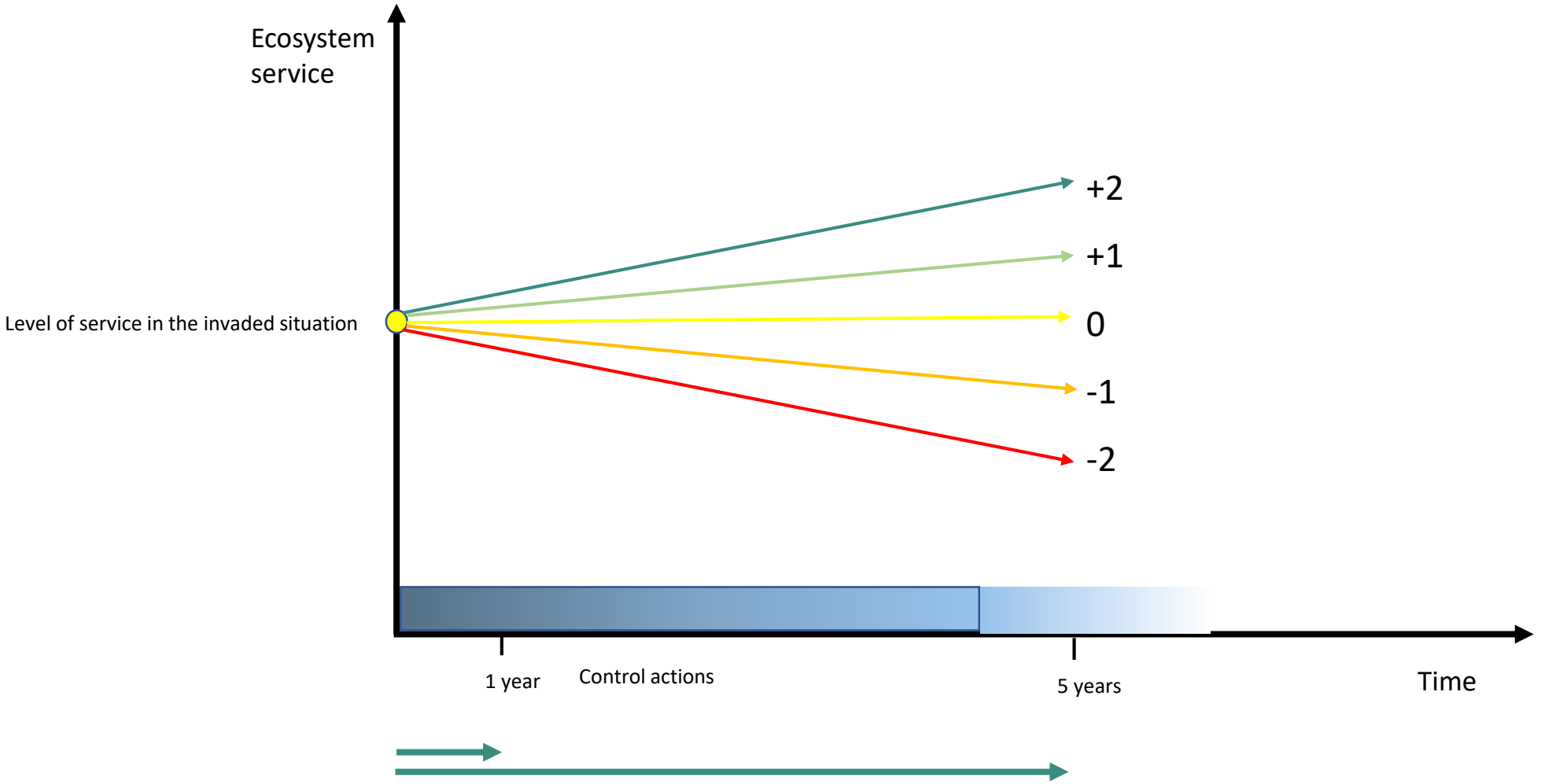


Assessing the impact of control methods on ecosystem services - Workflow

Expert assessment

- SurveyMonkey® online survey

→ Large email diffusion (March to July 2022)

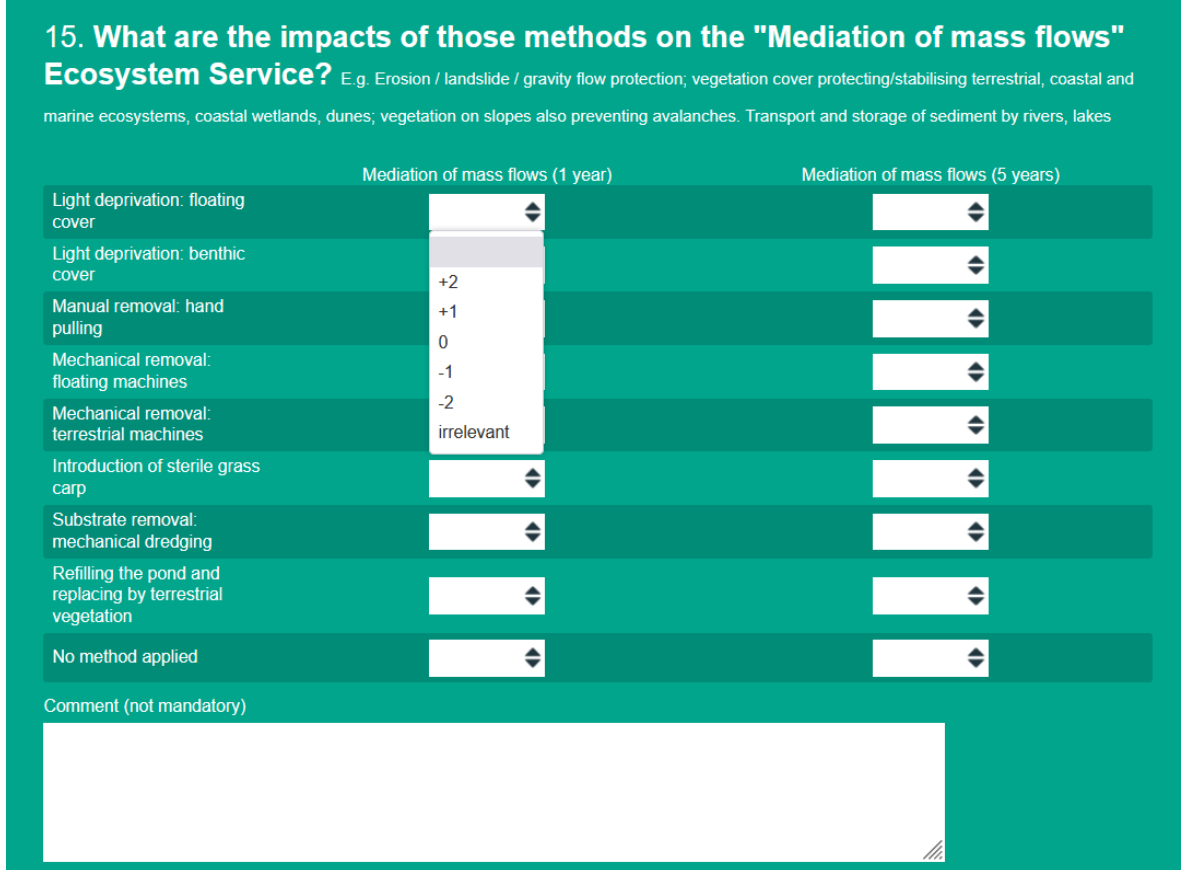
→ 2 workshops (Uliège, ICAIS)

→ Technical explanations of the control methods

- 26 different experts participated

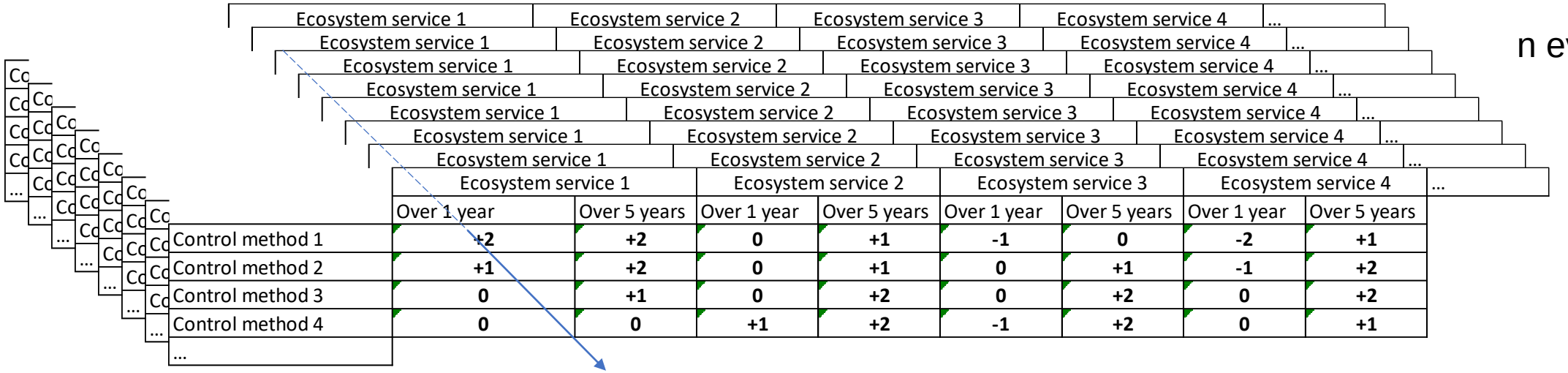
→ Crayfish: 12.2 evaluations per cell

→ Aquatic plants: 8.4 evaluations per cell



Assessing the impact of control methods on ecosystem services - Workflow

Analyses



	Ecosystem service 1		Ecosystem service 2		Ecosystem service 3		Ecosystem service 4	
	Over 1 year	Over 5 years	Over 1 year	Over 5 years	Over 1 year	Over 5 years	Over 1 year	Over 5 years
Control method 1	**+2**	**+2**	**0**	**+1**	**-1**	**0**	**-2**	**+1**
Control method 2	**+1**	**+2**	**0**	**+1**	**0**	**+1**	**-1**	**+2**
Control method 3	**0**	**+1**	**0**	**+2**	**0**	**+2**	**0**	**+2**
Control method 4	**0**	**0**	**+1**	**+2**	**-1**	**+2**	**0**	**+1**

n evaluators

Average — *How did the ecosystem service evolve?*

-2 -1 0 1 +2

ICC (2,k) — *Is the evaluation reliable?*

« good »>0.75 (Koo & Li 2016)

Assessing the impact of control methods on ecosystem services - Workflow

Matrices

	Provisioning						Regulation and maintenance										Cultural			
Average 1 year	Nutrition : biomass	Nutrition : water	Materials : biomass	Materials : water	Biomass-based energy sources	Mechanical energy	Mediation by biota	Mediation by ecosystems	Mediation of mass flows	Mediation of liquid flows	Mediation of gaseous / air flows	Lifecycle maintenance, habitat and gene pool protection	Pest and disease control	Soil formation and composition	Water conditions	Atmospheric composition and climate regulation	Physical and experiential interactions with biota, ecosystems, and landscapes	Intellectual and representational interactions with biota, ecosystems, and landscapes	Spiritual and/or emblematic interactions with biota, ecosystems, and landscapes	Other cultural outputs
Light deprivation: floating cover	-1.4	-0.5	-1.0	-0.1	-0.5		-1.6	-1.3	-1.0	-0.7		-1.2	0.3	-1.0	-1.6	-1.0	-0.7	-0.6	-0.4	
Light deprivation: benthic cover	-1.0	-0.4	-0.9	0.0	-0.3		-1.3	-0.9	-0.9	-0.6		-1.0	0.0	-1.2	-1.5	-1.0	-0.3	-0.4	-0.4	
Manual removal: hand pulling (aquatic	0.1	-0.1	-0.5	0.2	0.3		-0.3	-0.2	-0.3	0.1		0.0	0.0	-0.2	0.1	-0.2	0.3	0.4	0.3	
Mechanical removal: aquatic/floating	-0.9	-0.2	-0.9	0.1	0.5		-0.8	-0.6	-0.8	-0.2		-1.1	0.0	-0.5	-0.6	-0.2	-0.1	-0.1	-0.1	
Mechanical removal: terrestrial machines	-0.7	-0.3	-1.0	0.1	0.5		-0.5	-0.5	-1.1	-0.2		-1.1	0.1	-1.0	-0.5	-0.3	-0.2	-0.2	-0.1	
Biological control agent: grass carp	-0.6	-0.3	-0.4	0.0	-0.4		-0.9	-0.5	-0.6	0.2		-1.2	0.2	-0.2	-0.6	-0.8	-0.5	-0.2	-0.3	
Substrate removal: mechanical dredging	-1.3	-1.0	-1.0	-0.2	-0.2		-1.4	-1.3	-1.3	0.1		-1.6	0.0	-1.3	-0.8	-0.2	-1.0	-0.7	-0.7	
Draining and filling a pond/ destruction of	-1.6	-1.8	-1.0	-1.8	-1.1		-2.0	-2.0	-1.9	-1.8		-1.8	0.5	-1.0	-1.7	-0.8	-1.8	-1.5	-1.6	

Overall reliability (95% interval): 0,89< ICC(2,k) <0,93

RIPARIAS

Matrices

	Provisioning						Regulation and maintenance										Cultural			
Average 1 year	Nutrition : biomass	Nutrition : water	Materials : biomass	Materials : water	Biomass-based energy sources	Mechanical energy	Mediation by biota	Mediation by ecosystems	Mediation of mass flows	Mediation of liquid flows	Mediation of gaseous / air flows	Lifecycle maintenance, habitat and gene pool protection	Pest and disease control	Soil formation and composition	Water conditions	Atmospheric composition and climate regulation	Physical and experiential interactions with biota, ecosystems, and landscapes	Intellectual and representational interactions with biota, ecosystems, and landscapes	Spiritual and/or emblematic interactions with biota, ecosystems, and landscapes	Other cultural outputs
Light deprivation: floating cover	-1.4	-0.5	-1.0	-0.1	-0.5		-1.6	-1.3	-1.0	-0.7		-1.2	0.3	-1.0	-1.6	-1.0	-0.7	-0.6	-0.4	
Light deprivation: benthic cover	-1.0	-0.4	-0.9	0.0	-0.3		-1.3	-0.9	-0.9	-0.6		-1.0	0.0	-1.2	-1.5	-1.0	-0.3	-0.4	-0.4	
Manual removal: hand pulling (aquatic	0.1	-0.1	-0.5	0.2	0.3		-0.3	-0.2	-0.3	0.1		0.0	0.0	-0.2	0.1	-0.2	0.3	0.4	0.3	
Mechanical removal: aquatic/floating	-0.9	-0.2	-0.9	0.1	0.5		-0.8	-0.6	-0.8	-0.2		-1.1	0.0	-0.5	-0.6	-0.2	-0.1	-0.1	-0.1	
Mechanical removal: terrestrial machines	-0.7	-0.3	-1.0	0.1	0.5		-0.5	-0.5	-1.1	-0.2		-1.1	0.1	-1.0	-0.5	-0.3	-0.2	-0.2	-0.1	
Biological control agent: grass carp	-0.6	-0.3	-0.4	0.0	-0.4		-0.9	-0.5	-0.6	0.2		-1.2	0.2	-0.2	-0.6	-0.8	-0.5	-0.2	-0.3	
Substrate removal: mechanical dredging	-1.3	-1.0	-1.0	-0.2	-0.2		-1.4	-1.3	-1.3	0.1		-1.6	0.0	-1.3	-0.8	-0.2	-1.0	-0.7	-0.7	
Draining and filling a pond/ destruction of	-1.6	-1.8	-1.0	-1.8	-1.1		-2.0	-2.0	-1.9	-1.8		-1.8	0.5	-1.0	-1.7	-0.8	-1.8	-1.5	-1.6	

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RIPARIAS

Matrices

	Provisioning						Regulation and maintenance										Cultural			
Average 1 year	Nutrition : biomass	Nutrition : water	Materials : biomass	Materials : water	Biomass-based energy sources	Mechanical energy	Mediation by biota	Mediation by ecosystems	Mediation of mass flows	Mediation of liquid flows	Mediation of gaseous / air flows	Lifecycle maintenance, habitat and gene pool protection	Pest and disease control	Soil formation and composition	Water conditions	Atmospheric composition and climate regulation	Physical and experiential interactions with biota, ecosystems, and landscapes	Intellectual and representational interactions with biota, ecosystems, and landscapes	Spiritual and/or emblematic interactions with biota, ecosystems, and landscapes	Other cultural outputs
Light deprivation: floating cover	-1.4	-0.5	-1.0	-0.1	-0.5		-1.6	-1.3	-1.0	-0.7		-1.2	0.3	-1.0	-1.6	-1.0	-0.7	-0.6	-0.4	
Light deprivation: benthic cover	-1.0	-0.4	-0.9	0.0	-0.3		-1.3	-0.9	-0.9	-0.6		-1.0	0.0	-1.2	-1.5	-1.0	-0.3	-0.4	-0.4	
Manual removal: hand pulling (aquatic	0.1	-0.1	-0.5	0.2	0.3		-0.3	-0.2	-0.3	0.1		0.0	0.0	-0.2	0.1	-0.2	0.3	0.4	0.3	
Mechanical removal: aquatic/floating	-0.9	-0.2	-0.9	0.1	0.5		-0.8	-0.6	-0.8	-0.2		-1.1	0.0	-0.5	-0.6	-0.2	-0.1	-0.1	-0.1	
Mechanical removal: terrestrial machines	-0.7	-0.3	-1.0	0.1	0.5		-0.5	-0.5	-1.1	-0.2		-1.1	0.1	-1.0	-0.5	-0.3	-0.2	-0.2	-0.1	
Biological control agent: grass carp	-0.6	-0.3	-0.4	0.0	-0.4		-0.9	-0.5	-0.6	0.2		-1.2	0.2	-0.2	-0.6	-0.8	-0.5	-0.2	-0.3	
Substrate removal: mechanical dredging	-1.3	-1.0	-1.0	-0.2	-0.2		-1.4	-1.3	-1.3	0.1		-1.6	0.0	-1.3	-0.8	-0.2	-1.0	-0.7	-0.7	
Draining and filling a pond/ destruction of	-1.6	-1.8	-1.0	-1.8	-1.1		-2.0	-2.0	-1.9	-1.8		-1.8	0.5	-1.0	-1.7	-0.8	-1.8	-1.5	-1.6	

Overall reliability (95% interval): 0,89< ICC(2,k) <0,93

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Matrices

	Provisioning						Regulation and maintenance										Cultural			
Average 5 years	Nutrition : biomass	Nutrition : water	Materials : biomass	Materials : water	Biomass-based energy sources	Mechanical energy	Mediation by biota	Mediation by ecosystems	Mediation of mass flows	Mediation of liquid flows	Mediation of gaseous / air flows	Lifecycle maintenance, habitat and gene pool protection	Pest and disease control	Soil formation and composition	Water conditions	Atmospheric composition and climate regulation	Physical and experiential interactions with biota, ecosystems, and landscapes	Intellectual and representational interactions with biota, ecosystems, and landscapes	Spiritual and/or emblematic interactions with biota, ecosystems, and landscapes	Other cultural outputs
Light deprivation: floating cover	0.8	0.3	0.3	0.3	0.0		0.1	-0.1	0.1	0.6		1.2	0.3	-0.3	0.3	0.3	1.4	1.3	1.0	
Light deprivation: benthic cover	0.8	0.3	0.3	0.3	-0.2		0.1	0.0	0.0	0.4		1.2	0.3	-0.3	0.3	0.3	1.4	1.3	1.0	
Manual removal: hand pulling (aquatic	1.1	0.2	0.4	0.6	0.3		0.5	0.3	0.2	0.6		1.2	0.3	0.2	0.5	0.2	1.5	1.4	1.1	
Mechanical removal: aquatic/floating	0.9	0.2	0.4	0.6	0.5		0.4	0.3	0.2	0.6		1.2	0.3	0.2	0.5	0.2	1.5	1.3	1.0	
Mechanical removal: terrestrial machines	1.0	0.2	0.4	0.6	0.5		0.5	0.4	0.2	0.6		1.1	0.3	0.0	0.5	0.2	1.5	1.3	0.8	
Biological control agent: grass carp	-0.2	0.1	0.3	0.0	-0.4		-0.6	-0.5	-0.6	0.5		0.1	-0.2	-0.3	-0.5	-0.5	0.1	0.2	-0.2	
Substrate removal: mechanical dredging	0.5	0.4	0.3	0.4	0.0		0.0	0.0	-0.1	0.4		1.1	0.5	-0.2	0.5	0.2	1.1	1.4	0.8	
Draining and filling a pond/ destruction of	-1.0	-1.8	-0.4	-1.5	-0.8		-1.5	-1.4	-1.7	-1.9		-1.2	0.3	-0.7	-2.0	0.6	-1.3	-0.9	-1.1	

Overall reliability (95% interval): 0,89< ICC(2,k) <0,93

RIPARIAS

Matrices

	Provisioning						Regulation and maintenance										Cultural			
Average 5 years	Nutrition : biomass	Nutrition : water	Materials : biomass	Materials : water	Biomass-based energy sources	Mechanical energy	Mediation by biota	Mediation by ecosystems	Mediation of mass flows	Mediation of liquid flows	Mediation of gaseous / air flows	Lifecycle maintenance, habitat and gene pool protection	Pest and disease control	Soil formation and composition	Water conditions	Atmospheric composition and climate regulation	Physical and experiential interactions with biota, ecosystems, and landscapes	Intellectual and representational interactions with biota, ecosystems, and landscapes	Spiritual and/or emblematic interactions with biota, ecosystems, and landscapes	Other cultural outputs
Light deprivation: floating cover	0.8	0.3	0.3	0.3	0.0		0.1	-0.1	0.1	0.6		1.2	0.3	-0.3	0.3	0.3	1.4	1.3	1.0	
Light deprivation: benthic cover	0.8	0.3	0.3	0.3	-0.2		0.1	0.0	0.0	0.4		1.2	0.3	-0.3	0.3	0.3	1.4	1.3	1.0	
Manual removal: hand pulling (aquatic	1.1	0.2	0.4	0.6	0.3		0.5	0.3	0.2	0.6		1.2	0.3	0.2	0.5	0.2	1.5	1.4	1.1	
Mechanical removal: aquatic/floating	0.9	0.2	0.4	0.6	0.5		0.4	0.3	0.2	0.6		1.2	0.3	0.2	0.5	0.2	1.5	1.3	1.0	
Mechanical removal: terrestrial machines	1.0	0.2	0.4	0.6	0.5		0.5	0.4	0.2	0.6		1.1	0.3	0.0	0.5	0.2	1.5	1.3	0.8	
Biological control agent: grass carp	-0.2	0.1	0.3	0.0	-0.4		-0.6	-0.5	-0.6	0.5		0.1	-0.2	-0.3	-0.5	-0.5	0.1	0.2	-0.2	
Substrate removal: mechanical dredging	0.5	0.4	0.3	0.4	0.0		0.0	0.0	-0.1	0.4		1.1	0.5	-0.2	0.5	0.2	1.1	1.4	0.8	
Draining and filling a pond/ destruction of	-1.0	-1.8	-0.4	-1.5	-0.8		-1.5	-1.4	-1.7	-1.9		-1.2	0.3	-0.7	-2.0	0.6	-1.3	-0.9	-1.1	

Overall reliability (95% interval): 0,89< ICC(2,k) <0,93

RIPARIAS

Matrices

	Provisioning						Regulation and maintenance										Cultural			
Average 5 years	Nutrition : biomass	Nutrition : water	Materials : biomass	Materials : water	Biomass-based energy sources	Mechanical energy	Mediation by biota	Mediation by ecosystems	Mediation of mass flows	Mediation of liquid flows	Mediation of gaseous / air flows	Lifecycle maintenance, habitat and gene pool protection	Pest and disease control	Soil formation and composition	Water conditions	Atmospheric composition and climate regulation	Physical and experiential interactions with biota, ecosystems, and landscapes	Intellectual and representational interactions with biota, ecosystems, and landscapes	Spiritual and/or emblematic interactions with biota, ecosystems, and landscapes	Other cultural outputs
Light deprivation: floating cover	0.8	0.3	0.3	0.3	0.0		0.1	-0.1	0.1	0.6		1.2	0.3	-0.3	0.3	0.3	1.4	1.3	1.0	
Light deprivation: benthic cover	0.8	0.3	0.3	0.3	-0.2		0.1	0.0	0.0	0.4		1.2	0.3	-0.3	0.3	0.3	1.4	1.3	1.0	
Manual removal: hand pulling (aquatic	1.1	0.2	0.4	0.6	0.3		0.5	0.3	0.2	0.6		1.2	0.3	0.2	0.5	0.2	1.5	1.4	1.1	
Mechanical removal: aquatic/floating	0.9	0.2	0.4	0.6	0.5		0.4	0.3	0.2	0.6		1.2	0.3	0.2	0.5	0.2	1.5	1.3	1.0	
Mechanical removal: terrestrial machines	1.0	0.2	0.4	0.6	0.5		0.5	0.4	0.2	0.6		1.1	0.3	0.0	0.5	0.2	1.5	1.3	0.8	
Biological control agent: grass carp	-0.2	0.1	0.3	0.0	-0.4		-0.6	-0.5	-0.6	0.5		0.1	-0.2	-0.3	-0.5	-0.5	0.1	0.2	-0.2	
Substrate removal: mechanical dredging	0.5	0.4	0.3	0.4	0.0		0.0	0.0	-0.1	0.4		1.1	0.5	-0.2	0.5	0.2	1.1	1.4	0.8	
Draining and filling a pond/ destruction of	-1.0	-1.8	-0.4	-1.5	-0.8		-1.5	-1.4	-1.7	-1.9		-1.2	0.3	-0.7	-2.0	0.6	-1.3	-0.9	-1.1	

Overall reliability (95% interval): 0,89< ICC(2,k) <0,93

RIPARIAS

Matrices

	Provisioning						Regulation and maintenance										Cultural			
Average 1 year	Nutrition : biomass	Nutrition : water	Materials : biomass	Materials : water	Biomass-based energy sources	Mechanical energy	Mediation by biota	Mediation by ecosystems	Mediation of mass flows	Mediation of liquid flows	Mediation of gaseous / air flows	Lifecycle maintenance, habitat and gene pool protection	Pest and disease control	Soil formation and composition	Water conditions	Atmospheric composition and climate regulation	Physical and experiential interactions with biota, ecosystems, and landscapes	Intellectual and representational interactions with biota, ecosystems, and landscapes	Spiritual and/or emblematic interactions with biota, ecosystems, and landscapes	Other cultural outputs
Baited and unbaited trapping	0.1			0.1			0.2	0.3	0.5	0.0		0.6	0.6		0.1		0.3	0.3	0.2	
Seine fishing/ seining	-0.3			0.2			0.0	0.4	0.4	0.0		0.2	0.6		0.3		-0.3	0.4	0.0	
Temporary drainage	-1.2			-1.0			-0.9	-0.9	-0.3	-0.1		-1.7	1.0		-0.1		-1.1	-0.2	-0.6	
Biological control agent: indigenous predatory fish	0.1			0.0			0.0	0.1	0.3	0.0		0.1	0.2		0.3		0.9	0.4	0.5	

Overall reliability (95% interval): 0,79< ICC(2,k) <0,88

RIPARIAS

Matrices

	Provisioning						Regulation and maintenance										Cultural			
Average 1 year	Nutrition : biomass	Nutrition : water	Materials : biomass	Materials : water	Biomass-based energy sources	Mechanical energy	Mediation by biota	Mediation by ecosystems	Mediation of mass flows	Mediation of liquid flows	Mediation of gaseous / air flows	Lifecycle maintenance, habitat and gene pool protection	Pest and disease control	Soil formation and composition	Water conditions	Atmospheric composition and climate regulation	Physical and experiential interactions with biota, ecosystems, and landscapes	Intellectual and representational interactions with biota, ecosystems, and landscapes	Spiritual and/or emblematic interactions with biota, ecosystems, and landscapes	Other cultural outputs
Baited and unbaited trapping	0.1			0.1			0.2	0.3	0.5	0.0		0.6	0.6		0.1		0.3	0.3	0.2	
Seine fishing/ seining	-0.3			0.2			0.0	0.4	0.4	0.0		0.2	0.6		0.3		-0.3	0.4	0.0	
Temporary drainage	-1.2			-1.0			-0.9	-0.9	-0.3	-0.1		-1.7	1.0		-0.1		-1.1	-0.2	-0.6	
Biological control agent: indigenous predatory fish	0.1			0.0			0.0	0.1	0.3	0.0		0.1	0.2		0.3		0.9	0.4	0.5	

Overall reliability (95% interval): 0,79< ICC(2,k) <0,88

RIPARIAS

Matrices

Average 1 year	Provisioning						Regulation and maintenance										Cultural			
	Nutrition : biomass	Nutrition : water	Materials : biomass	Materials : water	Biomass-based energy sources	Mechanical energy	Mediation by biota	Mediation by ecosystems	Mediation of mass flows	Mediation of liquid flows	Mediation of gaseous / air flows	Lifecycle maintenance, habitat and gene pool protection	Pest and disease control	Soil formation and composition	Water conditions	Atmospheric composition and climate regulation	Physical and experiential interactions with biota, ecosystems, and landscapes	Intellectual and representational interactions with biota, ecosystems, and landscapes	Spiritual and/or emblematic interactions with biota, ecosystems, and landscapes	Other cultural outputs
Baited and unbaited trapping	0.1			0.1			0.2	0.3	0.5	0.0		0.6	0.6		0.1		0.3	0.3	0.2	
Seine fishing/ seining	-0.3			0.2			0.0	0.4	0.4	0.0		0.2	0.6		0.3		-0.3	0.4	0.0	
Temporary drainage	-1.2			-1.0			-0.9	-0.9	-0.3	-0.1		-1.7	1.0		-0.1		-1.1	-0.2	-0.6	
Biological control agent: indigenous predatory fish	0.1			0.0			0.0	0.1	0.3	0.0		0.1	0.2		0.3		0.9	0.4	0.5	

Overall reliability (95% interval): 0,79< ICC(2,k) <0,88

RIPARIAS

Matrices

	Provisioning						Regulation and maintenance										Cultural			
Average 5 years	Nutrition : biomass	Nutrition : water	Materials : biomass	Materials : water	Biomass-based energy sources	Mechanical energy	Mediation by biota	Mediation by ecosystems	Mediation of mass flows	Mediation of liquid flows	Mediation of gaseous / air flows	Lifecycle maintenance, habitat and gene pool protection	Pest and disease control	Soil formation and composition	Water conditions	Atmospheric composition and climate regulation	Physical and experiential interactions with biota, ecosystems, and landscapes	Intellectual and representational interactions with biota, ecosystems, and landscapes	Spiritual and/or emblematic interactions with biota, ecosystems, and landscapes	Other cultural outputs
Baited and unbaited trapping	0.7			0.1			0.5	0.6	1.0	0.2		1.1	0.9		0.7		1.0	0.8	0.5	
Seine fishing/ seining	0.4			0.2			0.4	0.5	0.9	0.1		0.6	0.8		0.5		0.7	0.9	0.3	
Temporary drainage	0.8			0.1			0.7	0.6	0.9	0.0		0.6	1.2		0.6		0.8	0.5	0.4	
Biological control agent: indigenous predatory fish	0.5			0.2			0.5	0.6	0.9	0.2		0.8	0.5		0.5		1.0	0.7	0.7	

Overall reliability (95% interval): 0,79< ICC(2,k) <0,88

RIPARIAS

Matrices

	Provisioning						Regulation and maintenance									Cultural			
Average 5 years	Nutrition : biomass	Nutrition : water	Materials : biomass	Materials : water	Biomass-based energy sources	Mechanical energy	Mediation by biota	Mediation by ecosystems	Mediation of mass flows	Mediation of liquid flows	Mediation of gaseous / air flows	Lifecycle maintenance, habitat and gene pool protection	Pest and disease control	Soil formation and composition	Water conditions	Atmospheric composition and climate regulation	Physical and experiential interactions with biota, ecosystems, and landscapes	Intellectual and representational interactions with biota, ecosystems, and landscapes	Spiritual and/or emblematic interactions with biota, ecosystems, and landscapes	Other cultural outputs
Baited and unbaited trapping	0.7			0.1			0.5	0.6	1.0	0.2		1.1	0.9		0.7		1.0	0.8	0.5	
Seine fishing/ seining	0.4			0.2			0.4	0.5	0.9	0.1		0.6	0.8		0.5		0.7	0.9	0.3	
Temporary drainage	0.8			0.1			0.7	0.6	0.9	0.0		0.6	1.2		0.6		0.8	0.5	0.4	
Biological control agent: indigenous predatory fish	0.5			0.2			0.5	0.6	0.9	0.2		0.8	0.5		0.5		1.0	0.7	0.7	

Overall reliability (95% interval): 0,79< ICC(2,k) <0,88

RIPARIAS

Take Home Message

- Balance to be found between **realistic expert evaluation** and **precision**
- Most ecosystem services are altered during plant control actions…

… but not for crayfish

- After 5 years most actions have positive effects !

Thank you for your attention !




NATURA 2000

Life

NEOBIOTA

bruxelles environnement leefmilieu brussel .brussels

AGENTSCHAP NATUUR & BOS

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LIÈGE université Gembloux Agro-Bio Tech

.be Biodiversity.be

Wallonie service public SPW

GETTE DYLE CONTRAT RIVIÈRE

Dendre Contrat de rivière

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