Compilation of case studies on the management of vertebrate invasive alien species of Union concern (and others), collected through an online questionnaire

Task 3A, Deliverable D3A.2.

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1. Introduction

This report presents a series of case studies on the management of vertebrate invasive alien species of Union concern (and other additional species) mobilised through the project I*dentification, Assessment, Sharing and Dissemination of Best Practices for Humane Management of Invasive Alien Species* (contract No. 07.027746/2019/812504/SER/ENV.D.2) funded by the EC.

The project consisted of three phases; the first was the identification and assessment of management measures for the vertebrate IAS of Union concern, and the production of a draft manual. The second was proactive engagement with stakeholder groups across Europe, including National Authorities, animal welfare groups, conservation organisations, hunting associations, academia, and zoos. The purpose of this engagement was to develop and incorporate regional conditions to the draft manual (e.g. individual Member State legal frameworks), mobilise case studies on the management actions, and develop plans to disseminate project outputs. To support this engagement process, eight separate stakeholder workshops were run, each focusing on a different region within the EU (Table 1). The case studies submitted were presented, discussed and 'scored' using a range of criteria at the relevant workshop. The third phase of the project was to develop the final manual and additional outputs, and run a final conference to support dissemination of the results. A selection of the highest scoring case studies was presented at the final conference. All case studies submitted to the project are presented in this report.

Table 1. Dates of the project regional workshops (and corresponding EU Member States), for which the regions were defined approximately using the Biogeographical regions in Europe[1].

Project workshop region	Member States included	Date of workshop
Alpine	Austria, Slovakia, Slovenia (and Liechtenstein)	10 & 11 June 2021
Atlantic	Belgium, France, Ireland, Netherlands (and UK)	28 & 29 April 2021
Black Sea, Steppic & Continental (EAST)	Bulgaria, Romania	23 & 24 March 2021
Boreal	Estonia, Finland, Latvia, Lithuania, Sweden	25 & 26 March 2021
Continental (CENTRAL) & Pannonian	Croatia, Czechia, Hungary, Poland	12 & 13 May 2021
Continental (WEST)	Denmark, Germany, Luxembourg	5 & 6 May 2021

[1] https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-2

Project workshop region	Member States included	Date of workshop
Mediterranean (EAST)	Cyprus, Greece	8 & 9 June 2021
Mediterranean (WEST)	Italy, Malta, Portugal, Spain	19 & 20 May 2021

The following case studies are a compilation of examples of the management of the 22 vertebrate IAS on the Union list (as of December 2021), as well as some additional species. These case studies were submitted through an online questionnaire entitled 'Good Practices on Humane Management of Vertebrate IAS', which was officially launched in English and 18 additional EU languages (Bulgarian, Croatian, Czech, Danish, Estonian, French, German, Greek, Hungarian, Italian, Latvian, Lithuanian, Polish, Portuguese, Romanian, Slovak, Slovenian and Spanish) in February 2021 (Table 2 and Appendix 1).

Table 2. Parameters (and details) requested in the Case Studies online questionnaire (see Appendix 1 for full questionnaire).

Parameter	Details (either for selection or free text)
Species group targeted	Mammals, Birds, Reptiles, Amphibians, Fishes
Objective	Rapid eradication (early stage intervention) Eradication (of widespread population) Control Containment
Country where measure was applied	Select from EU Member States or Other
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Biological control, Habitat manipulation, Hand removal, Poisoning or toxicants, Shooting, Trapping, Other
Measures used to remove (dispatch/sterilise/captivity) species	Cervical dislocation, Cranial depression, Decapitation, Electrocution, Freezing, Injection euthanasia, Keeping in captivity, Modified atmospheres, Shooting - dispatch restrained animals, Slaughter with a knife, Surgical sterilisation
Additional Measures	
Description of measure	
Time period	
Location and scale of application	
Effort	Preferably quantitative, for example: person days/year, #traps/km2/year.
Costs	Overall costs Personnel costs Equipment and infrastructure Other, including capacity building and overheads Currency used above (default: EUR)

Parameter	Details (either for selection or free text)
Sources of funding	
Effectiveness	Provide key evidence
Replicability	
Humaneness/animal welfare	
Public acceptance	
Side effect	
Stakeholder engagement – implementation	
Dissemination	
Innovation	
Lessons learned	
References	

During the project regional workshops, the case studies were presented and scored under different criteria by workshop participants, using a scoring system developed by the project consortium (Table 3). For each case study, participants used a *Likert scale response* (Strongly agree, Agree, Neither agree nor disagree/unknown, Disagree, Strongly disagree) against statements provided for seven separate criteria that reflect the project's aims (Table 3).

Table 3. Scoring system used by workshop participants to assess the different case studies.

Assessment Criteria	The case study…
1. **Regional representation**	*…. addresses one or more vertebrate IAS that is a major threat to biodiversity within the region.*
2. **Effectiveness**	*…was fully effective in meeting a clearly defined objective.*
3. **Humaneness/Animal welfare**	*…clearly took into account considerations for the impact on animal welfare across all phases of the implementation of actions (i.e. seeking to spare any avoidable pain, distress or suffering to animals).*
4. **Side effects**	*… led to no significant negative environmental, economic, or social side effects (or side effects were mitigated for).*
5. **Innovation**	*… successfully developed and/or used novel approaches or methods, and/or innovative technology.*

Assessment Criteria	The case study…
6. **Dissemination/communication activities**	*… identified, engaged and, where appropriate, involved different relevant stakeholder groups to improve the chances of success of the actions.*
7. **Public acceptance**	*… has been fully accepted by local public opinion (i.e. no significant objections remaining to the actions) in terms of e.g. its impacts upon animal welfare, ethical standards, health and safety.*

2. Case studies submitted per workshop region

Below we present the case studies on the management of vertebrate IAS of Union concern as of 2021 (or similar species) that were submitted through the online questionnaire mentioned above and that refer to the management of vertebrate IAS within the EU. The case studies showcased in this section were mostly presented, discussed and scored at each of the regional workshops (except those marked as 'not presented' in each region's summary tables below), and therefore are grouped per workshop region. For each subsection, first a summary of all the case studies submitted is presented per region, followed by the individual detailed case studies, which are arranged by country. Case studies referring to work conducted in the EU Outermost Regions (particularly the Canary Islands and Martinique in this work) were included in this section. Additionally, in one situation, management measures were implemented in an EU Member State (Spain), but coupled with work in Outermost Regions, Overseas Territores and further afield. On occasions, where a field was not completed by the respondent to the questionnaire, the category has been removed in its entirety from the corresponding table.

2.1. Alpine Region: Austria, Slovakia, Slovenia (and Liechtenstein)

2.1.1. Summary of case studies submitted for the Alpine region

	Country	Entity submitting	Species	Measures used to restrain, capture and/or remove (kill/sterilise) the species	Measures used to remove (dispatch/sterilise/captivity) species	Average score at workshop
1	Austria	Land Oberösterreich, Landesfischereiverein	*Pseudorasbora parva*	Pond drainage Hand removal: physical fishing methods	Cranial depression Anaesthetic overdose	3.3
2	Slovakia	State Nature Conservancy of SR (Area Dunajské luhy)	*Alopochen aegyptiaca*	Hand removal (combined with use of sedatives)	Keeping in captivity	3.8
3	Slovakia	State Nature Conservancy of SR (Area Horná Orava and Park Veľjá Fatra)	*Nyctereutes procyonoides*	Shooting	N/A	3.3
4	Slovakia	State Nature Conservancy of SR (Area Dunajské luhy)	*Trachemys scripta*	N/A	Keeping in captivity	3.4
5	Slovenia	Zoosofia Peter Maričić s.p.	*Carassius auratus**	Hand removal: physical fishing methods Trapping: cage traps	Electrocution Freezing Keeping in captivity	N/A[1]
6	Slovenia	Societas Herpetologica Slovenica	*Lithobates catesbeianus*	Trapping: cage traps	Keeping in captivity	3.7
7	Slovenia	Fisheries Research Institute of Slovenia	*Trachemys scripta*	Hand removal Hand removal: physical fishing methods Trapping: cage traps	Injection euthanasia	3.2
8	Slovenia	Zavod Republike Slovenije za varstvo narave	*Trachemys scripta*	Hand removal Hand removal: physical fishing methods Trapping: cage traps	Injection euthanasia	3.6

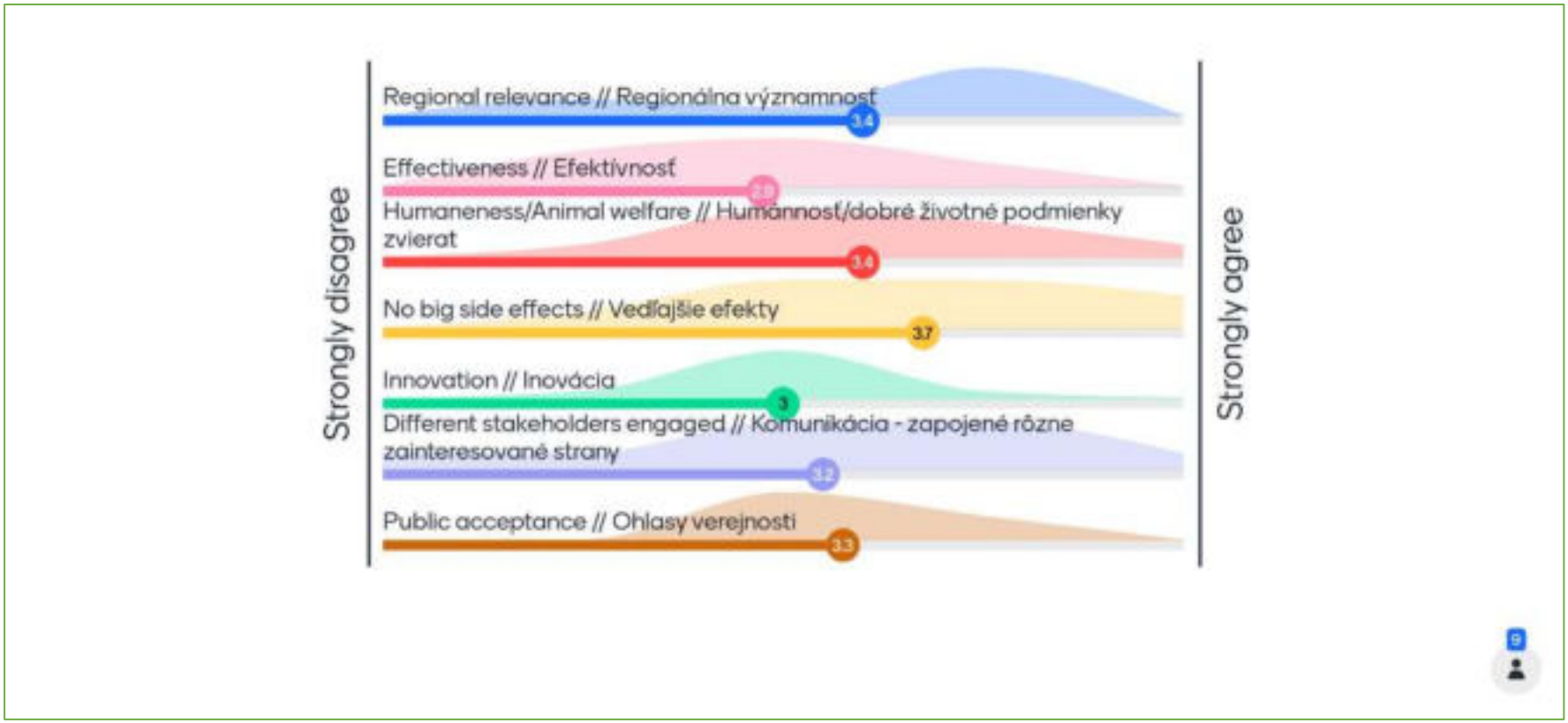
* Vertebrate IAS not on the Union list

[1] Case study presented at the workshop but not scored, as it refers to a species not on the Union list

2.1.2. Case study 1. Austria: *Pseudorasbora parva*

Group: Fish	
Country: Austria	
Entity: Land Oberösterreich, Landesfischereiverein	
Category	**Response**
Species targeted	*Pseudorasbora parva* (Stone moroko)
Objective(s)	Control Containment
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Pond drainage • Physical fishing methods (nets)
Measures used to remove (dispatch/sterilise/captivity) species	• Cranial depression • Anaesthetics overdose
Description of the measure	During yearly catching season for carp, a number of bycatch species are caught in carp polyculture ponds in Upper Austria. A large number of fish are invasive *Pseudorasbora parva*, which by fisheries law has to be killed after catching. The fish are caught in small rest water bodies during the pond drainage and killed with cranial depression or at higher numbers with the use of an anaesthetic overdose. The anaesthetic in use is clove oil, because of easy way to obtain it and relatively cheap price. Killed according to fishing legislation/with anaesthetics and put back into the drained pond as fertilizer. Outside season fish are used as death bait for predatory fish.
Time period	Seasonal, every other year during fishing season (November, December)
Location and scale of application	Schacher ponds, Upper Austria
Effort	Approx. 5 – 10 days drainage, one day catching carp and bycatch
Costs	No information as it is done by a private fishing club. Cost of anaesthetics approx. 10 €
Source(s) of funding	Income from various private fishing licenses
Effectiveness	Moderately effective

Replicability	Used method is fully replicable for all fish species
Humaneness/animal welfare	Used method (anaesthetic overdose) is humane and do not lead to any suffering of fish if done right. Keeping the right dose is important as both lower and higher concentration can lead to suffering. Large number of fish can suffocate during pond drainage if done too fast.
Public acceptance	Very good. Carp are sold for consumption. People are informed about carp polyculture
Side effects	No side effects of the method
Stakeholder engagement – implementation:	Wider public
Dissemination	Regional public media: newsletter
Lessons learned	Total eradication of invasive species during pond drainage is nearly impossible as fishes survive in the system.
References	Personal communication

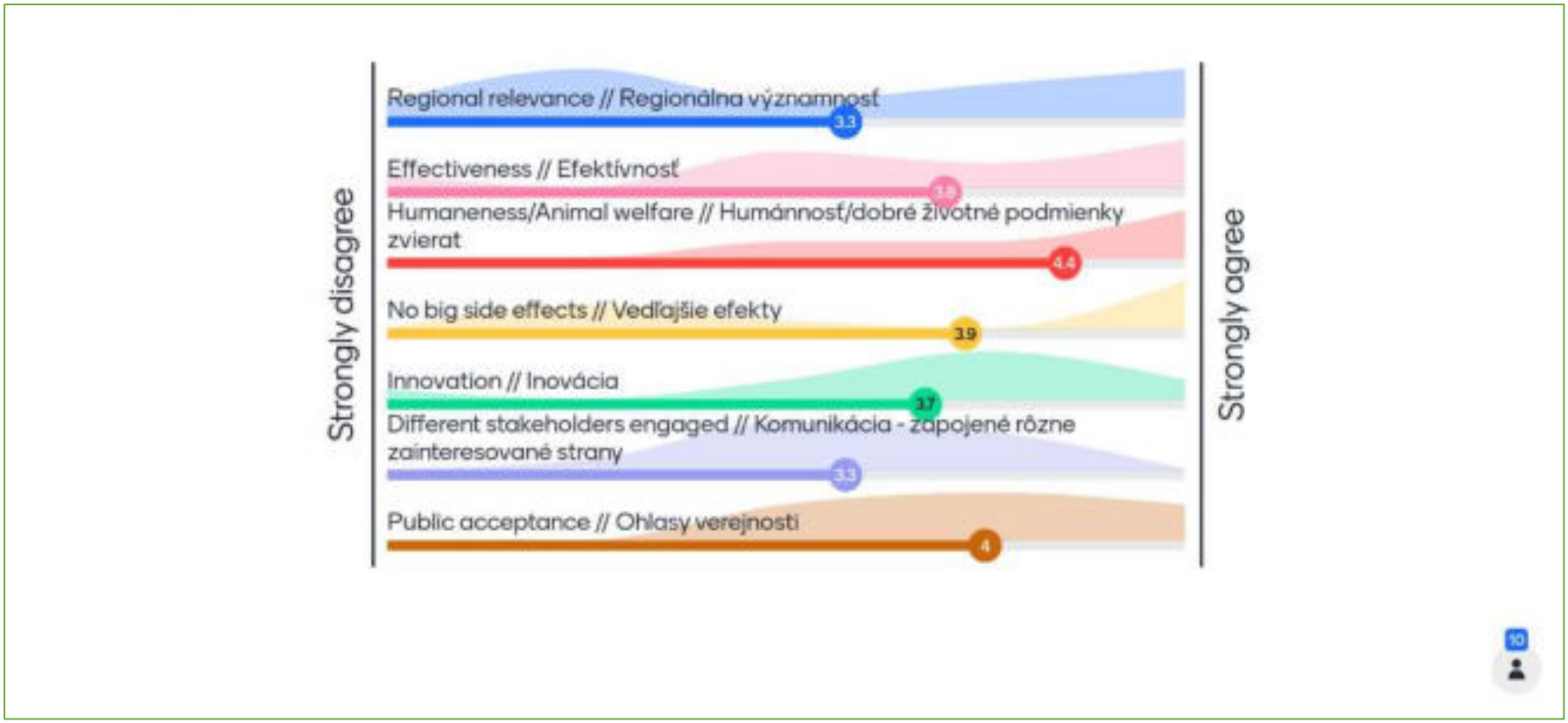


Case study 1 score. Austria: *Pseudorasbora parva*

2.1.3. Case study 2. Slovakia: *Alopochen aegyptiaca*

Group: Birds	
Country: Slovakia	
Entity: State Nature Conservancy of Slovakian Republic (Administration of Protected Landscape Area Dunajské luhy)	
Category	**Response**
Species targeted	*Alopochen aegyptiaca* (Egyptian goose)
Objective(s)	Control
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Hand removal (combined with use of sedatives)
Measures used to remove (dispatch/sterilise/captivity) species	Keeping in captivity
Description of the measure	Problematic specimens of Egyptian goose in the city of Bratislava (Kuchajda Lake) were captured using sedatives. Sedatives were prescribed by a vet, placed into the food. Captured specimens were placed into captivity (ZOO Bratislava).
Time period	May – July 2020
Location and scale of application	Kuchajda Lake, Bratislava, Slovak Republic
Effort	Approx. 5-10 days, per day 2-5 hours/ capturing 5 Egyptian geese
Costs	Overall costs: approximately 10 days/3 hours/2 employees; Personnel costs: approx. 10 €/hour/person; Equipment and infrastructure: sedatives (provided by a vet); Other, including capacity building and overheads: using of a service-car of State Nature Conservancy of SR for transportation of employees and captures specimens.
Source(s) of funding	Budget of the State Nature Conservancy of SR, Slovakia
Effectiveness	Effective
Key evidence/results	5 specimens of Egyptian Goose captured and removed from natural environment during 10 days of effort

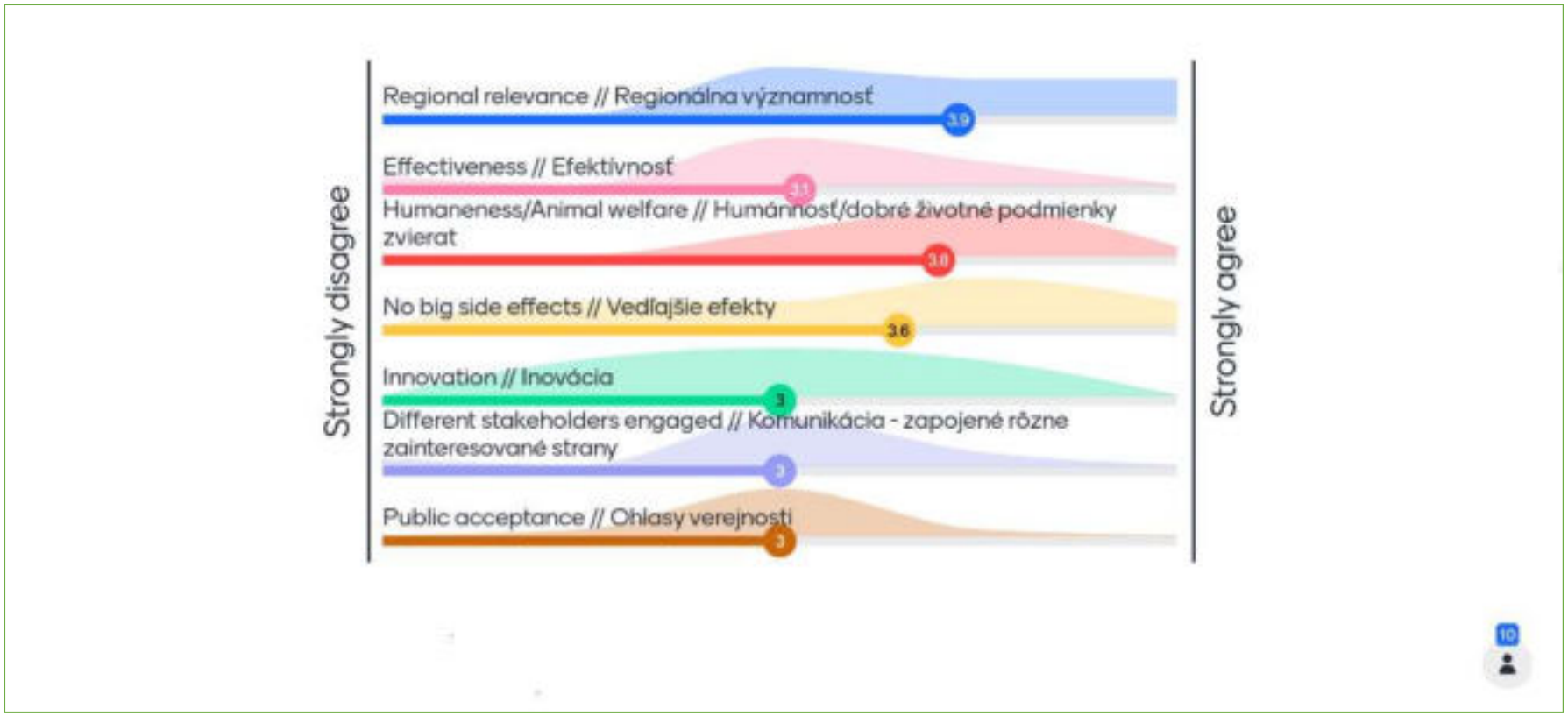
Replicability	Used method is fully replicable. This method can be also used for other IAS, e.g. Indian house crow (*Corvus splendens*), ruddy duck (*Oxyura jamaicensis*), sacred ibis (*Threskiornis aethiopicus*), common myna (*Acridotheres tristis*). If anybody is interested, we can provide details e.g. type/dose of the used sedative.
Humaneness/animal welfare	Used method was fully humane and did not lead to any suffering of birds. But keeping the right dose of the sedative is important.
Public acceptance	Public acceptance of removal of a problematic pair of Egyptian goose from natural conditions in a city (Bratislava) was good.
Side effects	No side effects of the method
Stakeholder engagement – implementation:	State Nature Conservancy of SR, local government, wider public, veterinary surgeon, captive- breeding facilities.
Dissemination	Local, regional and national public media: television, radio, newsletters, etc.
Lessons learned	Method involves a lot of species observation at the site and use of right dose of selected sedative
References	Pačenovský, S. & Lešová, A. 2020: On occurrence and breeding of the Egyptian Goose (*Alopochen aegyptiaca*) in Slovakia. Tichodroma 32: 51-55. [In Slovak with English summary].



Case study 2 score. Slovakia: *Alopochen aegyptiaca*

2.1.4. Case study 3. Slovakia: *Nyctereutes procyonoides*

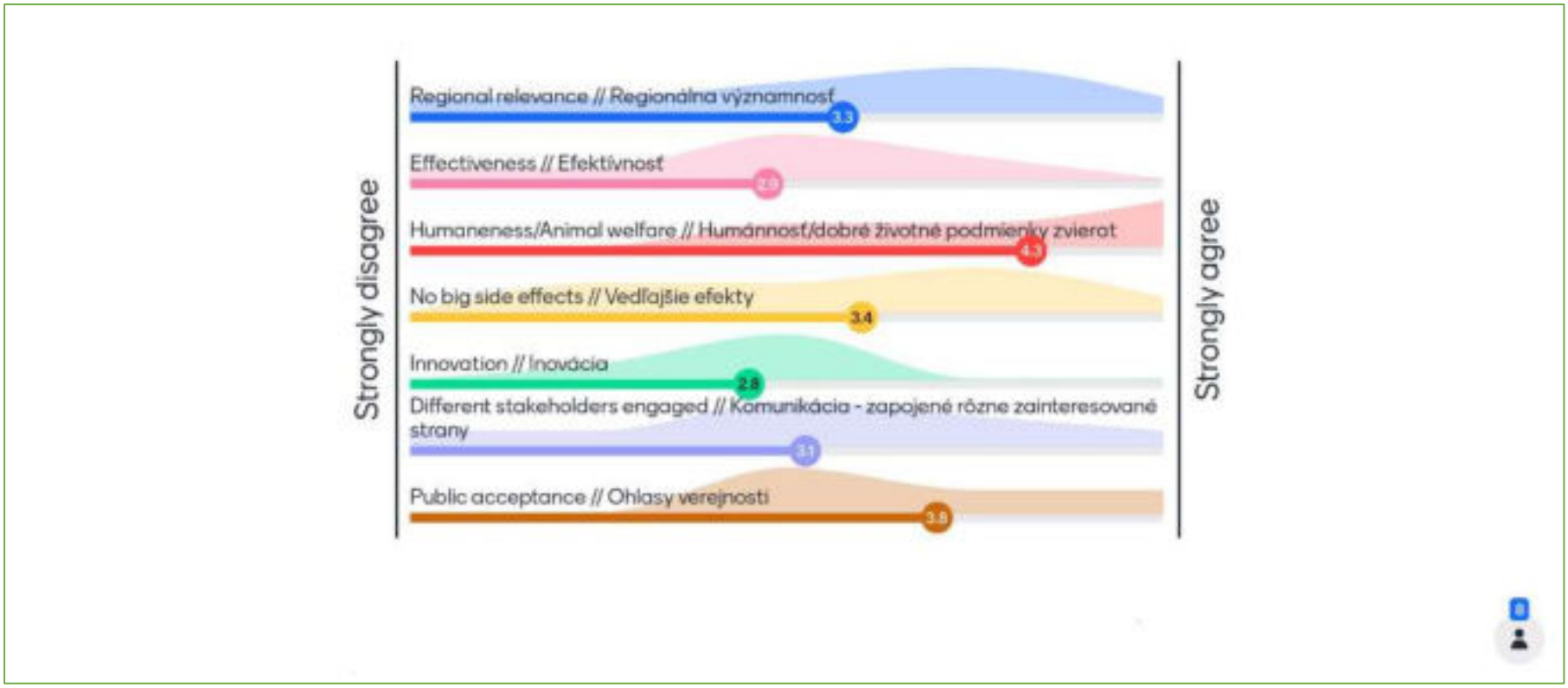
Group: Mammals	
Country: Slovakia	
Entity: ŠOP SR, CHKO Horná Orava	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog)
Objective(s)	Control Containment
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Shooting
Effectiveness	Moderately effective



Case study 3 score. Slovakia: *Nyctereutes procyonoides*

2.1.5. Case study 4. Slovakia: *Trachemys scripta*

Group: Reptiles	
Country: Slovakia	
Entity: State Nature Conservancy	
Category	**Response**
Species targeted	*Trachemys scripta* (Red-eared, yellow-bellied and Cumberland sliders)
Measures used to remove (dispatch/sterilise/captivity) species	Keeping in captivity
Description of the measure	We captured specimens of *Trachemys scripta* at problematic sites, where they can compete with European pond turtle and placed them into captivity.
Time period	May – July 2020
Location and scale of application	Bratislava, Slovak Republic
Effort	The turtles were captured accidentally, so it is not possible to express it in quantitative way
Public acceptance	Public acceptance of removal of non-native turtles from nature is also good
Side effects	No side effects of the measure



Case study 4 score. Slovakia: *Trachemys scripta*

2.1.6. Case study 5. Slovenia: *Carassius auratus*

Group: Fish	
Country: Slovenia	
Entity: Zoosofia, Peter Maričić s.p.	
Category	**Response**
Species targeted	*Carassius auratus* (Goldfish)
Objective(s)	Eradication (of widespread population) Long-term eradication and awareness with the help of pet shops
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Hand removal: Physical fishing methods - including aquatic nets • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Electrocution • Freezing • Keeping in captivity
Description of the measure	Selection of pond with established goldfish population Communication with local community (we remove fish only if agreed with local inhabitants) - Fishing with nets and funnel traps with baits 10-14 day quarantine For every individual the iris is photographed and put into a database for possible future identification Delivery of fish to the pet shops New owners are aware of the origin of the animals and undertake not to release the animals into the wild. They know that all fish can be identified through the database of iris images Some fish are distributed to schools, hospitals, nursing homes..., where "Urban pond with aquaponics" is installed, which ensure facilitated care. This has an attractive appearance and it is a good awareness tool
Time period	Project has started in 2014 and is still ongoing
Location and scale of application	The fish are caught in the Slovenian Coastal-Karst region (1.043 km^2). Applied so far to 9 ponds (measuring from 15 m^2 to 400 m^2) - in most of the ponds populations were merely reduced (7 ponds); and in 2 of the ponds fish

	were completely eradicated. Populations in the last two ponds were small: 9 and 88 gold fish, respectively. The rest of the ponds hold larger populations: from one of them 900 fish were removed at one occasion, but the population is still remaining in the pond. From the largest of these ponds (400 m^2), approximately 1200 fish were removed from 2014, but the population remains enormous (estimated over 10.000 fish).
Effort	Since 2014 eight people have participated on the project, none of them full-time, most were volunteers. Work was not intensive, but spanned mostly during spring/summer season. The field effort was limited due the limited space capacity (aquaria) and demand from the pet shops. Fieldwork included approximately 30 days (1 person for cca. 4 hours), additional time was spent on subsequent work (quarantine and veterinary supervision, database processing).
Costs	13000 € - Personnel costs: 6000 € - Equipment and infrastructure: 4000 € - Other, including capacity building and overheads: 3000 €
Additional details on costs	Labour costs included fieldwork (fishing) and iris imaging, transport of fish, quarantine and veterinary supervision, database processing, development of a prototype biometric system, urban pond with aquaponic development and construction. There was help from volunteers - less in the field and more after the fish were kept in aquaria (iris photography, feeding, etc.).
Source(s) of funding	Private and institutional
Effectiveness	Effective
Key evidence/results	Anyone who bought a goldfish from the environment (ca. 3000 fish) was informed about the invasiveness/harmfulness and about the size that a goldfish reaches as an adult. The project provides a long-term approach, which is why we can expect an increase in the demand of goldfish from the environment in the future. This also means ever-improving efficiency in relieving goldfish from the environment. The main advantage of the project is traceability of fishes. We are upgrading the project to remove more fish - communicating with breeders of animals that could use goldfish as food (e.g. zoos, animal shelters, ...).
Replicability	A similar approach is possible with alien terrapins, both those that are banned and those that are not currently banned. Possible transfer also to other invasive species that are pet-animals, as far as they are made traceable.
Humaneness/animal welfare	Animal welfare was one of the key points that led to this project - fish are captured and then bred in captivity, monitored for health issues. No fish are killed. Removal of fish from nature could have included their killing, but we chose a different - sustainable approach.

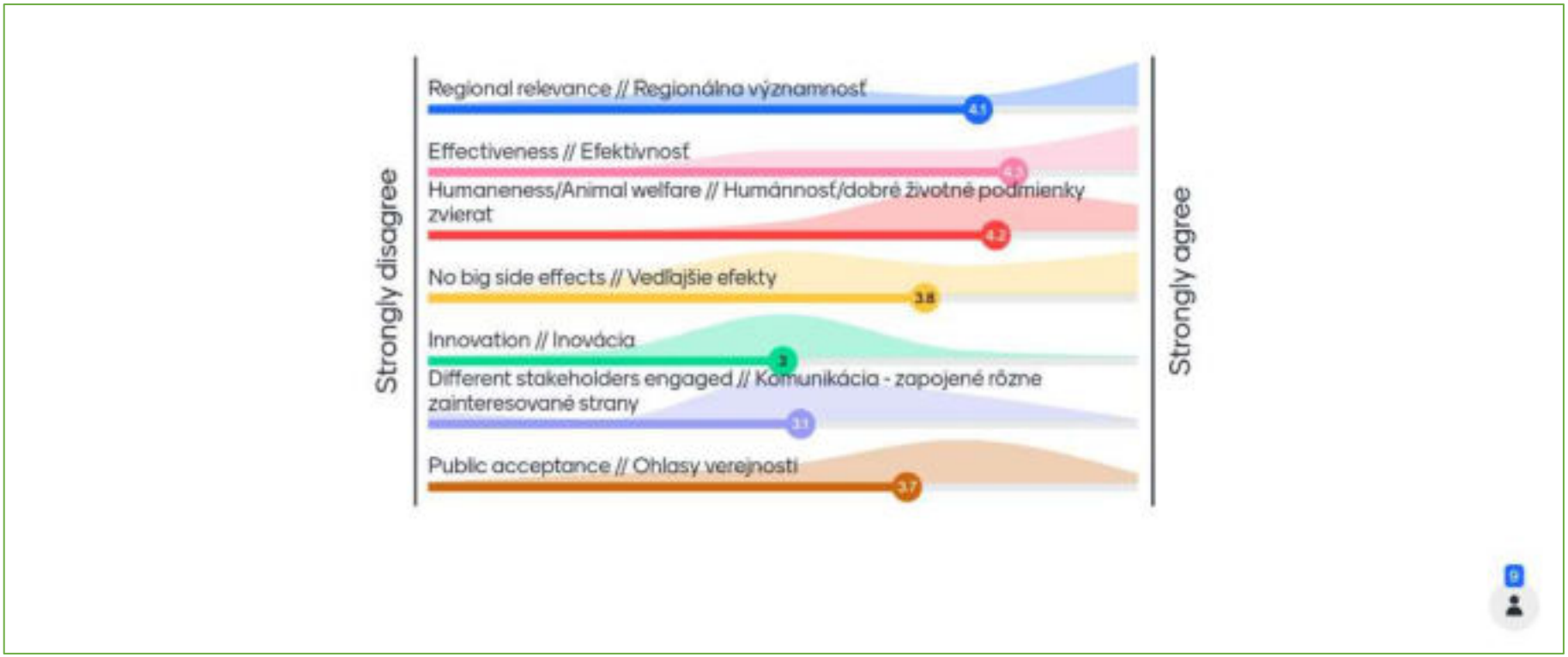
Public acceptance	Presentation of the project on national and local television, numerous interviews in local publications, publication of scientific articles. The public response has always been positive.
Side effects	There are numerous positive effects of the project: - positive effect on the environment (containment of alien fish species affecting the pond environment, especially amphibians, invertebrates and plants) - contribution to more responsible animal trade - ensuring the traceability of animals using (non-invasive) iris scans - using different ways of raising awareness about invasive alien species (e.g. by the development of an urban pond with aquaponics) - raising animal welfare awareness Negative effects: - possible further animal trade - risk of re-release into the environment - relatively few animals removed from the environment, because of the limited demand.
Stakeholder engagement – implementation:	• Zoosofia Peter Maričić s.p.: pioneer of the use of biometric system in the animal trade, fishing goldfish from the environment, quarantine, veterinary supervision, iris imaging and database processing, supply of goldfish to pet shops, developing innovative urban ponds with aquaponic system for terrapins and goldfishes. • Faculty of Mathematics, Natural Sciences and Information Technologies, University of Primorska - Department of Biodiversity: within the project "Biometric Reader as a Tool for Tracing Invasive Animal Species" was demonstrated a practical usefulness of iris recognition technology for 3 different species of animals - Department of Information Science and Technologies (DIST): developed a prototype biometric system for verification of specimens of Italian crested newt (*Triturus carnifex*), goldfish (*Carassius auratus*) and subspecies of pond slider (*Trachemys scripta* spp.). • Slovenian pet stores: sale of goldfish from the environment, responsible trade of animals, raising awareness of invasive species, informing customers that animals are recorded (eye recognition system) in a database, raising awareness on their welfare - local people, usually the custodians of ponds: raising awareness. • Protected areas: For example Škocjan, Caves Park, where some of the project ponds are. The protected areas are aware of the harmfulness of alien species and strive to have ponds in their area restored into natural state (without fish), thus they make a good example and encourage and educate people in their area.
Dissemination	The project raises awareness on several levels: - with the help of animal stores we raise awareness about the harmfulness of invasive animals, we inform customers that it is prohibited to release animals into the natural environment, customers are informed that the animals are recorded and traceability is ensured - sale of urban ponds with aquaponics to educational and medical institutions. One of the reasons for releasing animals into the environment is also demanding care. For this reason we teach children and the general public about the appropriate conditions and care for terrapins and goldfish.

Innovation	Prototype biometric system for verification of specimens of goldfish (*Carassius auratus*), Italian crested newt (*Triturus carnifex*), and subspecies of pond slider (*Trachemys scripta* spp.). Innovative way to raise awareness by using pet shops like awareness booster and animal adoption accelerator. Urban pond with aquaponics which can be placed both indoors and outdoors and is an interesting awareness tool.
Lessons learned	Prohibition of certain species on market has been proven to be ineffective. One example is the ban on *Trachemys* (sub)species, where a trader finds another (sub)species to offer to the market which becomes also invasive. For this reason it is necessary to find a new, innovative way to raise awareness and strive for responsible animal trade.
References	Marušič A. 2016. Biometrični sistem za identifikacijo živali na podlagi očesne šarenice. https://www.famnit.upr.si/files/zakljucna_dela_repo/471 (Biometric System for Animal Identification Based on Iris Identification; final project paper)

2.1.7. Case study 6. Slovenia: *Lithobates catesbeianus*

Group: Amphibians	
Country: Slovenia	
Entity: Herpetološko društvo - Societas herpetologica slovenica	
Category	**Response**
Species targeted	*Lithobates catesbeianus* (North American bullfrog)
Objective(s)	Rapid eradication (early stage intervention)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	Keeping in captivity
Description of the measure	On 30.5.2014 and 9.6.2015, the area of the two lakes in Fiesa on the Slovenian coast (Gauss– Krüger coordinates Y: 389643, X: 43056 [lat.: 45.523007, long.: 13.582537]) was checked for amphibian activity. Afterward, a two-day field work on invasive species within the framework of activities carried out by Societas herpetologica slovenica was conducted on 27. and 28. 9. 2015. Because of the steep and overgrown water edges, most of the work was done from boats. Both lakes were checked for amphibian activity and sampled with dipnets where possible. 20 funnel traps were set on the shore of both lakes.
Time period	20 funnel traps were set on the shore of both for only two days
Location and scale of application	Two small lakes (0, 0185 km^2). Population size: unknown (only a male bullfrog advertisement call was heard and recorded prior the intervention).
Effort	The intervention was done by a NGO (Herpetological society - societas herpetologica slovenica). - 6 persons were involved for two days/12 h per day 20 traps were laid out on 0, 0185 km^2 lake size.
Costs	7000 € - Personnel costs: 5000 € - Equipment and infrastructure: 1500 € - Other, including capacity building and overheads: 500 €

Additional details on costs	The specified costs are an estimation. All the work was done voluntarily by the Herpetological society. The equipment used were an inflatable boat and 20 funnel traps.
Source(s) of funding	Private NGO funds
Effectiveness	Moderately effective
Key evidence/results	The heard male bullfrog was captured on the first day that the traps were laid out. The measure is only moderately effective due to the lack of the population estimation prior the intervention and no follow-up was done to ensure that no more bullfrogs were present on the location.
Replicability	The measure is transferable to new areas and replicable
Humaneness/animal welfare	The individual has been transferred to a Zoo where it is held in captivity. The individual was also tested for possible diseases like chytridiomycosis.
Public acceptance	No negative comments have been reported
Stakeholder engagement – implementation:	NGO, scientists, national body for nature protection, Ministry for environment
Dissemination	No communication activities were undertaken prior the intervention. After the intervention a report was send to the Ministry for environment and spatial planning and to the Institute of the Republic of Slovenia for Nature Conservation.
References	All work has been published in the scientific journal *Natura Sloveniae* and is available at the following link: https://www.dlib.si/stream/URN:NBN:SI:DOC-6PNBRNIS/ae90d69f-140a-4cd9-985d71d69370896f/PDF Kirbiš, N., Bedjanič, M., Kus Veenvliet, J., Veenvliet, P., Stanković, D., Lipovšek, G., Poboljšaj, K. (2016). First records of the American bullfrog *Lithobates catesbeianus* (Shaw, 1802) in Slovenia. *Natura Sloveniae* 18(1): 23-27.

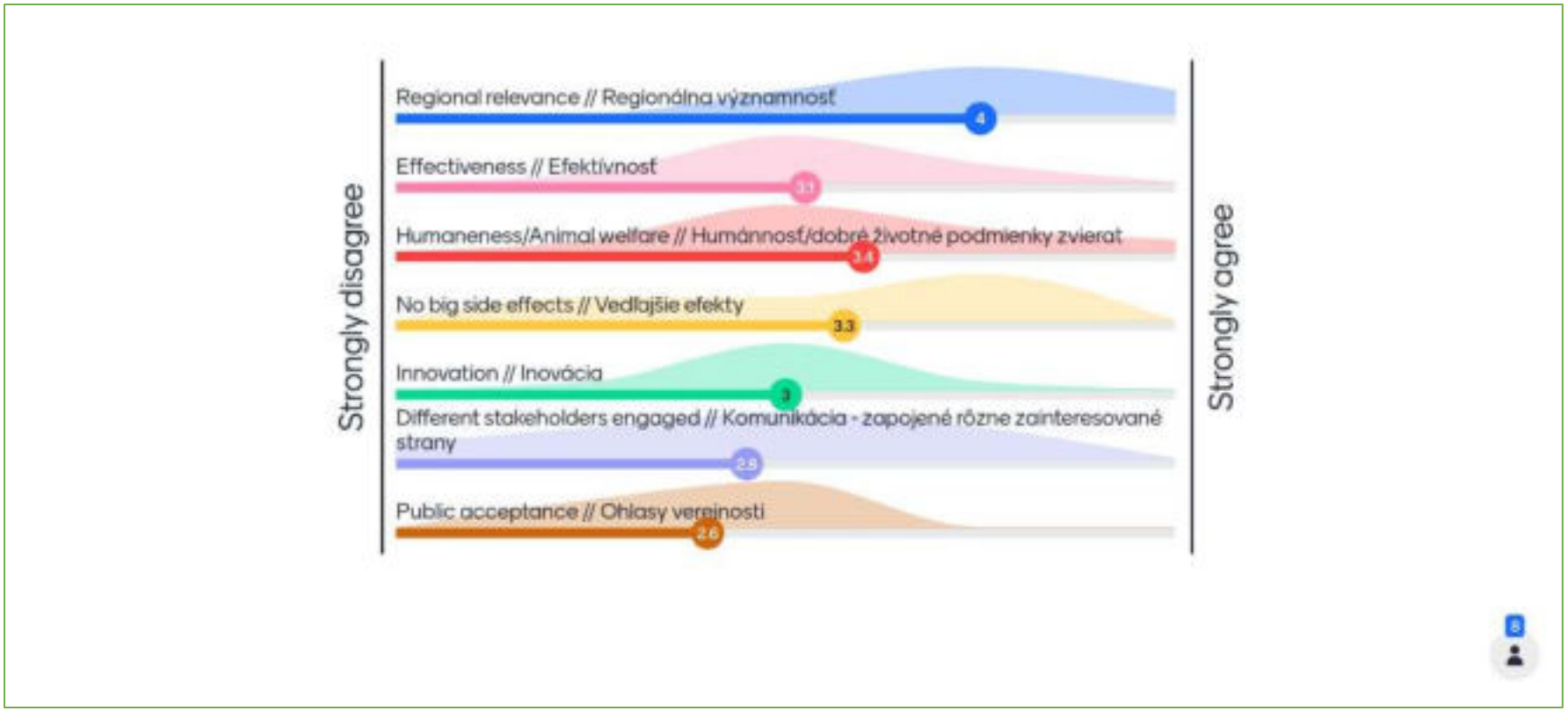


Case study 6 score. Slovenia: *Lithobates catesbeianus*

2.1.8. Case study 7. Slovenia: *Trachemys scripta*

Group: Reptiles	
Country: Slovenia	
Entity: Fisheries Research Institute of Slovenia	
Category	**Response**
Species targeted	*Trachemys scripta* (Red-eared, yellow-bellied and Cumberland sliders)
Objective(s)	Eradication (of widespread population). We are trying to remove as many individuals from Vipava valley in western Slovenia. Control: We are trying to completely remove invasive turtles from ponds that hold a population of indigenous European terrapin (*Emys orbicularis*).
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Hand removal: Hand removal • Hand removal: Physical fishing methods - including aquatic nets • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Injection euthanasia
Description of the measure	Main method of collecting invasive turtles in nature is by using the fishing traps for catching crabs. These are big enough to allow the entry of even the largest individuals. We use a mixture of freshwater fish and fish food to attract the turtles. We set the traps in a way that allows the captured turtles to come to the surface for air and they don't drown. We check the traps periodically with no more than 3 days apart. Besides fishing traps we also use a common fishing net on a handle for collecting juveniles and occasionally we catch adults by hand, if the conditions allow it. No other methods of collecting have been used so far.
Time period	April - October depending on the weather situation
Location and scale of application	The location of eradication is in Vipava valley in western Slovenia. The invasive turtles eradication is done under an environment protection project called Project VIPava and the starting aim was to remove at least 100 individuals from Vipava valley. So far, after 3 years of field work, we have collected and removed more than 420 individuals. The eradication area is entire Vipava valley, so about 300 square kilometers, but we only focus on waterways and ponds in the valley.

Effort	2 persons for about 50 hunting days per year. In a typical hunting day we set and check about 20 traps for turtles.
Costs	No information
Source(s) of funding	EU and Republic of Slovenia
Effectiveness	Effective
Key evidence/results	We have so far removed more than 400% more turtles than we initially estimated
Replicability	There were similar projects with similar methods implemented in Slovenia in the past years, although nothing on such a large scale as project VIPava.
Humaneness/animal welfare	We tried to find the most humane method of catching and euthanizing turtles. We concluded the fish traps, that are regularly checked and injection euthanasia are the best and most humane options.
Public acceptance	Since the turtles are seen as positive in Slovenia we've had quite a lot of negative responses when the public found out about euthanisations. Therefore, we are not publicizing this aspect too much. If someone asks directly, where do we put the turtles, we of course tell the truth, but we also try to argument that this is actually the only available method, that the law dictates these turtles to be euthanized, that they (invasive turtles) are expanding rapidly and are very harmful to our only indigenous turtle specie. And we try to compare with other animals...like no one bats an eye if we kill 1000 rats, but we euthanize one invasive turtle and everyone loses their minds.
Side effects	Not much negative impact was recorded. There is some amount of bycatch (mostly fish and amphibians), but they are usually still alive and set free.
Lessons learned	It is more or less impossible to completely eradicate an invasive turtle species from the nature

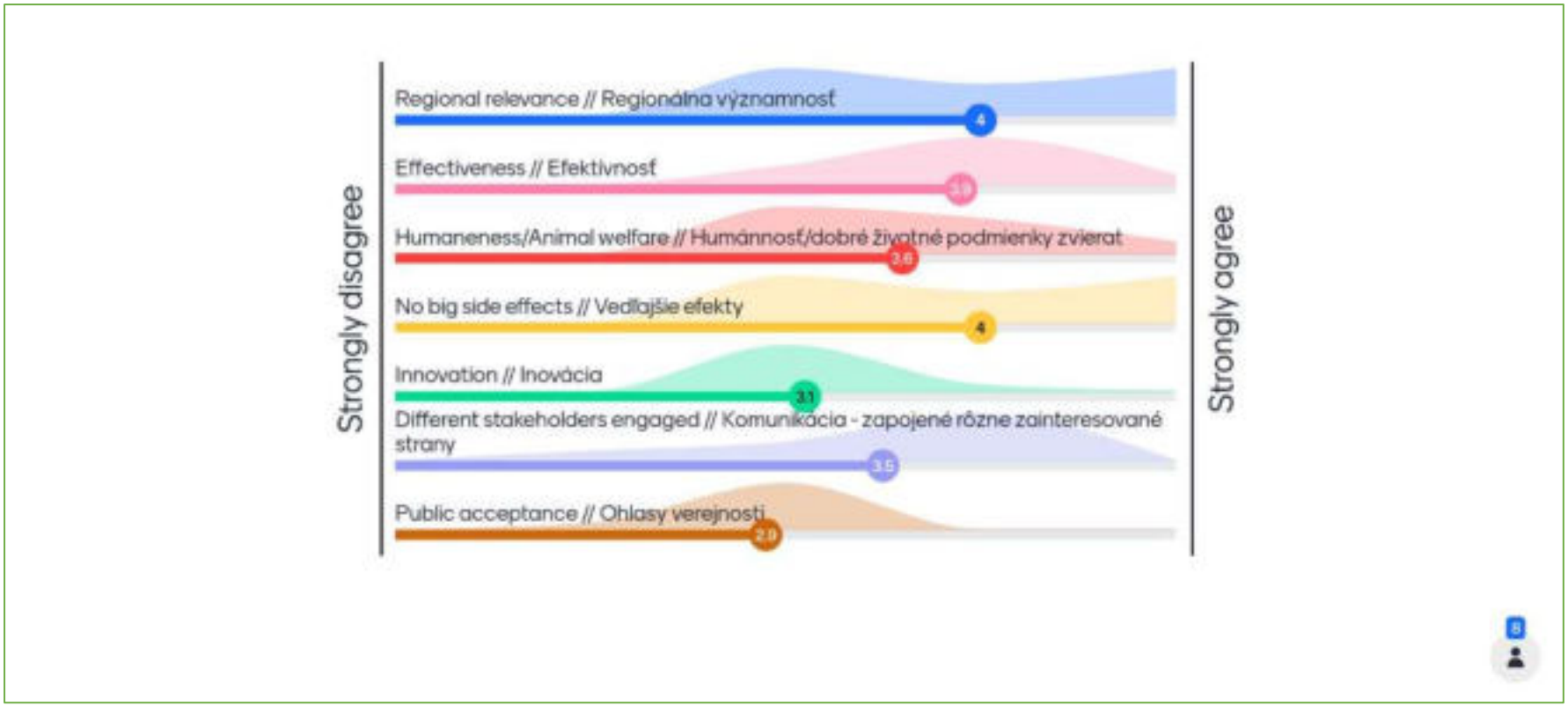


Case study 7 score. Slovenia: *Trachemys scripta*

2.1.9. Case study 8. Slovenia: *Trachemys scripta*

Group: Reptiles	
Country: Slovenia	
Entity: Zavod Republike Slovenije za varstvo narave (Institute of the Republic of Slovenia for Nature Conservation)	
Category	**Response**
Species targeted	*Trachemys scripta* (Red-eared, yellow-bellied and Cumberland sliders)
Objective(s)	Control
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Hand removal: Hand removal • Hand removal: Physical fishing methods - including aquatic nets • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Injection euthanasia
Description of the measure	Aquatic nets - hoop nets with bait Pyramid net with bait Hand nets
Location and scale of application	Small scale – local pond
Effort	Hoop nets – 5 days Pyramid nets – 2 hours/day Hand nets – 7 days Total of 7 days (1-2 person)
Costs	4000 €
Source(s) of funding	Government funding and Climate funds
Effectiveness	Moderately effective
Key evidence/results	We caught 12 individuals the first year and 2 individuals the second year using the same method
Replicability	The method is transferable for other areas (smaller ponds)

Humaneness/animal welfare	Hoop nets are installed in a way that one third of the net is outside of the water, so that captured animals do not drown. Hoop nets are checked each day to shorten the time in captivity for native and non-native animals.
Public acceptance	Local people were interested in what we are doing and what will happened with captured pond sliders. We provide information also about euthanasia. People would prefer non-lethal methods.
Side effects	Not much negative impact was recorded. There is some amount of bycatch (mostly fish, amphibians and snakes), but they are usually still alive and set free.
Dissemination	Management action was implemented near touristic facility. We obtained permission from the director of the hotel. We communicated why we are conducting the management action and the methodology. Each day, when contractor was on site, he was communicating with tourists and local people who came by the pond.
Lessons learned	Complete eradication of *Trachemys scripta* from the pond is not possible due to its proximity to touristic facilities and local community. People from wider surrounding areas are also bringing individuals to the pond, if they do not want to/cannot take care of them anymore. The pond is located near the Natura 2000 area (designated for the protection of European pond turtle (*Emys orbicularis*)). The long-term control measures are needed to prevent the spread of *Trachemys scripta* into the protected area.
References	Govedič, M., A. Lešnik & G. Lipovšek, 2019. Izlov tujerodnih želv iz Lotosovega ribnika v Šmarjeških Toplicah. Poročilo. Center za kartografijo favne in flore, Miklavž na Dravskem polju. 10 str. [Naročnik: Zavod republike Slovenije za varstvo narave, Ljubljana]



Case study 8 score. Slovenia: *Trachemys scripta*

2.2. Atlantic Region: Belgium, France, Ireland, Netherlands (and UK)

2.2.1. Summary of case studies submitted for the Atlantic region

	Country	Entity submitting	Species	Measures used to restrain, capture and/or remove (kill/sterilise) the species	Measures used to remove (dispatch/sterilise/captivity) species	Average score at workshop
1	Belgium	Service Public de Wallonie	*Procyon lotor*	Trapping: spring operated traps Trapping: cage traps	Shooting - dispatch restrained animals	3.9
2	Belgium	Flemish Environment Agency, INBO	*Myocastor coypus*, *Ondatra zibethicus*	Trapping: drowning traps Trapping: spring operated traps Trapping: cage traps	Cervical dislocation Shooting - dispatch restrained (and wounded) animals	3.5
3	Belgium	RATO vzw/ Rattenbestrijding Oost-Vlaanderen	*Alopochen aegyptiaca*	Trapping: live decoy traps (Larsen-type traps with decoy bird)	Decapitation Modified atmospheres	3.9
4	France	Office Français de la Biodiversité - Direction de la recherche et de l'appui scientifique	*Callosciurus erythraeus*, *Muntiacus reevesi, Myocastor coypus, Neovison vison*, Nyctereutes procyonoides*, *Ondatra zibethicus*, *Procyon lotor*, *Tamias sibiricus*	Shooting Trapping: cage traps, spring operated traps	Cervical dislocation Cranial depression Injection euthanasia Keeping in captivity Shooting - dispatch restrained animals	3.3
5	France	Office Français de la Biodiversité (UMS Patrinat, CNRS, MNHN)	*Callosciurus erythraeus*, *Tamias sibiricus*	Trapping: cage traps Shooting	Cervical dislocation Cranial depression Shooting - dispatch restrained (and wounded) animals	3.5
6	France	Association Départementale des Piégeurs Agréés de la Gironde	*Myocastor coypus, Ondatra zibethicus*, *Procyon lotor*	Trapping: cage traps	Shooting - dispatch restrained animals	3.2
7	France	Communauté de Communes de la Dombes	*Myocastor coypus*, *Ondatra zibethicus*	Habitat manipulation: aquatic habitat management - Pond drying/draining Shooting, Trapping: cage traps	Injection euthanasia Shooting - dispatch restrained animals: small calibre rifles	3.3

	Country	Entity submitting	Species	Measures used to restrain, capture and/or remove (kill/sterilise) the species	Measures used to remove (dispatch/sterilise/captivity) species	Average score at workshop
8	France	POLLENIZ (Réseau pour la santé du végétal en Pays de la Loire)	*Myocastor coypus*, *Ondatra zibethicus*	Shooting Trapping: cage traps	Cervical dislocation Cranial depression Shooting - dispatch restrained animals Slaughter with a knife	3.3
9	France	FREDON Hauts-de-France	*Myocastor coypus*, *Ondatra zibethicus*	Trapping: Spring operated traps Trapping: Cage traps	Cranial depression Shooting - dispatch restrained (and wounded) animals Slaughter with a knife	3.2
10	France	Bayer Environmental Science	*Myocastor coypus*, *Ondatra zibethicus*	Trapping: cage traps (connected traps)	Keeping in captivity	N/A[1]
11	France	Métropole Européenne de Lille	*Alopochen aegyptiaca*, *Branta canadensis**, *Ondatra zibethicus*	Hand removal Trapping: cage traps Fertility control: shaking the eggs	Cervical dislocation Shooting - dispatch restrained (and wounded) animals	3.2
12	France (Martinique)	DEAL Martinique	*Herpestes javanicus*	Trapping: Goodnature self-resetting traps Trapping: cage traps	Shooting - dispatch restrained (and wounded) animals	N/A[2]
13	France (and Germany)	European Federation for Hunting and Conservation (FACE)	*Myocastor coypus*	Additional measures: bowhunting	Shooting - dispatch restrained animals	3.3
14	Netherlands	Dutch Mammal Society	*Callosciurus erythraeus*	Trapping: cage traps	Keeping in captivity Surgical sterilisation	4.2
15	Netherlands	Province of Limburg	*Procyon lotor*	Trapping: cage traps	Keeping in captivity	3.9
16	Netherlands	Dutch Water Authorities	*Myocastor coypus*, *Ondatra zibethicus*	Trapping: drowning traps Trapping: spring operated traps Trapping: cage traps Trapping: Live decoy traps Other methods: hunting dogs, Judas animals	Shooting - dispatch restrained animals	3.6

* Vertebrate IAS not on the Union list

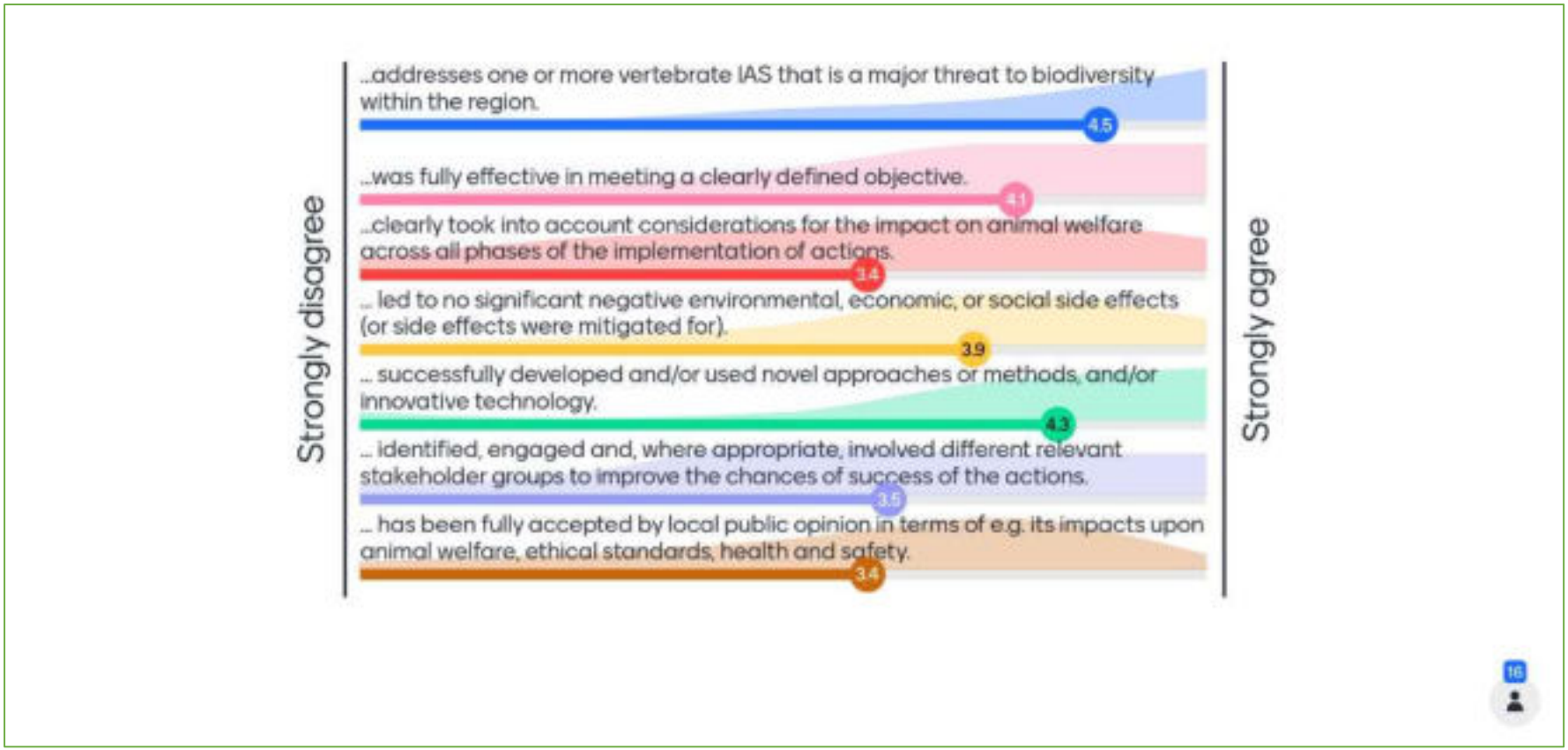
[1] Case study presented at the workshop but not scored, as it refers to a general measure

[2] Case study not scored as it provided an example from the French Outermost Regions

2.2.2 Case study 1. Belgium: *Procyon lotor*

Group: Mammals	
Country: Belgium	
Entity: Service Public de Wallonie (Invasive Species Unit)	
Category	**Response**
Species targeted	*Procyon lotor* (Raccoon)
Objective(s)	Control: Reduce population abundance and mitigate impact on biodiversity and ecosystem services
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Trapping: Spring operated traps • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Shooting - dispatch restrained animals
Description of the measure	Wire cages (live traps) and adapted conibears (killing traps). Conibears were adapted to reduce by-catch of non-target organisms. The reduction of raccoon population by trapping was motivated to suppress wild boar trap triggering by raccoons and increase trapping effectiveness in the framework of African swine fever control.
Time period	15th May 2019 - 30th September 2020
Location and scale of application	Southern Belgium, over the area contaminated by African Swine Fever (1.106 km^2)
Effort	40 live traps and 70 conibears were used over the whole trapping area. Traps were moved from site to site during the trapping campaign, once local depopulation of raccoons was observed.
Costs	No accurate estimation of control cost was calculated
Source(s) of funding	Government (Service Public de Wallonie)
Effectiveness	Effective
Replicability	1,685 raccoons killed, leading to a population reduction by > 50%. Wild boar trap triggering by raccoons was suppressed, together with a decrease of complaints from local residents by 80% in the control area.

Humaneness/animal welfare	Animal welfare considerations were taken into consideration when designing trapping design. Live traps were visited once per day to reduce animal stress as much as possible. Killing time by adapted conibears was measured and proved to be less than 1 minute.
Public acceptance	No strong opposition by the public was encountered because public access was limited due to measures taken to eradicate African swine fever in this area. Managers were motivated to reduce raccoon densities to improve trapping efficiency of wild boars.
Side effects	By-catch rate was assessed as < 0.5% due to high trapping selectivity (corvids, ermine, marten and red squirrel)
Stakeholder engagement – implementation:	Rat catchers, foresters and hunters collaborate in the catching effort
Innovation	Adaptation of the triggering mechanism of conibears allowed to strongly increase trap selectivity
Lessons learned	The control campaign demonstrated the high catchability of raccoons using traps and that their use allows to strongly reduce population density at large scale. Short killing time by adapted conibears (< 1 minute) allows to comply with animal welfare concerns.
References	Mazzamuto, M. V., Panzeri, M., Bisi, F., Wauters, L. A., Preatoni, D., & Martinoli, A. (2020). When management meets science: adaptive analysis for the optimization of the eradication of the Northern raccoon (*Procyon lotor*). *Biological Invasions*, 22(10), 3119-3130. Suzuki, T., & Ikeda, T. (2020). Invasive raccoon management systems and challenges in regions with active control. *BMC ecology*, 20(1), 1-13.



Case study 1 score. Belgium: *Procyon lotor*

2.2.3. Case study 2. Belgium: *Myocastor coypus* and *Ondatra zibethicus*

Group: Mammals	
Country: Belgium	
Entity: Flemish Environment Agency (VMM) and Research Institute for Nature and Forest (INBO)	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu), *Ondatra zibethicus* (Muskrat)
Objective(s)	Rapid eradication: coypu (influx from the Netherlands) Control: The aim is to manage Flanders as a muskrat free area with continuous control at the borders
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Trapping: Drowning traps • Trapping: Spring operated traps • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Cervical dislocation • Shooting - dispatch restrained (and wounded) animals
Description of the measure	General guidelines: - The quantity and the location of the trapping material set out in the field is proportional to the number and nature of muskrat traces and the risk of bycatch. Active control, in which trapping material is only placed where there are clear indications of the presence of muskrat, is the current standard method of control. In addition to the known traces (food remains, faeces, burrows, etc.), detection by means of eDNA is also a sufficiently clear indication of the presence of muskrat. Passive control can only be carried out under exceptional circumstances, specified per trap type. <u>The Conibear trap type</u> Setting the Conibear trap (e.g. Woodstream): The two bars of the trigger mechanism are spread apart in the opening of the frame. Bait should not be used. With one hand, the spring is strongly compressed, allowing the two jaws to rotate relative to each other. With the other hand, the two jaws are turned so that the dog can be placed in the opening at the top of the trigger mechanism. The underlying jaw is fitted into the dog in one of the notches. The pressure on the spring can then be relaxed and the trap is set. This trap should be secured, for instance with pickets: to position the frame correctly, and to put through (the ring on) the chain to anchor the trap to the river bed or bank.

Use of the Conibear trap: This trap is placed underwater in front of or in an active den entrance (i.e. one where there are traces of muskrat activity), or on an actively swum trail, preferably with the spring horizontal. It should be checked at least once a week and may stay in the same place for a maximum of three weeks. This is the standard method for trapping muskrats; all other trapping methods are subject to additional conditions of use. It may only be placed partially (i.e. max. one-third) above-water if this is done in front of a clearly active den entrance; placement in this case should be intended to trap an animal that is present in the den. Measures should be taken where possible to prevent animals from approaching the traps from outside. To this end, the trap can be screened off with wire, branches, stakes, pickets or other material that prevents access to it.

The ground trap type

Setting the ground trap: The two jaws are pulled apart until the moving part on the trigger mechanism is opposite the moving jaw. The short moving plate on this moving jaw, the blade, is rotated over the end of the long bent bar of the trigger mechanism and placed in the notch on the moving part, the dog. The dog is retracted until the blade extends neatly into the notch and the wires are tightened between the two jaws. This type of trap is used without further securing by means of picket.

Use of the ground trap: This trap is only placed underwater in front of or in an active den entrance (i.e. one where there are traces of muskrat activity), or on a trail actively swum by muskrats where use of the Conibear is inadvisable. The use of bait is not permitted. It is placed like a roof over the trail with the trigger mechanism at the bottom, so that the wires are stretched horizontally across the trail. On a soft river bed, the trap can also be placed on one side with the moving jaw at the bottom and the dog at the top. This reduces sinkage in the mud. Only in exceptional cases may the trap be placed partially above water, and only when it is not technically possible to place a Conibear trap (e.g. because the river bed or bank has been hard surfaced). Placement should be aimed at trapping an animal that is present in the den.

Measures should be taken to prevent animals or passers-by from approaching the traps from outside. To this end, the trap can be screened off with wire, branches, stakes, pickets or other material that prevents access to it. Ground traps should be checked within one week and may stay in the same place for a maximum of three weeks.

The bait trap type

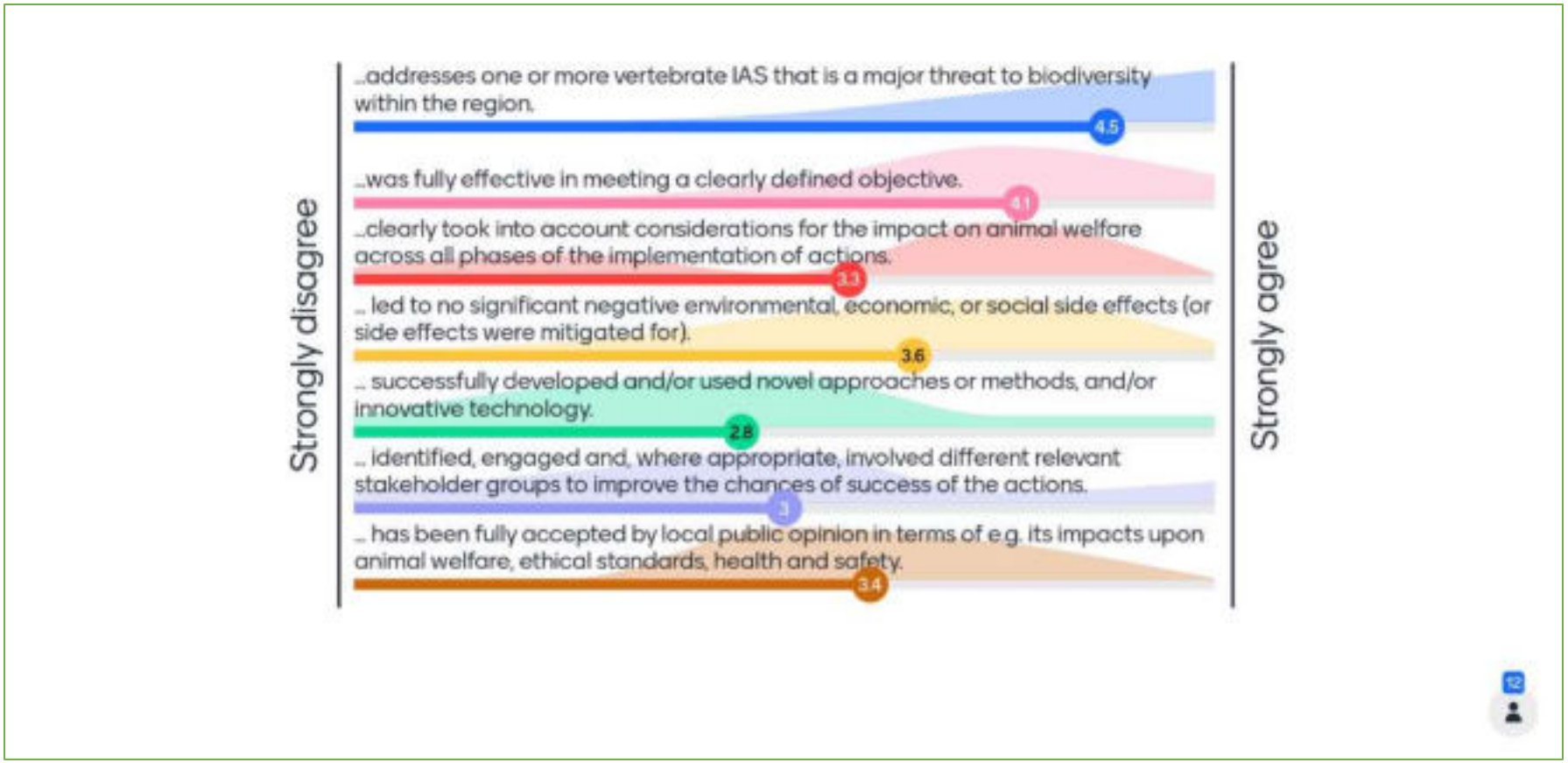
Setting the bait trap: The bracket is rotated over the moving jaw and the trigger mechanism is slid into the centre of the bracket. Only a piece of carrot may be attached as bait to the rods of the trigger mechanism. The two jaws are now pulled apart until the bracket fits into the notch in the hook on the moving jaw. The hook must also fit in the opening between the fastening points of the trigger mechanism, and the rod for the pecking protection must be at the top of the moving jaw.

Use of the bait trap: May only be used in places where the pipes or the bed of the watercourse are inaccessible or where placing equipment underwater is not recommended due to the current. The trap is placed on the bank in the vicinity of active muskrat trails, max. 1 m from the waterline. The trap is positioned with the springs away from the water. Measures must be taken to hinder/prevent the trap from being approached from behind, for example by installing a wire cover or by digging the trap into the bank. The traps may also be mounted on a raft. This must be properly anchored to the bed or bank of the watercourse. The raft must be fitted with a wire mesh cover or an individual screen for each trap that sufficiently restricts access to the traps.
Traps should be checked each week and may stay in the same place for a maximum of three weeks. Bait traps may also be placed during the spring migration (1st February - April 15th) of muskrats in the border zone with France, Wallonia and the Netherlands where an important influx of muskrats is observed. In this case it is not necessary to place the traps in the vicinity of active muskrat trails. During this period, the bait traps may be placed in this border zone up to 1km from the border and a maximum of 1 m from the waterline or on rafts.
The cage trap type
Set-up: A check should be made to ensure that the doors can move freely and close quickly.
Use: This trap is only placed underwater in front of or in an active den entrance (i.e. one where there are traces of muskrat activity), or on a trail actively swum by muskrats where use of a body-grip trap is not feasible. The top of the cage must always be at least 5 cm below the waterline. Users must take account of changing water levels. The (combined) width of the cage trap(s) should never exceed half of the width of the stream.
Cage traps should be checked twice per week and may be left in the same location for up to two weeks. Cage traps may also be placed during the spring migration (1st February - April 15th) of muskrats in the border zone with France, Wallonia and the Netherlands where an important influx of muskrats is observed. In this case it is not necessary to place the traps in the vicinity of active muskrat trails. During this period, the cage traps may be placed in this border zone up to 1 km from the border.
The funnel trap type
Use: This trap may only be used for catching muskrat underwater, and exclusively in circumstances where the use of the previously listed traps is impossible, for example in watercourses that are too deep or on river banks that are too concave, making den entrances inaccessible. The top of the trap must always be at least 5 cm below the waterline. Users must take account of changing water levels. The (combined) width of the funnel trap(s) should never exceed half of the width of the stream.
Funnel traps should be checked twice per week and may be left in the same location for up to two weeks. Funnel traps may also be placed during the spring migration (1st February - April 15th) of muskrats in the border zone with France, Wallonia and the Netherlands where an important influx of muskrats is observed. In this case it is not

	necessary to place the traps in the vicinity of clear muskrat traces. During this period, the funnel traps may be placed in this border zone up to 1 km from the border. Artificial burrows or stovepipe traps consist of cage traps placed into PVC pipes. The cage trap inside the pipe must always be at least 5 cm below the waterline. Users must take account of changing water levels. They may only be placed during the spring migration (1st February - April 15th) of muskrats in the border zone with France, Wallonia and the Netherlands up to 1 km from the border. They should also be checked twice per week. The live cage trap type Setting: A check should be made to ensure that the doors can move freely and close. Use: This trap is only used above water to catch muskrats in the period from the first of May until the 30th of September, when there are indications that young are present in the lodge or burrow. They are only set up in front of a lodge or in front of a burrow whose entrance is above the waterline due to drought (Figure 12). No bait is used. They should be checked within 24 hours of set-up and removed after a maximum of 3 nights. If max. daytime temperatures above 20°C are forecast, the traps should be protected from the sun and checked in the morning. If an animal other than a muskrat or brown rat is caught, it must be released immediately. Muskrats or rats that are caught are killed immediately using the most humane method: body-grip traps such as the Conibear or the ground trap can be used for this.
Time period	Conibears can be placed in the vicinity of muskrat traces for a maximum of 3 weeks. Ground traps can be placed in the vicinity of muskrat traces for a maximum of 3 weeks. Bait traps can be placed in the vicinity of muskrat traces for a maximum of 3 weeks or for longer during spring migration (1st February - April 15th). Funnel traps can be placed in the vicinity of muskrat traces for a maximum of 2 weeks or for longer during spring migration (1st February - April 15th). Cage traps can be placed in the vicinity of muskrat traces for a maximum of 2 weeks or for longer during spring migration (1st February - April 15th). Live cage traps can be placed in the vicinity of muskrat traces for a maximum of 3 nights. Artificial burrows can only be placed during the spring migration (1st February - April 15th).
Location and scale of application	This Best Practice is applied in the whole region of Flanders (13,625 km²) although most catches occur near the borders with France, the Netherlands and the region of Wallonia. No population estimates are available but there were a total of 5.822 muskrat catches in 2019.
Effort	There are 65 full time equivalents in public service for which pure muskrat work represents about 20 full time equivalents. It is coordinated centrally as well as at catchment level (3 coordinators each responsible for 3-4 basins). This is complemented with other management actors, such as provincial and municipal trappers, Rattenbestrijding Oost-Vlaanderen (RATO vzw) and Polders and Wateringen.

Costs	No specific information on costs
Source(s) of funding	Government institutions
Effectiveness	This best practice has taken effect in November 2020 therefore it is not possible to determine its effectiveness yet. In the three provinces that have been managed according to these principles for several years muskrat catches are consistently low and only occurring at the border.
Replicability	This best practice could easily be applied in other areas to trap muskrats. Coypu inhabit the same niche as muskrats and some of the methods described in the best practice could therefore be applicable to them as well.
Humaneness/animal welfare	One of the aims of the best practice was the use of trapping methods in which animal welfare is maximised by killing the animals as quickly and painlessly as possible. The frame of reference here is the provisions of the Agreement on International Humane Trapping Standards (AIHTS). The evaluation of the various traps used to control muskrats has taken into account not just the characteristics of the traps themselves, but the way in which they are used in the field. The design and trigger mechanism of a trap may be completely non-selective, yet its prescribed use according to the code makes bycatch fairly unlikely. Conversely, the trapping equipment with the best results in terms of selectivity may score poorly in terms of animal welfare; its use is only permitted in specific, exceptional situations. The preference was given to body-grip traps, mechanical traps that kill the animal by the impact and clamping force of a moving jaw on the body, while drowning traps (funnel traps and underwater cages) are only permitted in exceptional circumstances. The use of rodenticides is prohibited for the control of muskrats.
Side effects	4% of all catches made are by-catches. These are usually common waterfowl or voles. Muskrat burrowing causes dykes and levees to become unstable and even collapse, resulting in flooding. Keeping the muskrat population at a sufficiently low level prevents these damages and the associated economic costs.
Stakeholder engagement – implementation:	The best practice was established following consultation between INBO and the Operational Water Management Department at the Flemish Environment Agency (VMM). The VMM is the responsible agency for trapping muskrats in three out of five provinces in Flanders and responsible for the trapping on the main watercourses in the other two provinces. This best practice was used to draft the Flemish Muskrat Management Regulation. The drafting process was supported by a steering committee with representatives from: - The Agency for Nature and Forest (ANB) - RATO vzw: responsible for trapping in the province of East-Flanders - the Invasive Species secretariat - the Animal Welfare Service - the province of West-Flanders
Dissemination	The best practice was communicated to the managerial community via the working group on muskrat control in Flanders, where various organisations including the Flemish Environment Agency, the Research Institute for Nature and Forest, the Agency for Nature and Forest, the Animal Welfare Service, RATO vzw, nature organisations, the provinces, cities and municipalities and the Polders and Water Boards Association are represented. Several videos

	were made detailing the proper use of all available trap types (https://www.ecopedia.be/dieren/muskusrat-0). This best practice was used to draft the Flemish Muskrat Management Regulation. All trappers are required to read this regulation and all new trappers are required to follow a training where the provisions of the regulation are clearly communicated.
References	Cartuyvels E., Adriaens T., Baert K., Huysentruyt F., Stuyck J. (2020). Best Practice for trapping muskrat*, Ondatra zibethicus*, in Flanders. Reports of the Research Institute for Nature and Forest 2020 (29). Research Institute for Nature and Forest, Brussels. DOI: doi.org/10.21436/inbor.18446121

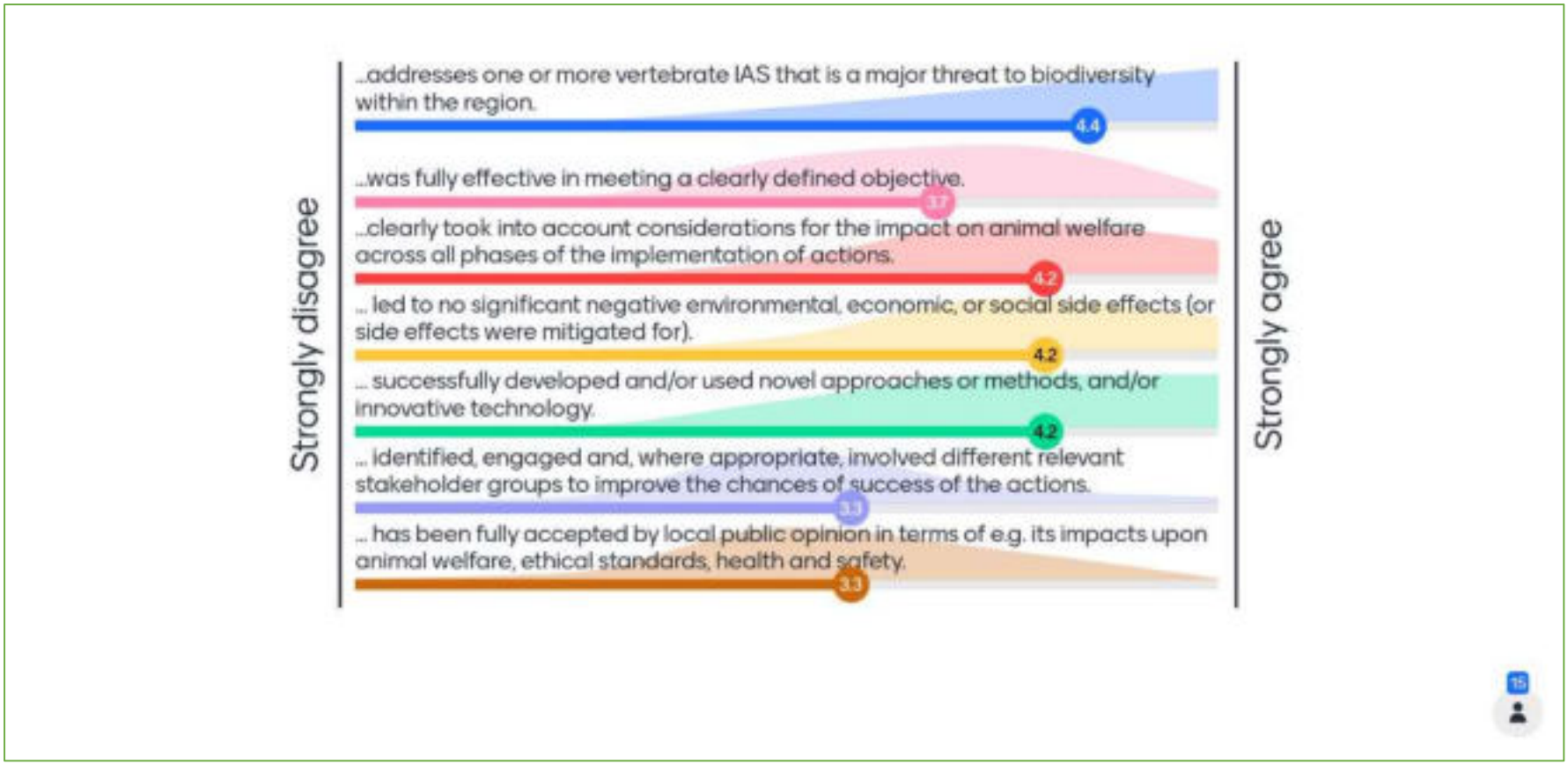


Case study 2 score. Belgium: *Myocastor coypus* and *Ondatra zibethicus*

2.2.4. Case study 3. Belgium: *Alopochen aegyptiaca*

Group: Birds	
Country: Belgium	
Entity: Rattenbestrijding Oost-Vlaanderen (RATO vzw)	
Category	**Response**
Species targeted	*Alopochen aegyptiaca* (Egyptian goose)
Objective(s)	Control: experimental control, in search for a capture method
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Trapping: Live decoy traps (Larsen-type traps with decoy bird)
Measures used to remove (dispatch/sterilise/captivity) species	• Decapitation • Modified atmospheres
Description of the measure	Live, movable decoy traps are used with a live lure and are used to trap Egyptian goose. Also trialling a walk-in cage. One very successful capture of 40 birds at once. We started prebaiting the birds in the cage to get them comfortable. After several days, monitoring with wildlife cameras was initiated, waiting until there were a good number of birds in the cage. Via a magnet the system is then signalled to close the trap
Time period	The method with the live decoy birds: from September until late November. Experiment with the live walk-in cage: several weeks in February 2021.
Location and scale of application	Live decoy traps: locations throughout the province of East Flanders (3000 km^2); walk-in trap: one set-up in a field in Kaprijke (east Flanders). The local Population on that location was 330 birds of which 40 were captured.
Costs	Main expenses relate to material to build Larsen traps and to staff costs: 1 person can manage about 10 Larsen trap inspections/day.
Source(s) of funding	Partly with Interreg funding, partly on public money from province/municipalities
Effectiveness	Larsen traps have proven effective in removing small breeding groups of Egyptian geese. A trial at 27 different locations showed that over 1 to 9 days (total number of catching days: 89), land-based Larsen traps were able to remove all breeding birds from an area (where typically one to two breeding couples were present). There is evidence that land-based Larsen traps are more successful than floating trap designs which were also trialled (19

	locations, 860 trapping days in total) and was able to remove 80 Egyptian goose from the wild, but whereas Egyptian geese were caught in all 27 land-based Larsen traps, only 15 out of the 19 floating Larsen traps were successful. When expressing effectiveness as the number of Egyptian goose caught per trapping day, land-based traps yield an average of 0.7 animals/trapping day while floating traps only reach 0.09 geese/trapping day. A field trial conducted in 27 locations across the western part of Belgium showed that a single land-based Larsen trap was able to remove all breeding pairs present (typically one or two couples) within a time-span of 1 to 9 days. A rough rule of thumb based on the data indicates that land-based Larsen traps with decoy Egyptian geese present can allow to catch about 0.7 Egyptian geese per day per trap.
Humaneness/animal welfare	The walk-in trap minimizes the amount of stress imposed on the animals as no handling is required. It also avoids the use of a live lure.
Side effects	Using the floating Larsen trap design, over a period of in total 860 trapping days, 80 Egyptian geese and 68 non target species (including 17 non-target invasive bird species) were caught during a field trial. As traps were checked daily, these non-target species were released back into the wild unharmed.
Innovation	Walk-in trap
References	Van Daele, P., Adriaens, T., Devisscher, S., Huysentruyt, F., Voslamber, B., De Boer, V., Devos, K. and Casaer, J. (2012) Beheer van Zomerganzen in Vlaanderen en Zeeuws-Vlaanderen. Rapporten van het Instituut voor Natuur- en Bosonderzoek 2012 (INBO.R.2012.58). Instituut voor Natuur- en Bosonderzoek, Brussel. Strubbe, D. 2017. Information on measures and related costs in relation to species included on the Union list: *Alopochen aegyptiaca*. Technical note prepared by IUCN for the European Commission.

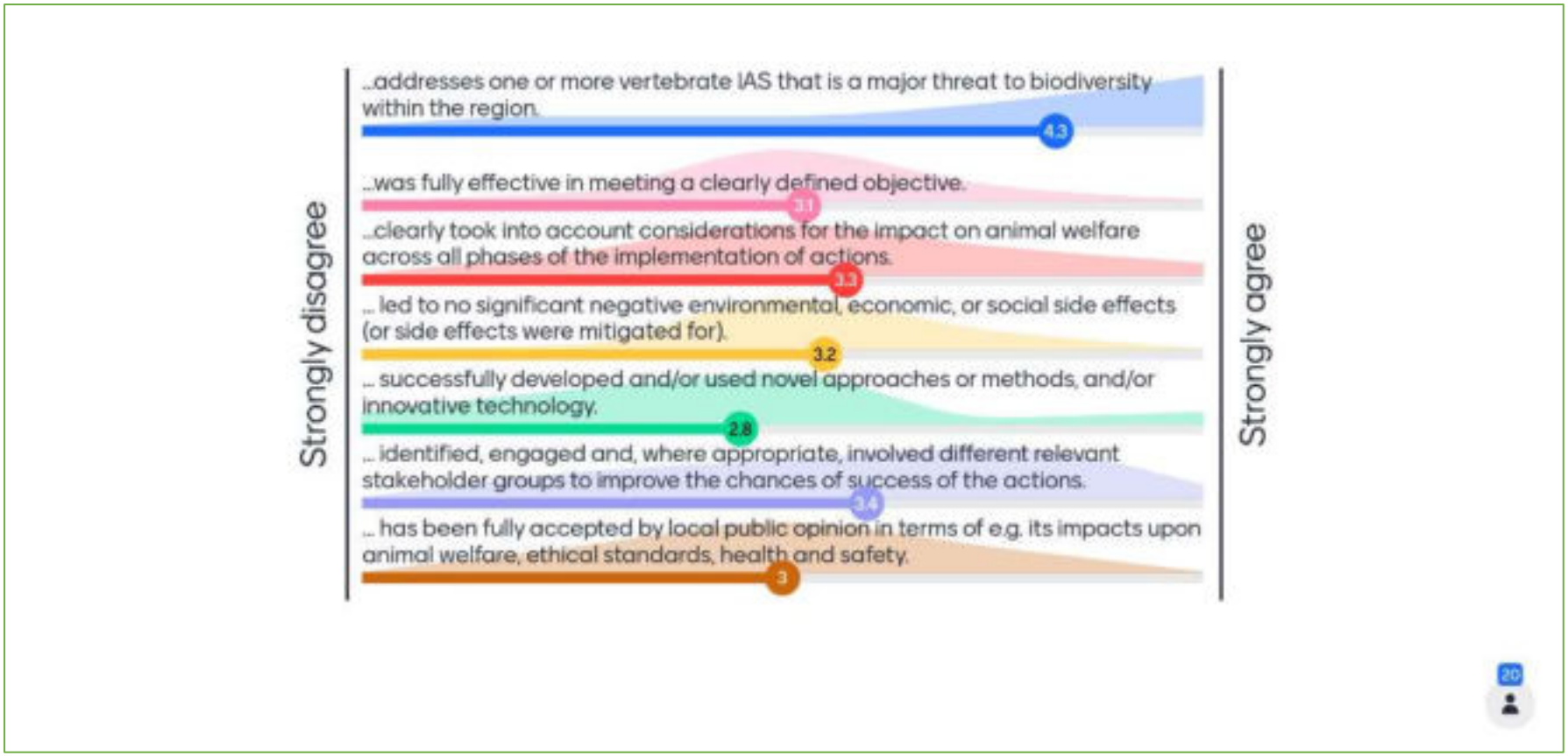


Case study 3 score. Belgium: *Alopochen aegyptiaca*

2.2.5. Case study 4. France: *Callosciurus erythraeus*, *Myocastor coypus, Muntiacus reevesi, Nyctereutes procyonoides*, *Ondatra zibethicus, Procyon lotor*, *Tamias sibiricus* and *Neovison vison*

Group: Mammals	
Country: France	
Entity: Office Français de la Biodiversité - Direction de la Recherche et de l'appui scientifique	
Category	**Response**
Species targeted	*Callosciurus erythraeus* (Pallas's squirrel), *Tamias sibiricus* (Siberian chipmunk), *Procyon lotor* (Raccoon), *Nyctereutes procyonoides* (Raccoon dog), *Ondatra zibethicus* (Muskrat), *Myocastor coypus* (Coypu), *Muntiacus reevesi* (Muntjac deer), *Neovison vison* (American mink)
Objective(s)	Rapid eradication: *Muntiacus reevesi, Tamias sibiricus* Eradication: *Callosciurus erythraeus* Control: *Procyon lotor, Nyctereutes procyonoides* Containment: *Ondatra zibethicus, Myocastor coypus*
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Trapping: Cage traps, spring operated traps
Measures used to remove (dispatch/sterilise/captivity) species	• Cervical dislocation • Cranial depression • Injection euthanasia • Keeping in captivity • Shooting - dispatch restrained animals
Description of the measure	Hunting: permitted for raccoon, raccoon dog on an opportunistic basis. Not a method developed for this purpose. Shooting with a smooth-bore gun. see https://www.legifrance.gouv.fr/loda/id/JORFTEXT000033117600/ Spring traps: possible with prefectural trapping authorisation (after training) for a range of traps. see https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000648027/ and https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000327349/ for raccoon (little used), coypu, muskrat. Cage traps: see above. Used more for small and medium-sized mammals: raccoon, raccoon dog, coypu, muskrat, American mink. They are killed by shooting with a rifle (usually 22 long rifle, which requires a valid hunting licence).

	For the Pallas squirrel and the Siberian chipmunk, which are not species that can be trapped by an approved trapper, their capture is carried out under the supervision of a professional structure (OFB in particular) due to a localised approach. For these species, traps not provided for in the list of approved traps are possible, in particular of smaller size. In this case, the killing is done by cranial shock or cervical dislocation. Cervical dislocation and skull fracture: only for sciurids. Euthanasia: exceptional for a few individuals captured and brought to a veterinarian (raccoon). Captivity: possible but remains rare for raccoons. Zoos are not always inclined to accept them because of quarantine, in particular, and because of the stocks that are already present in captivity, no specific centre for IAS. Shooting of animals immobilised in cages by 22 LR in particular (shooting in the skull). Shooting from a distance: regulatory framework different from hunting: destruction of coypu and muskrat (outside hunting periods) but also all year round for professionals (OFB). Muntjac, Pallas squirrels - shooting with shotgun or rifle (scope, silencer).
Time period	Raccoon, coypu, muskrat, raccoon dog: trapping all year round by volunteer trappers without necessarily established strategies American mink: detection and targeted trapping all year round Siberian chipmunk: May to August Pallas squirrel: shooting all year round (more successful in autumn/winter due to absence of leaves) Muntjac: shooting by hunters during the hunting season from 1 June to 31 March and all year round by OFB professionals
Location and scale of application	Raccoon, coypu, muskrat, raccoon dog: the whole of metropolitan France but raccoon located in the east and north of France, in Auvergne and Gironde (Léger & Ruette 2014). American mink: on the estimated range of the European mink in particular (Léger *et al*. 2018). Siberian chipmunk: Echirolles (Isère) along a river on 2 km. Pallas squirrel: on the 2 known areas of presence (Istres, Antibes). Chinese muntjac: on the known area
Source(s) of funding	State funding (OFB)
References	Léger, F., Ruette, S., 2014. Raccoon and raccoon dog: an update on their distribution in France. *Faune Sauvage* 302, 9-16. Léger, F., Steinmetz, J., Laoué, E., Maillard, J.-F., Ruette, S., 2018. The expansion of the American mink in France. Period 2000-2015. *Faune Sauvage* 23-31.



Case study 4 score. France: *Callosciurus erythraeus, Myocastor coypus, Muntiacus reevesi, Nyctereutes procyonoides, Ondatra zibethicus, Procyon lotor, Tamias sibiricus* and *Neovison vison*

2.2.6. Case study 5. France: *Callosciurus erythraeus* and *Tamias sibiricus*

Group: Mammals	
Country: France	
Entity: Office Français de la Biodiversité (UMS Patrinat, CNRS, MNHN)	
Category	**Response**
Species targeted	*Callosciurus erythraeus* (Pallas's squirrel), *Tamias sibiricus* (Siberian chipmunk)
Objective(s)	Eradication (of widespread population): For a population of *Tamias sibiricus* (Isère: edge of the Drac, Échirolles (45°8'N, 5°41'E), on about ten hectares (see Chapuis, Gerriet, Losinger-Chabod, Pisanu 2018) Control: Population of *Callosciurus erythraeus* in Istres (Chapuis *et al*. 2018) Containment: Population of *Callosciurus erythraeus* in Antibes (Chapuis *et al*. 2018)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Trapping: Cage traps • Shooting
Measures used to remove (dispatch/sterilise/captivity) species	• Cervical dislocation • Cranial depression • Shooting - dispatch restrained (and wounded) animals
Description of the measure	*Tamias sibiricus*: Population of Echirolles (Isère, France): By means of trapping (Sherman traps, non-lethal) and shooting campaigns with rifles (small calibre 9 mm) (cf. Chapuis *et al*. 2018; Losinger-Chabod *et al*. 2020) *Callosciurus erythraeus*: Populations of Istres and Antibes: Shooting campaigns with rifles (12, 16, 20 or 410 calibre) throughout the year on previously identified priority sectors (Chapuis *et al*. 2012; Chapuis *et al*. 2018; Gerriet *et al*. 2018), as well as non-lethal trapping (dobby type : Chapuis *et al*. 2018), particularly in inhabited sites (e.g. private homes).
Time period	*Tamias sibiricus*: In 2018 and 2019, interrupted in 2020, and resumed in 2021, two campaigns per year of 3 to 4 consecutive weeks, in March and August outside the period of suckling and dispersal of young (see Chapuis, Gerriet, Losinger-Chabod, Pisanu 2018; Losinger-Chabod, Pisanu, & Blottière 2020).

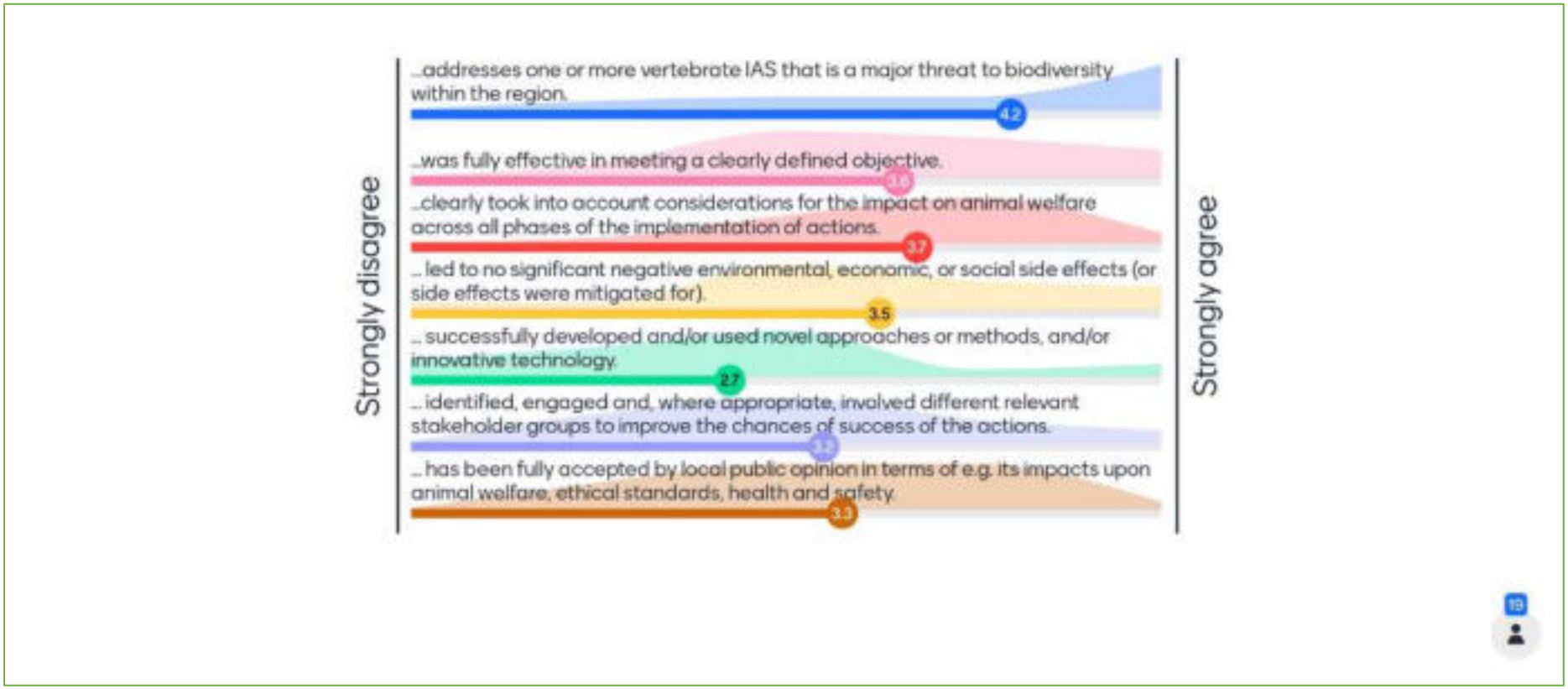
	Callosciurus erythraeus: Regular campaign throughout the year since 2012 on Cap d'Antibes, and since 2016 on Istres (see Chapuis, Gerriet, Losinger-Chabod, Pisanu 2018; Gerriet, Liardet, Pisanu & Chapuis 2018), with a particular effort during the winter period, before the start of breeding.
Location and scale of application	*Tamias sibiricus*: Very small population present in two communes (Isère: Echirolles [45°08'37"north, 5°43'06" east], Le Pont-de-Claix [45°07'44" north, 5°41'56" east]), with less than 50 squirrels occupying about 10 hectares in a peri-urban riparian zone (Chapuis *et al*. 2018; Losinger-Chabod *et al*. 2020). *Callosciurus erythraeus*: Population present in the commune of Istres (village of Entressens; 43°30'54" north, 4°59'22" east) - with sightings covering an area of about 5,000 ha in 2020. Population present in several communes of the Cap d'Antibes province - with sightings covering an area of about 35 km² in 2018, slightly expanding in 2020 (BP pers. com.).
Effort	*Tamias sibiricus*: Over two years (2018 and 2019): In total - 85 agent/operator days (Losinger-Chabod *et al*. 2020); 3660 trap days. Total - 30 individuals collected. *Callosciurus erythraeus*: Cap d'Antibes Period 2012-2014: 20-50 person-days/year for hunting actions (Chapuis *et al*. 2014) Period 2015-2018: 50-80 person-days/year for hunting actions; 20-30 person-days/year for trapping (Gerriet *et al*. 2018) Istres Period 2016-2020. Data currently being processed.
Costs	136,245 € - Personnel costs: 60,410 € - Equipment and infrastructure: 56,835 € - Other, including capacity building and overheads: 19,000 €
Additional details on costs	*Tamias sibiricus*: Over two years 2018-2019; no operations in 2020; operation planned March 2021 (cf Losinger-Chabod, Pisanu, & Blottière 2020) Personnel costs: 29,410€ (85 days at 348 euros/day) Equipment/infrastructure: 2,835€ Overheads: not reported *Callosciurus erythraeus*: Annual costs - excluding research activity (management only) Cap d'Antibes period 2012-2014 (cf Chapuis, Gerriet, Pisanu, Pauvert 2014) Staff costs: 5,000€/year (Permanent position) Equipment/infrastructure: 10,000€/year Overheads: 5,000€/year period 2015 - 2018 (cf Chapuis, Gerriet, Losinger-Chabod, Pisanu 2018) Staff costs: 4,000€/year (Permanent position) Equipment/infrastructure: 6,000€/year Overheads: 1,000€/year Istres Period 2016-2020. Data currently being processed.
Source(s) of funding	Public funds: governmental body (Office Français de la Biodiversité [ex. ONCFS]) and local authorities (State/Region/City)

Effectiveness	Effective
Key evidence/results	Effective: In terms of animal welfare, environmental and societal impacts, trapping is effective in most cases. It allows to: • Control the euthanasia protocol in optimal conditions - i.e. reduce handling time and ensure that the animal is dead (and not just injured), • Release individuals of non-target species - while ensuring that the impact of trapping on them is minimal (choice of bait, hyper- or hypothermia in relation to temperature and rain,. • Furthermore, it does not affect natural habitats in the long term, apart from disturbance or the risk of trampling when setting and checking the traps. Shooting is also effective and does not affect non-target species when carried out by trained individuals. Again, euthanasia is instantaneous in the vast majority of cases (95%), and individuals are recovered in over 99% of cases. Shooting can affect habitats or species in natural environments through disturbance when operators move to control sites. This type of intervention may also require the interruption of an economic or leisure activity. However, such disturbances can be minimised if they are taken into account beforehand.
Replicability	Trapping: this method - selective - is applicable and transferable for a large majority of rodent species, as well as more generally medium-sized terrestrial mammals, in most wild or peri-urban habitats. In urban areas, it is well suited when a request is specifically motivated by landowners, and when licensing and regulatory conditions are met. This method must be carried out by trained and authorised persons, in selected conditions with protected areas or away from the general public in order to avoid any disturbance. Control by shooting: this method - selective - is applicable and transferable for a majority of terrestrial vertebrate species, in most sparsely populated wild or peri-urban habitats. In urban areas, it is not suitable, except in very specific situations of natural or semi-natural areas covering a large surface (large public or private parks and gardens, urban woods, etc.). This method must be implemented by qualified, trained and authorised persons.
Humaneness/animal welfare	The main animal welfare considerations taken into account were those set out in Regulation EU-1099/2009 ensuring that suffering, pain and stress during depopulation operations are minimised. Although outside its scope, considerations for euthanasia methods in the context of scientific research protocols were also taken into account (Annex IV of Directive 2010/63/EU on the protection of animals used for scientific purposes). For all the euthanasias carried out from trapping in Échirolles (n = 30), Cap d'Antibes province (n = 208 individuals) and Istres (data not compiled), suffering, pain and stress were minimised. Individuals were captured in non-lethal traps, minimising the time spent by an animal in a trap (at least 2, sometimes 3 trap checks per day), and then euthanized

	quickly (by cranial shock or by shooting) by trained officers during the systematic checking of the traps. In the case of shooting operations, more than 95% of the individuals (out of a total of 5,571) were shot on the spot, avoiding any suffering, pain or stress. In less than 5% of the cases, the shot animals were not killed on the spot, but could be found and finished within minutes of being wounded. Almost no animals escaped wounded (much less than 1%).
Public acceptance	In the case of Siberian ground squirrel trapping operations, acceptance by the general public is average to low, despite general information provided to the public, presenting the purpose of the control operations, as well as the regulatory legitimacy. In the case of Pallas' Squirrel trapping operations, the majority were carried out at the request of the public wishing to "get rid" of squirrels invading their gardens, thus gaining good support. In the case of shooting operations, again - a majority of citizens have responded well to the measure. The operations are carried out by professionals, under the cover of authorisations issued by local public authorities establishing precise regulations (a prefectoral decree in France).
Side effects	Methods using non-lethal traps or shooting actions have virtually no side effects due to their selectivity, when carried out by qualified, trained and instructed persons. No damage to the environment, health, welfare or economy has been observed during the operations. In particular, the operators of the control plans take care to inform their presence before their interventions when they take place near inhabited areas - in order to limit any risk of accident or disturbance for people living or frequenting the sites subject to invasive squirrel control. In addition, the negative effects of disturbance of the people visiting the intervention sites are negligible, as they are anticipated and avoided.
Stakeholder engagement – implementation:	**Siberian ground squirrel**: The control was set up, organised and conducted by agents of a research organisation (Muséum National d'Histoire Naturelle de Paris), jointly with agents of the Office Français de la Biodiversité (OFB: Direction de la Recherche et de l'Appui Scientifique, Direction Surveillance-évaluation-données, and Délégation régionale Auvergne-Rhône-Alpes). **Pallas's squirrel**: The control was set up, organised and conducted jointly by research bodies (Muséum National d'Histoire Naturelle de Paris, Muséum d'Histoire Naturelle de Nice), agents of the national services of the Office Français de la Biodiversité (Direction de la Recherche et de l'Appui Scientifique, Direction Surveillance-évaluation-données), regional (Délégation régionale Provence-Alpes-Côte d'Azur), and territorial (Service départementaux des Bouches-du-Rhône et des Alpes-maritimes), as well as with the collaboration of agents from the municipal services of the cities of Antibes and Istres. In addition - between 5 and 15 volunteer citizen participants work on the implementation of the control plan - under the direction of the regional and territorial agents of the OFB. Participation in connection with the monitoring of the presence of Pallas's squirrels in the town of Istres is ensured

	by volunteers from the naturalist associations, as well as landowners allowing access to their private property to carry out the control plan.
Dissemination	**Siberian ground squirrel**: Communication is carried out by agents of the French Office of Biodiversity at the site of the operations. A management report, specifying the methods of action, the results of the operations, as well as the costs and benefits are published on the website of the Resource Centre on Invasive Alien Species (http://especes-exotiques-envahissantes.fr/; see Losinger, Pisanu, & Blottière 2020). **Pallas's squirrel**: Communication is carried out by agents of the Office Français de la Biodiversité at the site of the operations, as well as by the Natural History Museum of the city of Nice, and the city of Antibes. All the actions undertaken are the subject of regular reports (4-year period), which are published in free access on a website dedicated to squirrel species in France, run by the Muséum National d'Histoire Naturelle (Chapuis, Pisanu, & Dozières 2012).
Innovation	The measures used for control (non-lethal trapping, shooting) have been tried and tested for many years for the control of invasive rodents. No particular innovations have been developed.
Lessons learned	Combined trapping and shooting actions appear appropriate for the management of populations of two introduced squirrel species in France (Siberian ground squirrel and Pallas squirrels). These methods reduce stress, pain and injury to target animals and non-target species, in contrast to lethal traps or the use of biocides. In terms of ethical consideration of animal welfare, a refinement of euthanasia methods could be implemented during trapping campaigns - to further increase consideration of stress and pain at the time of killing.
References	Chapuis, Pisanu, & Dozières 2012. Les écureuils en France. https://ecureuils.mnhn.fr, Muséum National d'Histoire Naturelle, Paris (consulté le 08/03/2021). Chapuis, Gerriet, Pisanu, Pauvert 2014 https://ecureuils.mnhn.fr/sites/default/files/documents/plan_evr_bilan_2012-2014_et_perspectives_2015-2018.pdf Chapuis, Gerriet, Losinger-Chabod, Pisanu 2018. https://ecureuils.mnhn.fr/sites/default/files/documents/chapuis_et_al._2018_gestion_ecureuils_exo.pdf Dozières 2012. https://ecureuils.mnhn.fr/sites/default/files/documents/theseannedozieres1.pdf Gerriet, Liardet, Pisanu & Chapuis 2018 https://ecureuils.mnhn.fr/sites/default/files/documents/pnl_ecp_bilan_2018.pdf Losinger, Pisanu, & Blottière 2020. http://especes-exotiques-envahissantes.fr/wp-content/uploads/2020/06/tamia-de-siberie-fiche-rex-vf.pdf

	Règlement (CE) n o 1099/2009 du Conseil du 24 septembre 2009 sur la protection des animaux au moment de leur mise à mort. https://eur-lex.europa.eu/legal-content/FR/TXT/PDF/?uri=CELEX:32009R1099&from=FR Directive 2010/63/UE du Parlement européen et du Conseil du 22 septembre 2010 relative à la protection des animaux utilisés à des fins scientifiques Texte présentant de l'intérêt pour l'EEE https://eur-lex.europa.eu/legal-content/FR/ALL/?uri=CELEX%3A32010L0063



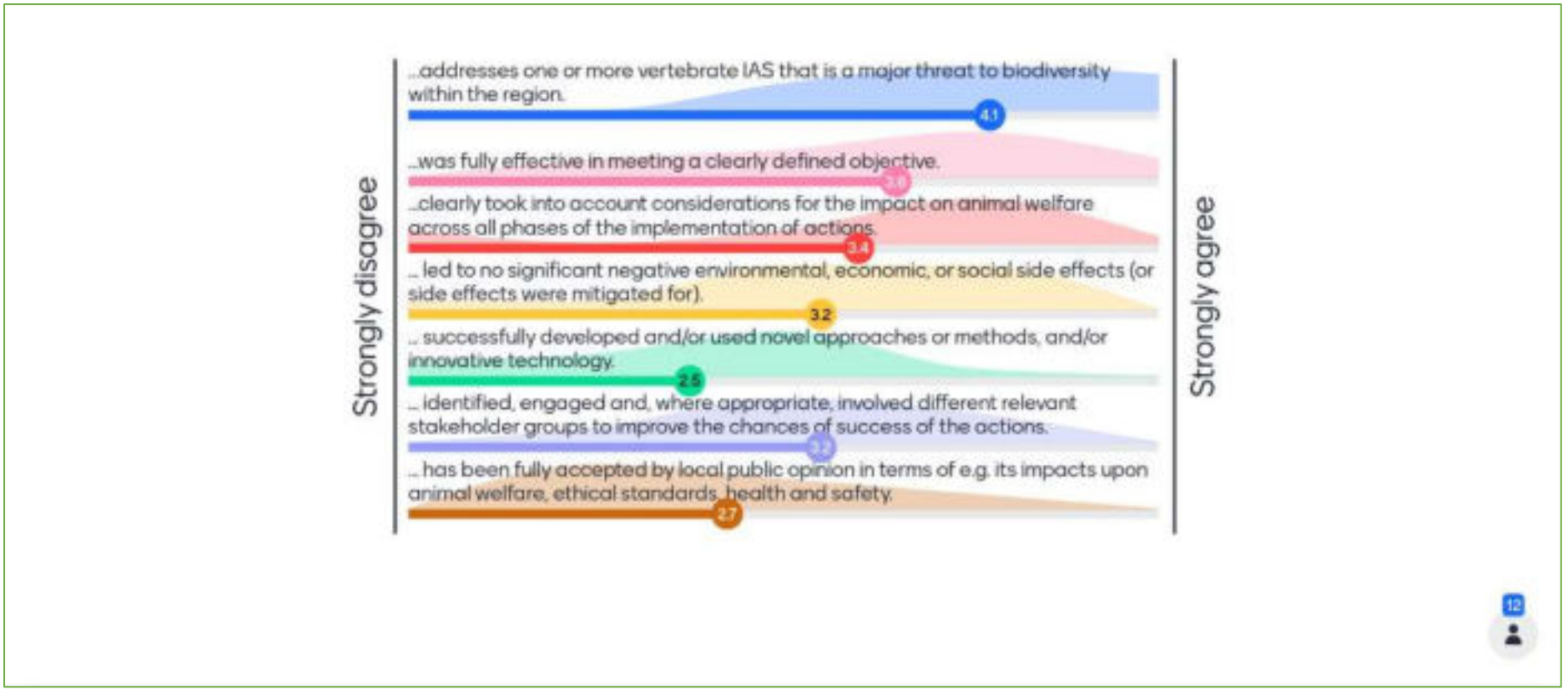
Case study 5 score. France: *Callosciurus erythraeus* and *Tamias sibiricus*

2.2.7. Case study 6. France: *Myocastor coypus, Ondatra zibethicus* and *Procyon lotor*

Group: Mammals	
Country: France	
Entity: Association Départementale des Piégeurs Agréés de la Gironde (ADPAG)	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu), *Ondatra zibethicus* (Muskrat), *Procyon lotor* (Raccoon)
Objective(s)	Eradication (of widespread population)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	Shooting - dispatch restrained animals
Description of the measure	The most frequently used trap is a category 1 cage trap, measuring 80x30x30 cm, fitted with a "gaboulette" (mink hole) (opening of 5x5 cm), open from April to July inclusive and closed the other months of the year. This opening allows accidentally captured European mink (especially females) to escape during this period (breeding season). For the killing of trapped animals, the trappers generally use a small calibre firearm (22LR or 9 mm).
Time period	The trapping of these species is carried out throughout the year by different licensed trappers. For example, for the 2019-2020 season (i.e. between 01/07/19 and 30/06/20) and out of the 1641 approved trappers registered in the Gironde departmental file: • 360 trappers reported at least one capture of coypu (8.837 captures in total in the department), • 41 trappers reported at least one capture of muskrat (252 captures in total in the department), • 12 trappers reported at least one capture of raccoon (43 captures in total in the department).
Location and scale of application	Trapping is carried out year round in all known locations for these species. The Gironde department covers an area of approximately 10,000 km².
Effort	Number of trap nights carried out by approved trappers in the Gironde during the 2019-2020 season: 2,252 for raccoon (extrapolation of the total number of trap nights in the Gironde for the 2019-2020 season for raccoon:

	3,026), for coypu: 321,577 (extrapolation of the total number of trap nights in the Gironde during 2019-2020 season 419,327).
Costs	Overall cost: 61,218 € - Personnel cost: 2,052 € (administrative costs invoiced for the 2019-2020 season when requesting interventions (agreements, estimates, etc.). - Equipment and infrastructure: 44,341 € (number of traps made available to the Association's member trappers multiplied by the current price of the traps (981 x 45.20 €). - Other costs, including capacity building and overheads: 14,825 € (corresponds to the amount of compensation for approved volunteer trappers in the 2019-2020 season)
Source(s) of funding	Membership fees, Gironde Departmental Council, various local authorities
Effectiveness	Effective
Key evidence/results	Number of captures made during the last 3 hunting seasons (2017-2018, 2018-2019, 2019-2020): 28,528 Coypu, 827 Muskrats, 122 Raccoons.
Replicability	Apart from the 3 species concerned, approved trappers can also trap other species classified as “ESOD” (Espèce Susceptible d'Occasionner des Dégâts) in the Gironde. The list of these species as of 09/03/21 is as follows: weasel, red fox, magpie, carrion crow, starling, wild rabbit.
Humaneness/animal welfare	During training courses for licensed trappers, we recommend the use of a small-calibre firearm for killing trapped animals. Licensed trappers who do not have a hunting licence or a shooting licence are not allowed to carry a gun. We would like to offer them an alternative method of killing, while respecting an immediate and painless kill.
Public acceptance	During the training of trappers, we explain that despite the purpose of trapping damaging animals, the traps must be visited daily and the killing must take place quickly and without suffering. These explanations seem obvious to participants, and we have never had any remarks on this subject. As far as the non-trapping public is concerned, we have had campaigns against the capture of raccoons (letters to the town hall, posters in the town, articles in the press, etc.). For the coypu and the muskrat, it is rare to encounter such problems, certainly because the animal's sympathy capital is less strong than for the raccoon and because there are risks.
Side effects	During a trapping campaign, traps are often vandalised or stolen. Also, it can happen that local residents threaten the authorised trapper who goes to the trapping site to set, visit or remove traps.
Stakeholder engagement – implementation:	Approved trappers work on a voluntary basis to capture these species. Nevertheless, at the request of local authorities, companies, farms, etc., ADPAG offers estimates or agreements that provide for the payment of the trapper’s fees.

Dissemination	Annual publication of a summary of trapping activities in the Gironde area. Annual publication of a report on the fight against coypu and muskrat.
Innovation	Following the approval of a category 4 trap for the capture of raccoons (the DUKE DP), we are currently in the testing phase to confirm the effectiveness of this trap and to give an opinion on the use of this trap with regard to the suffering that may be caused to the captured animal. We are also seeking to demonstrate in this study which bait is the most attractive and selective for capturing raccoons, and also to test an "anti-return" mechanism installed on category 1 cages to prevent the animal from escaping.
References	http://adpag.fr/telechargements/syntheses-de-piegeage/



Case study 6 score. France: *Myocastor coypus, Ondatra zibethicus* and *Procyon lotor*

2.2.8. Case study 7. France: *Myocastor coypus* and *Ondatra zibethicus*

Group: Mammals	
Country: France	
Entity: Communauté de Communes de la Dombes (federation of the municipalities of the Dombes area)	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu), *Ondatra zibethicus* (Muskrat)
Objective(s)	Control: Control of population nuclei of invasive alien rodents Containment: Limit expansion of populations on the ponds of the Dombes area
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Habitat manipulation: Aquatic habitat management - Pond drying/draining • Shooting • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Injection euthanasia • Shooting - dispatch restrained animals: small calibre rifles
Description of the measure	Trapping is performed with double entry rodent traps (30x30x102 cm). The euthanasia of the animals is carried out with small calibre ammunition such as 22 long rifle, 9 mm. BAYER Digitrap connected traps are used. In some areas where the use of these traps is restricted, conibear traps (N°13 to 18) are applied.
Time period	Continuous trapping depending on the availability of volunteer trappers. Many trappers are active in autumn/winter depending on ponds emptying and fishing and wildlife management (hunter's) activities. Most of the trapping occurs in spring, which induces pressure on the offspring of invasive aquatic rodents. Many trappers stop trapping in summer due to bycatch, the heat and the pressure to set traps early in the morning.
Location and scale of application	Area of the federation of the municipalities of the Dombes, 621 km^2 in size, 36 municipalities. Part of the Natura 2000 Bird Directive SPA of the Dombes (FR8212016).
Effort	Trapping in the federation of the municipalities involved 102 traps, 18 volunteer trappers, 24 private properties, around 70 ponds, and 9 months of trapping in 2020.
Costs	Overall costs are undocumented. - Personnel costs: a full-time position of technician in natural areas has been created for the logistics of trapping missions via the leader programme.

	- Equipment and infrastructure: 102 traps on loan, approximately 55€ per double entry trap
Additional details on costs	The trappers are volunteers, but the cost of fuel, traps and ammunition for the euthanasia of animals is high
Source(s) of funding	European Union LEADER programme for the development of the rural economy and the federation of the municipalities of the Dombes.
Effectiveness	Effective
Key evidence/results	Effective in areas under constant management, - 9 months of concrete trapping for 735 coypu and 44 muskrats trapped, - 25 volunteer trappers, 18 of whom are active, - Loan of 70 managed ponds spread over 24 territories of the CC Dombes, - A survey of 126 people, - 105 traps loaned (double-entry fawn boxes, connected traps)
Replicability	Easily replicable to other areas faced with invasive rodent populations. The actions will be renewed for 2021 and 2022.
Humaneness/animal welfare	Awareness of pond managers, owners and licensed trappers. The use of small calibre rifles for quick and painless euthanasia was chosen over old practices such as the use of hunting dagger and drowning.
Public acceptance	The actions are not actively presented to the public
Side effects	The use of small calibre guns (without a silencer) causes noise which can disturb wildlife, especially local birdlife. Another side-effect of applying this measure for dispatch is the increased cost of cartridges which adds to the expenses of the volunteer trappers.
Stakeholder engagement – implementation:	The departmental association of trappers and field guards (Association Départementale des Piégeurs et Gardes de l'Ain) are involved in the implementation of joint actions.
Dissemination	The project issues publications and official letters and enters in consultation with local stakeholders including anglers, hunters, landowners, farmers. Other means of communication include flyers, posters, digital signposts of the federation of municipalities and social media.
Innovation	The project piloted the use of digi traps to avoid time-consuming visits to ponds by trappers
Lessons learned	Communication and exchange with pond owners and volunteer trappers are very important to keep everyone engaged in long-term action

Case study 7 score. France: *Myocastor coypus* and *Ondatra zibethicus*

2.2.9. Case study 8. France: *Myocastor coypus* and *Ondatra zibethicus*

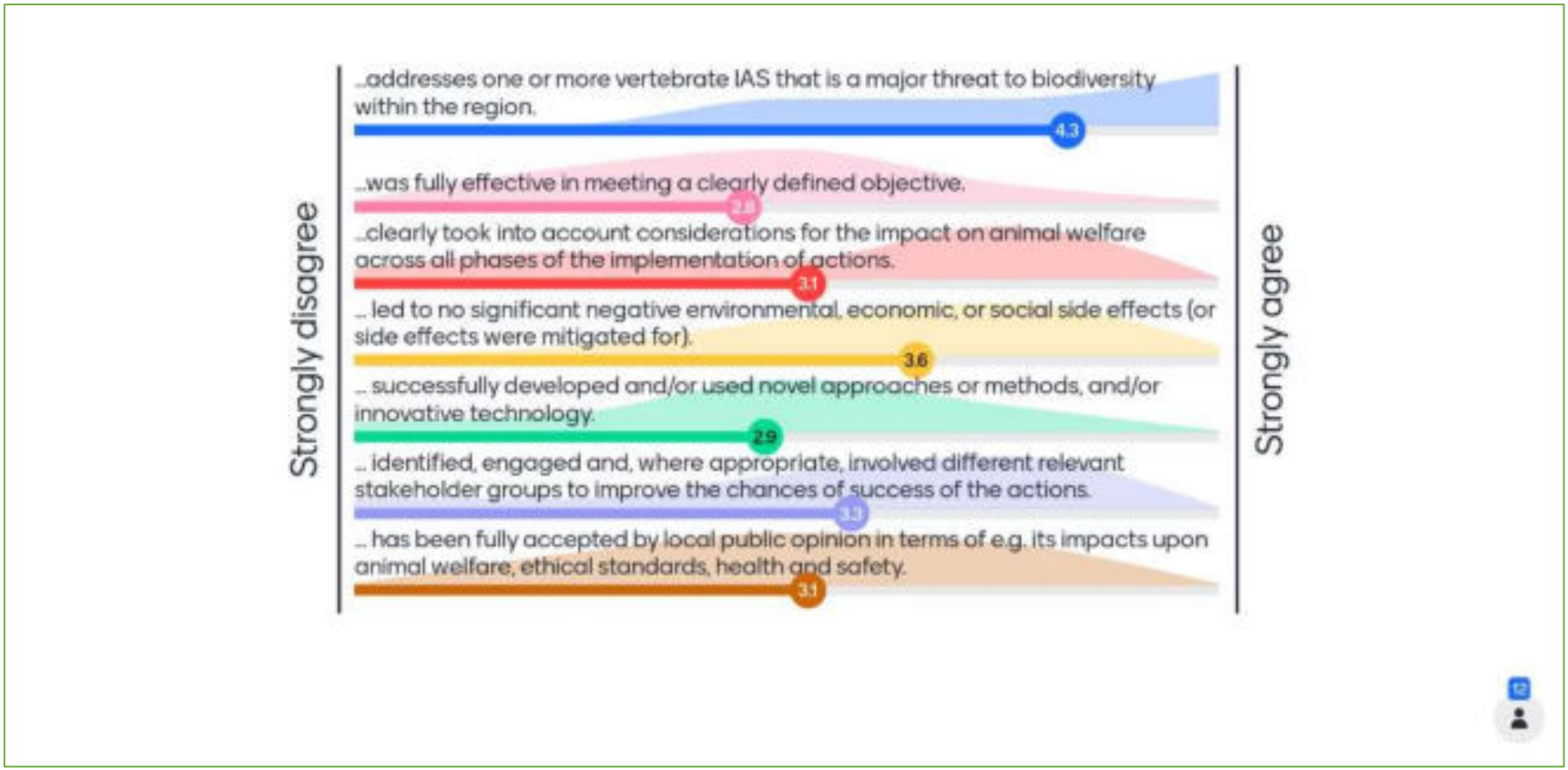
Group: Mammals	
Country: France	
Entity: POLLENIZ (Réseau pour la santé du végétal en Pays de la Loire)	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu), *Ondatra zibethicus* (Muskrat)
Objective(s)	Control: A very widespread species in the Pays de la Loire. Even if eradication is targeted, it is difficult to achieve with the means currently available so the strategy is population control.
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Cervical dislocation • Cranial depression • Shooting - dispatch restrained animals • Slaughter with a knife • Drowning: Although not advocated as a method, it is sometimes used by some trappers. The killing time is too long and causes suffering to these aquatic rodents.
Description of the measure	Trapping is carried out by volunteers and/or paid operators using cage traps placed on the ground or on floating rafts. The cage traps are baited with attractive plant food (carrots, apples, corn, parsnips), which is entirely natural. Shooting is carried out by hunters using firearms such as shotguns, rifles and bows. These programmes are organised by POLLENIZ in partnership with local authorities (municipalities, federation of the municipalities, catchment area associations, etc.) and local operators (trappers, hunters, etc.). A fee is paid for each coypu and muskrat caught, which varies from 1.5€ to 3€ depending on the territory. This sum is paid to the individual trapper or to the local hunting associations.
Time period	Trapping is carried out throughout the year. Certain periods are more favourable for trapping (March-April and October-November), depending on the availability of volunteer operators, the food resources present in the natural environment, accessibility (flooding) and the climate. Shooting is carried out in collective drives, from

	January to the end of March, depending on the water levels in certain wetlands (navigability) and in order not to disturb the fauna during the breeding period.
Location and scale of application	POLLENIZ organises, coordinates and runs monitoring, prevention and control plans throughout the Pays de la Loire region. The action programmes are developed and adjusted according to a catchment area approach. These plans are implemented at the level of a municipality, a federation of municipalities, a sub-catchment area, or even a catchment area, in partnership with the local authority corresponding to the geographical area selected.
Effort	The action plan is implemented in the Pays de la Loire region, which covers 32.000 km². On average over a year, 3.000 volunteer trappers are active. On average, one trapper carries out their trapping activity for 200 days per year. Annual captures vary between 250.000 and 280.000 invasive aquatic rodents, 80% of which are coypu. A trapper has an average of 4 and 5 cage traps. Collective shooting operations are currently only carried out in the Brière marshes (Loire Atlantique). Depending on the weather conditions and the availability of those involved, between 8.000 and 10.000 coypu and muskrat.
Source(s) of funding	Local authorities are the main financers
Effectiveness	Moderately effective
Key evidence/results	Trapping and shooting techniques are effective on their own. However, the configuration of the territory in which a control plan is implemented (surface area, potential for hosting the coypu and muskrat, enclosed waters/open waters, risk of recolonisation), the resources that can be mobilised (funding, human and material resources), and the dispersal and colonisation capacities of these two rodents determines the level of effectiveness: this may range from eradication (example: small enclosed pond) to temporary control of the populations. It should be noted that we do not have a reliable method for evaluating populations. It is therefore not always easy to determine the level of effectiveness of a control action. This analysis remains indirect: visual presence or not of individuals, their faeces and/or runs, disappearance of grazing, reappearance of local species, etc. One indicator may be relevant: the number of captures per night/trap. This is based on the goodwill of volunteer trappers, who must record all the necessary information in a trapping booklet: trapping sector, actual days of trapping, number of traps set and number of captures each day, every year in the same sector. This work has been underway for two years but remains partial and insufficient in time to begin measuring its effects.
Replicability	The methodology of a control programme based on the mobilisation of volunteer operators (trappers and hunters) can be replicated for many vertebrate species in the environments where they live and throughout the European Union.

Humaneness/animal welfare	For the implementation of its coypu and muskrat management programme, POLLENIZ recommends several humane and animal welfare-friendly best practices for trapping operations: • Choice of trap: as part of the training provided to volunteer trappers, only the cage trap is strongly recommended. This type of trap allows the release of non-target species. • Also, during training, POLLENIZ insists on the fact that traps must be collected every day and before noon (according to the regulations) and on the recognition of non-target species. • Choice of killing method: we recommend two techniques, which, in accordance with French regulations, allow for immediate killing without suffering. The firearm, used only by trappers holding a hunting licence and an annual validation. The skull fracture and cervical dislocation are used by trappers without a hunting licence. • Apart from the fact that France prohibits drowning traps, POLLENIZ does not consider drowning to be an "immediate and painless" method of killing.
Public acceptance	We do not carry out any specific actions to present the impact of the control methods on animal welfare to the general public. The action programme implemented each year in the Pays de la Loire region is accessible to the public in different ways. Press articles regularly mention the subject of coypu and muskrat control. To date, it has not been necessary to organise an event to present the impact of our actions (= the measure) on animal welfare. While it is easy to explain the act of trapping, it is less easy to show the act of killing. Indeed, part of the public shows great sensitivity to this necessary killing step. In view of the existing killing methods, a simple, effective, humane and discrete method is probably missing.
Side effects	The action programme implemented, based largely on trapping, has both positive and negative side effects. Positive effects include the release of all non-target species without harming them, traps do not cause any handling danger for the user (unlike the X-trap Conibear). Also, the management system for the collection of corpses (burial or evacuation by the public rendering service) avoids any health risk (transmission of zoonoses or endoparasites). A well-organised and regular control plan in a given sector allows: the reduction of health risks linked to the transmission of zoonoses to humans and certain species of livestock; the reduction of impacts on crops (maize, cereals, vegetables ....) and temporary or permanent riparian meadows); the limitation of the loss of biodiversity with regard to aquatic fauna and aquatic and subaquatic flora; the reduction of damage to banks, dykes and other engineering structures. The majority of the work is carried out by volunteers, which considerably reduces the costs for the local authorities, the main financers. Negative effects: the sight of a captured animal in an easily visible trap can affect the sensitivity of the general public. Acts of vandalism are frequent on this very accessible equipment (10% of damage each year) and affect the motivation of volunteers. The use of volunteer operators leads to variability in their availability and commitment,

	which requires us to have a larger workforce to be at least as effective as paid staff. Some trappers are not committed to the methods currently available and authorised for killing.
Stakeholder engagement – implementation:	The stakeholders are: The POLLENIZ network, its departmental branches and local groups operating at different geographical levels, local authorities (municipalities, federations of municipalities, catchment area unions, Public Territorial Basin Establishments, natural area managers, drinking water supply unions, etc.), state services (DDT (M), DREAL, DRAAF, ARS, OFB), private managers (VEOLIA, SUEZ, SAUR, etc.), departmental hunters' federation, departmental associations of approved trappers.
Dissemination	Dissemination is aimed at different audiences: 1. LOCAL AUTHORITIES: - Action report for each territory financing a control plan against Invasive Aquatic Rodents; - RAE INFO, a POLLENIZ newsletter for those involved in control. - General Assembly of the "Collectivities" college within POLLENIZ 2. OPERATORS: - Trapping books for each trapper; - Initial and ongoing training for volunteer trappers; - Training documents; - RAE INFO, the POLLENIZ newsletter for those involved in pest management. - General Assembly of the "Volunteer Operators" college within POLLENIZ 3. GENERAL PUBLIC - Regional Action Plan for Invasive Aquatic Rodents validated by the CROPSAV (Regional Council for Animal and Plant Health Policy), which can be consulted on the POLLENIZ and DRAAF websites; - Prefectural and municipal decrees; - Posters and flyers for the recruitment of new operators; - POLLENIZ website; - Didon information panel on the challenges of collective control of the coypu and muskrat; - Dibon information leaflets to be placed on cage traps; - Flyer for the general public; - Health flash, including a "special leptospirosis" issue (electronic publication produced in partnership with the Pays de la Loire Regional Health Agency); - Press, radio and television articles
Innovation	For several years, POLLENIZ has been working on various techniques described as innovative. Some remain experimental, one is being implemented. - the search for attractive food that can be kept for longer, without a cold chain, and that has a much longer shelf life in the field, while retaining its palatability. This research has shown the interest of dehydrated food. Research into a multi-capture trap to increase trapping efficiency while reducing trapping time: a prototype exists. It is now necessary to move on to a large-scale experimental stage in order to ensure the interest of the trap, before the industrialisation phase; - Research into a connected device installed at the trap in order to know when an animal is captured and thus optimise trapping and travel time. Devices exist on the market. If they meet certain needs, there is still the problem of cost. This reserves the technique for very specific situations, whether for professionals or individuals.

	Finally, Polleniz and FREDON Bretagne and Normandie have worked on an interesting means of killing, based on the "MATADOR" process used in slaughterhouses to kill farm animals without suffering and quickly. A prototype has been tested and meets the need perfectly. But we now need to go further, not only at the experimental level in the field, but also at the regulatory and ethical level, to achieve acceptance of such a process.
Lessons learned	The control of coypu and muskrat populations, based on the use of trapping and shooting as complementary methods, is possible. The control techniques used have much less negative impact than chemical control using rodenticides. The latter is no longer possible as no molecules are authorised for this use. An action programme implemented on the scale of a given territory, with a prior analysis of the situation, an adaptation of the means to the issues deemed to be priorities, and sufficient financial, human and technical means, can lead to real efficiency. But this is not always the case. The practice of such an action programme over the years allows us to draw some lessons. The population density has been at its highest level for several years: some biological knowledge is too old (reproduction, dispersion, etc.) and does not allow us to understand the situation. The lack of a population sampling method is felt because it does not allow for easy evaluation of the effects of a control plan on the environment and to know if the population reduction threshold has been reached in order to see the population decline over time in a given sector; human resources, although important, remain insufficient, whether at the level of field operators or at the level of programme management; financial resources are also lacking, even if they are already substantial; technical resources exist: some can be improved (type of traps, attractants to "bait", killing process. some can be improved (type of traps, baits, killing methods, etc.), others can be used more widely (connection of traps, collection of corpses, etc.).
References	Découvrir le PAR "RAE" en Pays de la Loire : https://polleniz.fr/wp-content/uploads/2020/01/PAR-RAE-VF-novembre-2019-internet.pdf Découvrir le Flash sanitaire (numéro spécial Leptospirose) : https://polleniz.fr/wp-content/uploads/2019/07/F Bonnet M, Guédon G, Pondaven M, Bertolino S, Padiolleau D, Pénisson V, et al. (2021) Aquatic invasive alien rodents in Western France: Where do we stand today after decades of control? *PLoS ONE* 16(4): e0249904. https://doi.org/10.1371/journal.pone.0249904



Case study 8 score. France: *Myocastor coypus* and *Ondatra zibethicus*

2.2.10. Case study 9. France: *Myocastor coypus* and *Ondatra zibethicus*

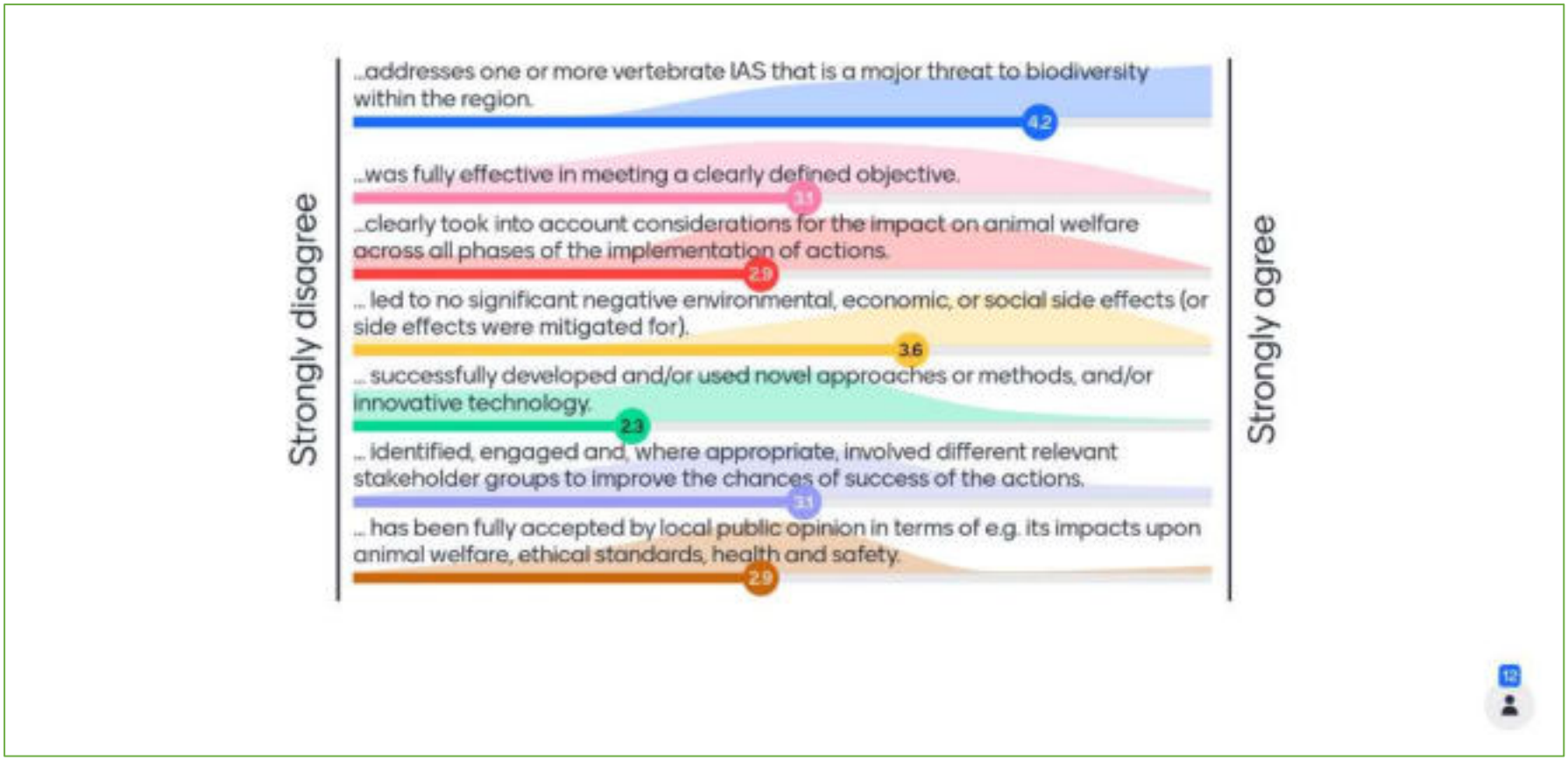
Group: Mammals	
Country: France	
Entity: FREDON Hauts-de-France	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu), *Ondatra zibethicus* (Muskrat)
Objective(s)	Rapid eradication (early stage intervention): for newly colonised territories Control: for established populations Containment: to limit expansion of established populations
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Trapping: Spring operated traps • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Cranial depression • Shooting - dispatch restrained (and wounded) animals • Slaughter with a knife
Description of the measure	The cage trap is placed by the trapper in strategic locations in the habitats of coypu and muskrat (bank edge, on rafts, etc.). This trap is not lethal and several individuals can be trapped at the same time. The traps are set every day and the trapped muskrats and coypu are killed quickly and without suffering (firearms for those who have permission, skull fracture, knife). Killing traps (spring trap, conibear) with or without bait are placed at the entrance of muskrat and coypu burrows and are adapted to the size of the species (muskrat and coypu). In some areas of the Hauts-de-France region, there is a derogation for the frequency of kill trap surveys monitored by the Wolfcatcher Royal (lieutenant de louveterie).
Time period	Trapping takes place all year round, however, between February and March, the operating groups set up "coup de poing" operations during which a maximum number of traps are deployed on the territory in order to trap a maximum number of individuals.
Location and scale of application	Muskrats and coypu are controlled throughout the Hauts-de-France region (31,813 km²), but the control is not the same everywhere, since the problems differ according to the habitat (dense or sparse hydrographic network) and according to the means implemented. Collective control has been in place in the Nord and Pas-de-Calais

	departments since 2003 (surface area: 12,414 km²) and mainly concerns territories with a developed hydrographic network. This control is coordinated by FREDON Hauts-de-France. In 2021, the project is to extend collective control of muskrats and coypu to the departments of Aisne, Oise and Somme (19,399 km²).
Effort	The data concern trapping data reported by trappers to the GDON (Groupements de défense contre les organismes) and to the APANGA (Association des Piégeurs Agréés du Nord et des Gardes Assermentés). Trappers do not always report their data, so there may be discrepancies between these data and reality. In addition, some GDON are not active, so there is no data on these territories. Département du Nord: Number of volunteer muskrat and coypu trappers on average per year in the territories of the GDONs of Flandre maritime, Radinghem-en-Weppes and Scarpe Aval, Bas Escaut and Pays de Pévèle (=210 communes): 180 volunteer trappers on average per year between 2015 and 2019. Number of paid muskrat and coypu trappers on average per year in the territories of the GDON of Flandre maritime, Radinghem-en-Weppes and Scarpe Aval, Bas Escaut and Pays de Pévèle (=210 communes): 11 paid trappers on average per year between 2015 and 2019. Total number of trappers of muskrats and coypu on average per year in the territories of the GDON of Flandre maritime, Radinghem-en-Weppes and Scarpe Aval, Bas Escaut and Pays de Pévèle (=210 communes): 191 trappers on average per year between 2015 and 2019. Average number of muskrats trapped per year in the territories of the GDON of Flandre maritime, Radinghem-en-Weppes and Scarpe Aval, Bas Escaut and Pays de Pévèle (=210 communes): 28,474 muskrats trapped on average per year between 2003 and 2019. Average number of muskrat catches per trapper and per year in the territories of the GDON of Flandre maritime, Radinghem-en-Weppes and Scarpe Aval, Bas Escaut and Pays de Pévèle (=210 communes): 158 muskrat catches per trapper and per year on average between 2015 and 2019 Number of muskrats trapped on average per period on the territories of the GDON of Cambrésis, Sambre Avesnois and Scarpe Amont and Bas Escaut (= 363 communes): 5749 muskrats trapped on average per period between 2006/2007 and 2019/2020 (source: APANGA). Number of coypu trapped on average per period on the territories of the GDON of Cambrésis and Sambre Avesnois (over the 2019/2020 period 23 communes are concerned): 63 coypu trapped on average per period between 2009/2010 and 2019/2020 (source: APANGA). Pas-de-Calais Department: Number of volunteer muskrat trappers on average per year in the territories of the GDON of the Pays de Saint Omer, the Audruicq region, the arrondissement of Béthune, the Boulonnais, the Calaisis and the Pays de Lumbres (=236 communes and 5,863 km² of known hydrographic sections): 511 volunteer trappers on average per year between 2015 and 2019. Number of paid muskrat and coypu trappers on average per year in the territories of the GDON of the Pays de Saint Omer, the Audruicq region, the arrondissement of Béthune, the Boulonnais, the Calaisis and the Pays de Lumbres (=236 communes and 5,863 km² of known hydrographical

	sections): 11 paid trappers on average per year between 2015 and 2019. Total number of muskrat trappers on average per year in the territories of the GDON of the Pays de Saint Omer, the Audruicq region, the arrondissement of Béthune, the Boulonnais, the Calaisis and the Pays de Lumbres (=236 communes and 5,863 km² of known hydrographical sections): 522 trappers on average per year between 2015 and 2019. Number of muskrats trapped on average per year in the territories of the GDON of the Pays de Saint Omer, the Audruicq region, the arrondissement of Béthune, the Boulonnais, the Calaisis and the Pays de Lumbres (=236 communes and 5,863 km² of known hydrographic sections): 56,752 muskrats trapped on average per year between 2015 and 2019 Average number of muskrats caught per trapper per year in the territories of the GDON of the Pays de Saint Omer, the Audruicq region, the arrondissement of Béthune, the Boulonnais, the Calaisis and the Pays de Lumbres (=236 communes and 5,863 km² of known river sections): 109 muskrats caught per trapper per year on average between 2015 and 2019. For the moment, no muskrats have been trapped by the trappers of the GDON of the Pays de Saint Omer, the Audruicq region, the arrondissement of Béthune, the Boulonnais, the Calaisis and the Pays de Lumbres.
Costs	Among the expenses, we find of course the salaries of the salaried trappers but also the capture bonus of 2 € given to voluntary trappers. Some operator groups also distribute protective equipment and traps to their trappers. It is also important to note the organisation of meetings and training sessions as well as the general coordination of the fight against pest species in the Hauts-de-France region.
Source(s) of funding	Regional nature park, municipalities, associations of municipalities, communities of agglomerations, urban communities, mixed syndicates, sections of Wateringues, local fishing association, syndicate association, Hauts-de-France Regional Council, DRAAF/SRAL Hauts-de-France, Departmental Councils.
Effectiveness	Moderately effective
Key evidence/results	There has been a decrease in the number of muskrat captures since 2015 (-44%) in the Nord and Pas-de-Calais, which may indicate a decline in muskrat populations.
Replicability	The measure is not reproducible on other species as it is specific but can be extended to other geographical areas taking into account the local subtleties of each territory and the hydrographic network.
Humaneness/animal welfare	For the implementation of its coypu and muskrat management programme, FREDON recommends several good practices that are humane and take into account respect for animal welfare in trapping operations: Choice of trap: as part of the training provided to volunteer trappers, the cage trap is recommended. This type of trap allows the release of non-target species. Also, during training courses, it is recommended that traps be collected every day before noon (according to the regulations).

	Choice of killing method: we recommend two techniques which, in accordance with French regulations, allow for immediate killing without suffering: (1) the firearm, used only by trappers with a hunting licence and an annual validation; (2) the skull fracture is used by trappers who do not have a hunting licence. Apart from the fact that France prohibits drowning traps, FREDON does not consider drowning to be an "immediate and painless" method of killing.
Public acceptance	We do not carry out any specific action to present the impact of the control methodology on animal welfare to the general public; press articles regularly mention the subject of coypu and muskrat control. To date, it has not been necessary to organise an event to present the impact of our actions (= the measure) on animal welfare. While it is easy to explain the act of trapping, it is less easy to show the act of killing. Indeed, part of the public shows great sensitivity to this necessary killing step. In view of the existing killing methods, a simple, effective, humane method is probably missing that would answer questions on the subject.
Side effects	The action programme implemented, based largely on trapping, has both positive and negative side effects. POSITIVE EFFECTS: • The cage trap allows the release of all non-target species without harming them. • This trap does not cause any handling danger for the user, unlike the X-trap (Conibear). • The management system for the collection of corpses (burial or evacuation by the public rendering service) avoids any health risk (transmission of zoonoses or endoparasites). • A well-organised and regular control plan in a given sector allows: * the reduction of health risks linked to the transmission of zoonoses to humans and certain species of livestock; * the reduction of impacts on crops (maize, cereals, vegetables ....) and temporary or permanent riparian meadows); * the limitation of the loss of biodiversity with regard to aquatic fauna and aquatic and subaquatic flora; * the reduction of damage to banks, dykes and other engineering structures. • The majority of the work is carried out by volunteers, which considerably reduces the costs for the local authorities, the main financiers. NEGATIVE EFFECTS: • The sight of a captured animal in an easily visible trap can affect the sensitivity of the general public. • Acts of vandalism are frequent on this very accessible equipment (10% of damage each year) and affect the motivation of volunteers. • The use of volunteer operators leads to variability in their availability and commitment, which requires us to have a larger workforce for an efficiency at least equal to that of paid labour. • Some trappers are not committed to the methods currently available and authorised for killing.

Stakeholder engagement – implementation:	**FREDON Hauts-de-France**: Raising awareness among the general public, elected officials, local stakeholders, trappers, coordination of regional control and transfer of knowledge Association des Piégeurs Agréés du Nord et des Gardes Assermentées (APANGA): **Trappers**: raising awareness among elected officials and the public, training of trappers Departmental hunting federations: Training of approved trappers DRAAF/SRAL Hauts-de-France: **Funding Hauts-de-France Regional Council**: Funding Nord Departmental Council: Funding until 2017 Communities of communes, communities of agglomerations, urban communities, communes, mixed syndicates, wateringues section, local fishing association, regional nature park and/or syndicate association involved with the operator groups: Funding and administrative support.
Dissemination	Annual review meeting with trappers and local stakeholders organised by FREDON Hauts-de-France Technical day on 26 November 2020 (in the form of a webinar in view of the health crisis) organised by FREDON Hauts-de-France, the Hauts-de-France Regional Council and the DRAAF/SRAL Hauts-de-France General meetings of each operating group every year.
Lessons learned	The involvement of volunteer trappers is essential in controlling muskrat and coypu populations



Case study 9 score. France: *Myocastor coypus* and *Ondatra zibethicus*

2.2.11. Case study 10. France: *Myocastor coypus* and *Ondatra zibethicus*

Group: Mammals	
Country: France	
Entity: Bayer Environmental Science	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu), *Ondatra zibethicus* (Muskrat)
Objective(s)	Control
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Trapping: Cage traps (connected traps)
Measures used to remove (dispatch/sterilise/captivity) species	Keeping in captivity
Description of the measure	Connected trap to be positioned on cages (billiard trap test in progress). The closing of the door and the detection of presence by Infra-red allows the sending of a message (SMS; messaging,...) to the trapper. Double information transmitted of closing and presence: 1. Allows to relieve the population of the voluntary trappers (more and more old, less and less numerous and motivated in front of the proliferation of the IAS). 2. Allows to improve the respect of the animal: From the obligation of a passage every day before 12.00 with a traditional trap to the obligation of passage in case of catch in the 2 hours after the sunrise (nocturnal catch), or in the 5hours after activation during the day for a connected trap. 3. Relieves the trapping companies, decreases the time spent on daily trap collection, increases the number of traps per employee, decreases the number of car kilometres, increases the reactivity during a trap collection, increases the image (less animal suffering, less impact on domestic animals)
Time period	Trapping can be carried out all year round. The connected trap is a tool for monitoring a re-infestation on a site
Location and scale of application	Connected traps being launched. Very good feedback on the Dombes region. First traps distributed in Oise. Answers to professionals monitoring lagoons.

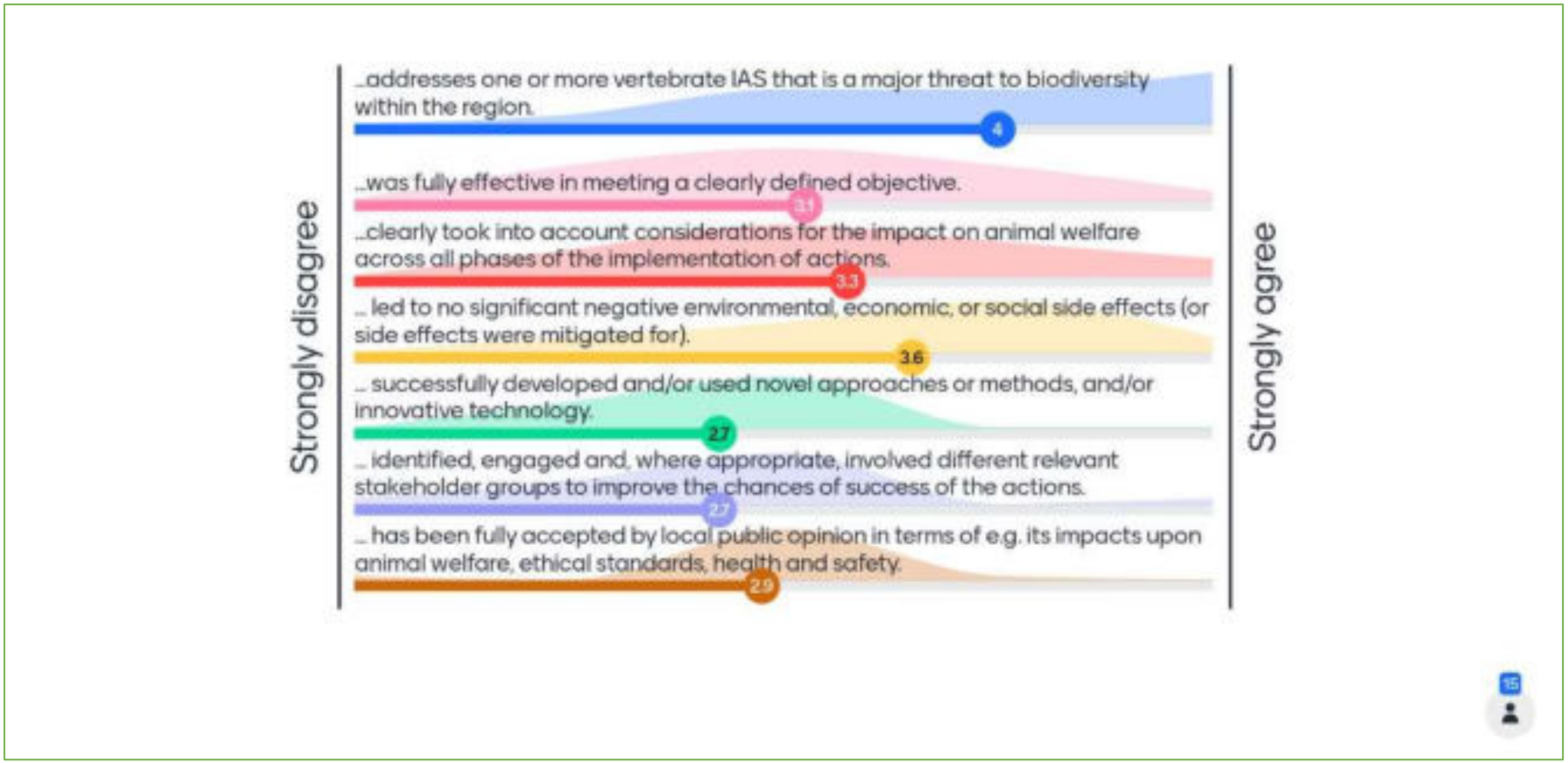
Effort	For coypu management, the trap becomes interesting in a territory when the population has decreased and we enter a surveillance period. The positioning of a connected cage in a strategic place allows to be informed of the recolonisation of a territory and of the need to intensify the control.
Costs	Cage + Connected Trap + Subscription: Example for 1 copy without discounts. 50€ + (from 51.90 €)+ (39.90 €/year)
Effectiveness	Effective
Replicability	Communication only on coypu, muskrats. However, the connected trap is occasionally used for wild boar, raccoons or other rodents (indoor).
Humaneness/animal welfare	The connected trap allows the trapper to be much more reactive and as required by the regulations, they intervene within 2 hours after sunrise for a night-time catch and within 5 hours after the catch for a daytime catch vs. immobilizations which can last up to 24 hours with a traditional trapping without a connected trap.
Public acceptance	The reactivity of the trapper makes it possible to limit the exposure of an animal (IAS or domestic) and thus reduce the exposure to a public that could release an animal or damage the equipment.
Side effects	1. Carbon gain: enormous limitation of car journeys (in the case of surveillance) otherwise identical 2. Gain in human time (for the amateur trapper of little importance) but very costly for a professional 3. Gain in image 4. Lower risk of traps being spotted as the trapper passes by less often (facilitating the catching of animals and less risk of deterioration by third parties) 5. Facilitation of traceability, presentation of trapping (mapping, catch history) - Modest cost but too high for volunteers, often retired, elderly 6. Regulatory obligations much more restrictive for connected traps than for traditional trapping
Stakeholder engagement – implementation:	Trapping federation, hunting federation, FDGDON Exchanges with trapping professionals ONF Chambers of agriculture/agricultural unions: Farmers: population most exposed to damage on banks, maize or grassland (cost: 32 €/coypu), leptospirosis diseases.
Dissemination	Press communication, digital media
Innovation	Connected trap: 2 catch validations (mechanical by magnet and infra-red) Communication by SIGFOX network Operational website, cartography
Lessons learned	The world of voluntary trapping has been overtaken by the development of IAS. POLLENIZ 44 figures: 70% of members > 65 years. Little investment and little motivation on the part of many trappers (low remuneration). Little investment by professionals because the cost/person in travel is very high. (source FDGDON: company = 5 to 10

	times the price of a volunteer) Reluctance to progress on the part of certain members: fear of accompanying a tool linked to a tightening of the regulations.
References	https://www.digitrap.fr/

2.2.12. Case study 11. France: *Alopochen aegyptiaca*, *Branta canadensis* and *Ondatra zibethicus*

Group: Birds and Mammals	
Country: France	
Entity: Métropole Européenne de Lille	
Category	**Response**
Species targeted	*Alopochen aegyptiaca* (Egyptian goose), *Branta canadensis* (Canada goose), *Ondatra zibethicus* (Muskrat)
Objective(s)	Containment: limit the expansion of species deemed to be a nuisance to our activities
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Hand removal • Trapping: Cage traps • Fertility control: Shaking the eggs
Measures used to remove (dispatch/sterilise/captivity) species	• Cervical dislocation • Shooting - dispatch restrained (and wounded) animals
Description of the measure	To limit the population of Canada geese and Egyptian geese, we have opted for egg sterilisation (and not the culling of the adults): this consists of shaking the eggs vigorously until the embryo is detached. As a precautionary measure, we make a second pass 15 days after the first. For muskrat trapping: we now prefer selective and non-lethal traps. We release the animals that we do not wish to control. For those we kill, we have stopped drowning (a muskrat takes 15 minutes to drown). We shoot a pellet in the head at close range when the animal becomes calm again.
Time period	Canada Geese: in spring, when eggs are laid Muskrats: at any time during trapping sessions

Location and scale of application	On the natural areas of the European Metropolis of Lille, in the North of France
Effort	Geese: 5 days/person/year Muskrat: difficult to estimate as different every year
Effectiveness	Effective
Key evidence/results	Geese: shaken eggs are not viable anymore. About 130 eggs are shaken each year. The main barrier is the administrative limit: we can only shake eggs from nests located on our territories. Muskrats: Rats killed by shooting at close range are killed instantly.
Replicability	Shaking the eggs is possible for any bird whose nest is easily accessible. Killing at close range is replicable for any animal in a cage or injured animal that cannot escape.
Humaneness/animal welfare	Shaking the eggs was the most humane choice for limiting the geese. Otherwise, it was a matter of killing the adults by shooting: a traumatic solution for the geese and not very effective. For rats: previously, they were killed by drowning. Knowing that a rat takes more than 15 minutes to drown, I opted for a quicker way of killing.
Public acceptance	We do not advertise these measures in particular, but when asked, they are relatively well accepted by the public. The public does not see the killing.
Stakeholder engagement – implementation:	Canada geese: l'Office Français de la Biodiversité, la fédération départementale des chasseurs, le Groupement Ornithologique et Naturaliste du Nord de la France (GON)



Case study 11 score. France: *Alopochen aegyptiaca, Branta canadensis* and *Ondatra zibethicus*

2.2.13. Case study 12. France (Martinique): *Herpestes javanicus*

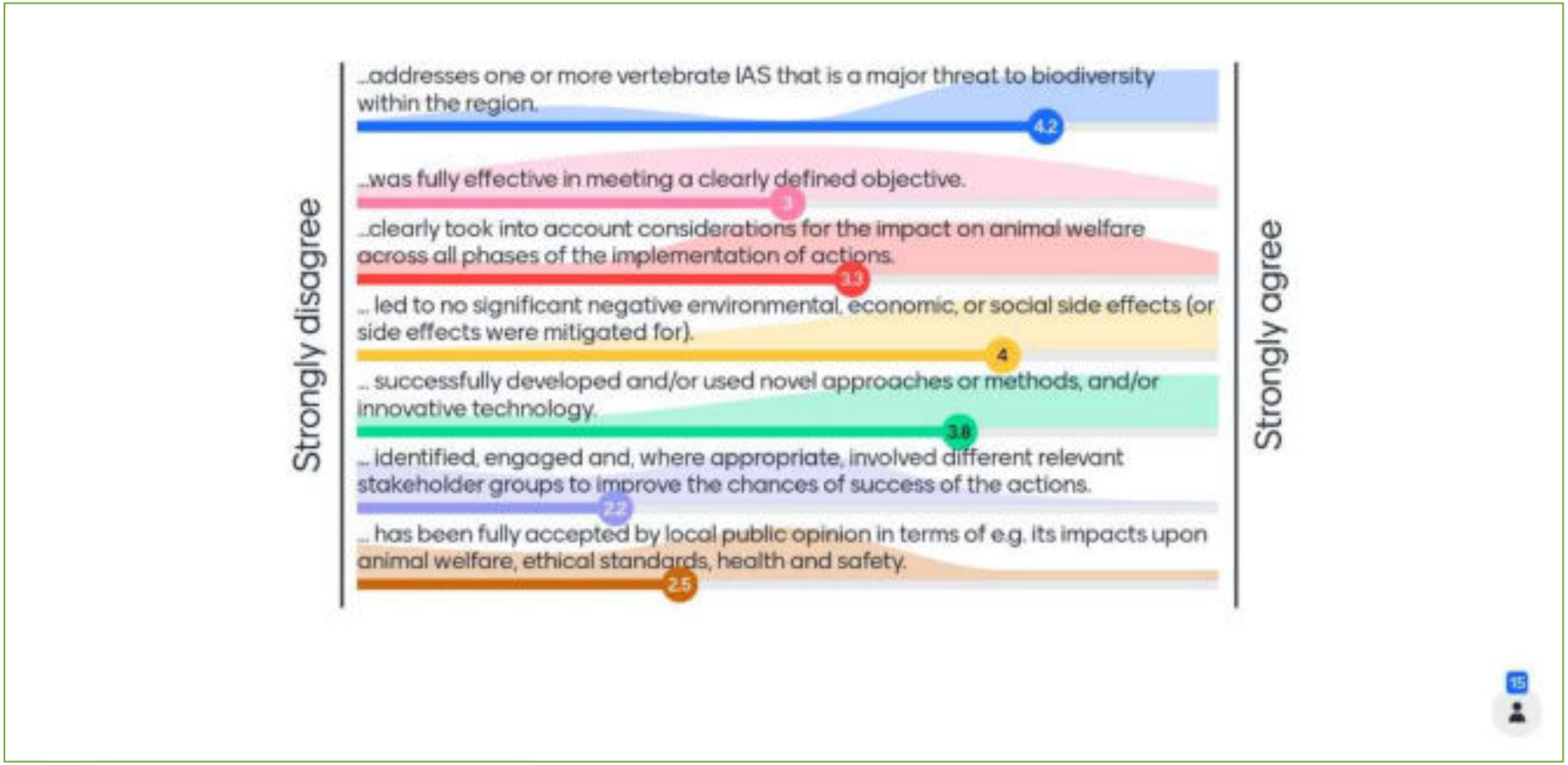
Group: Mammals	
Country: France (Martinique)	
Entity: DEAL Martinique	
Category	**Response**
Species targeted	*Herpestes javanicus* (= *H. auropunctatus*) (Small Indian mongoose)
Objective(s)	Control - to preserve species and sectors at stake: sea turtle nesting sites, White-breasted thrasher nesting areas
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Trapping: Goodnature self-resetting traps • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Shooting - dispatch restrained (and wounded) animals
Description of the measure	Marine turtle nesting sites (operator = ONF): Equipment: 4 types of traps were used (live capture to release non-targeted specimens) including 32 mongoose traps, 4 fawn cages, 2 chicken traps and 10 rat traps. 1 air rifle (19.9 joules) was used for killing; Area where the White-breasted thrasher (endangered species) is present (operator = PNRM): Goodnature automatic reset traps for young individuals - Bttm type cage traps "mechanical mongoose traps". 1 air rifle (19.9 joules) was used for killing.
Time period	Sea turtle nesting sites (17 days from 17/06 to 10/07/19) White-breasted thrasher sector: two trapping campaigns upstream and downstream of reproduction: 35 trapping days
Location and scale of application	Marine turtles 3 beaches: 2 in the north (Anse Lévrier and Anse à voile) and Anse Trabaud in the south White-breasted thrasher zone: entrance to the Caravelle national nature reserve + Pointe Rouge site. No information on the surface area and size of the population.
Effort	Marine turtles: 4 agents over 17 days: 32 mongoose traps, 4 wild booby traps, 2 chicken traps and 10 rat traps White-breasted thrasher zone: 126 A24 traps and 75 cages 107 days a year
Costs	No specific information on costs

Source(s) of funding	State funding (sites tortues marines) and EU (LIFE project) (White-breasted thrasher)
Effectiveness	Unknown: Since 2012, the CPUE has been decreasing. We will therefore have to wait for the results of the following years to know whether the capture effort is sufficient to limit predation of sea turtle eggs by mongooses or whether the latter have developed a trap avoidance strategy. In 2018, the CPUE is very low. This coincides with the massive *Sargassum* seaweed stranding that same year and therefore with the low number of turtle nests, and consequently, with the low attractiveness of the sites for mongooses. As regards the White-breasted thrasher, we will have to wait for the assessment in 2023 to judge the effectiveness of the actions.
Replicability	A24 trap also used for rats
Humaneness/animal welfare	Trap A24: animal dies on impact. As regards trapping, the cages are lifted daily in the morning and evening so that the animal is not stressed for too long if it is caught in the trap. The killing is done at point-blank range with a rifle, the animal dies on the spot.
Public acceptance	The trapping technique also makes it possible to manage stray cats (taken to the SPA) and mongooses (released outside the area at stake). Actions to control young mongooses (A24) also make it possible to control rats, which are predators of threatened species.
Stakeholder engagement – implementation:	ONF and PNRM staff. The RMNP has set up a team of volunteers to combat IAS
Dissemination	Feedback from the mongoose project will be published by the IUCN. Within the framework of the Life biodiv OM, the PNRM should communicate on the actions at its end in 2023.
References	To be published: Regulation of the mall Indian mongoose on marine turtle nesting sites in Martinique (IUCN feedback) + life biodiv OM White-breasted thrasher.

2.2.14. Case study 13. France (and Germany): *Myocastor coypus*

Group: Mammals	
Country: France (and Germany)	
Entity: European Federation for Hunting and Conservation (FACE)	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu)
Objective(s)	Control (coypu): bowhunting coalition assists control of invasive nutria in cities
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Additional measures: Bowhunting
Measures used to remove (dispatch/sterilise/captivity) species	Shooting - dispatch restrained animals
Description of the measure	In the project area, it is not possible to use a rifle, shotgun, traps or poison, due to the danger to people, pets, cars and houses being too great. The project was launched on 2 July 2017 by 27 hunters, consisting of members of the Alsatian Bow hunting federation (ACABR) and the German Bowhunting Association (DBJV). Four hunts took place in the early hours of the morning. The data collection on the coypu, which was subsequently examined at the Pathological Institute of the Veterinary University of Hannover, was carried out on-site by means of a survey questionnaire (designed by the Scientific advisory board “bowhunting”).
Location and scale of application	In Haguenau, France, along the German border, the Haguenau town council decided to take action against the coypu.
Effort	About 30 coypu were shot and over 550 hours of work time was spent by hunters and scientists during this initiative.
Effectiveness	Unknown
Stakeholder engagement – implementation:	Alsatian Bow hunting federation (ACABR) and the German Bowhunting Association (DBJV). Veterinary University of Hannover.
References	https://www.face.eu/2020/12/face-biodiversity-manifesto-project-of-the-month-bowhunting-coalition-assists-control-of-invasive-nutria-in-cities/

https://www.dbjv.org/assets/data/downloads/dbjv_bericht_nutria_reduzierung_haguenau_2017.pdf

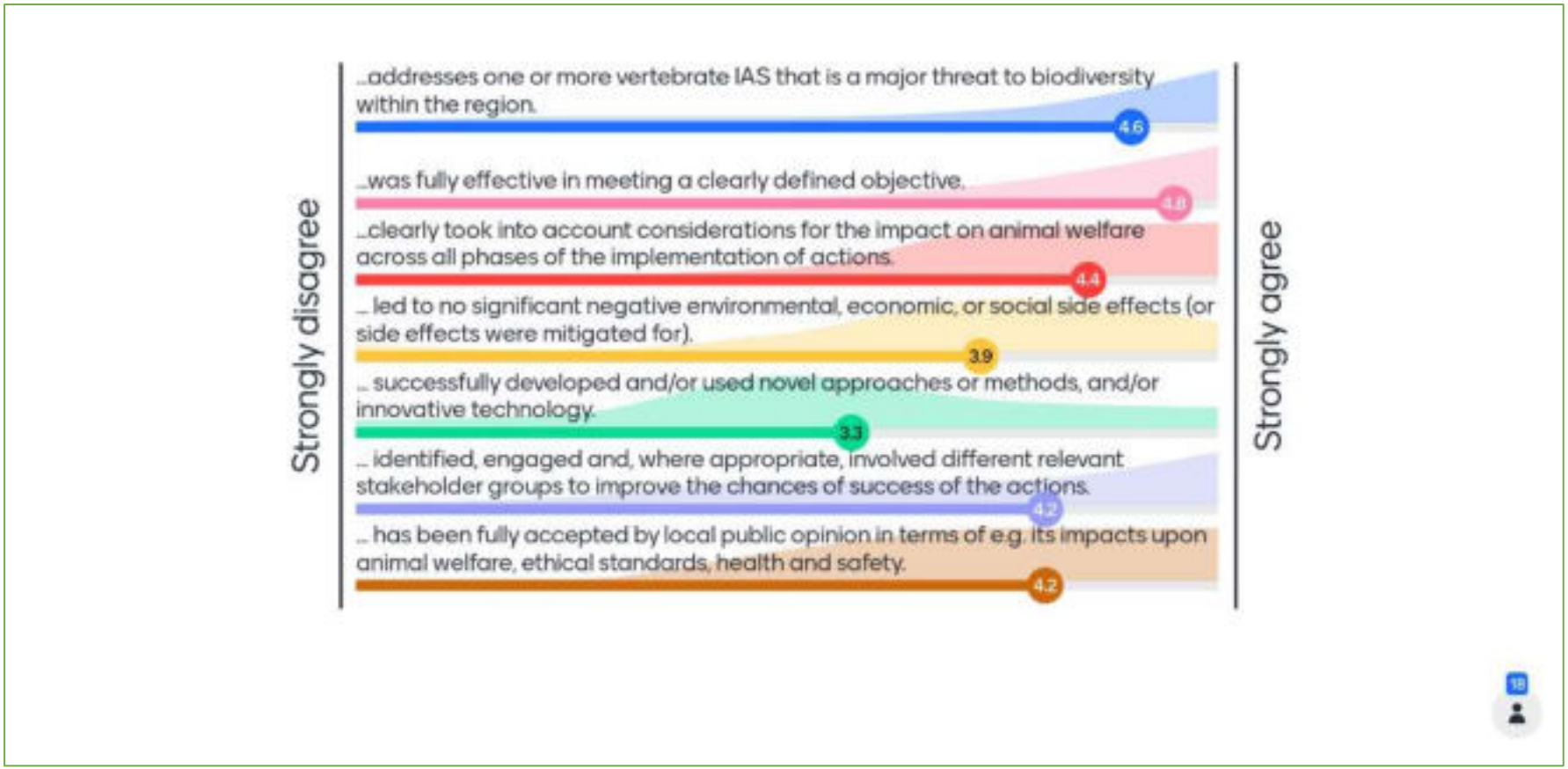


Case study 13 score. France (and Germany): *Myocastor coypus*

2.2.15. Case study 14. Netherlands: *Callosciurus erythraeus*

Group: Mammals	
Country: Netherlands	
Entity: Dutch Mammal Society (Zoogdiervereniging)	
Category	**Response**
Species targeted	*Callosciurus erythraeus* (Pallas's squirrel)
Objective(s)	Initially, the objective was rapid eradication (early stage intervention): removal of an established population in the early invasion stage. During the project, it was established that the populations turned out to be much larger so the objective was eradication of a widespread population.
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Keeping in captivity • Surgical sterilisation
Description of the measure	Placing medium sized cage wire live traps baited with walnuts on locations where presence of Pallas' were reported or where signs were present: mainly locations where bark of trees were striped by this species.
Time period	Squirrels were trapped during two consecutive winter periods, when food was scarce. Afterward the region was monitored for fresh signs and sightings by inhabitants could be reported for several years afterwards.
Location and scale of application	Municipality of Weert (Province of Limburg, The Netherlands), ca. 50 km^2
Effort	During two winters two professional trappers were active. Trapping was followed by an intensive inventory for remaining squirrels (or their signs of presence). It took ca. 4 years from detection till eradication. During these years a project coordinator spent 1-1,5 days/week during all years. Number of traps varied, but during trapping sessions ca. 300 traps were active in the area.
Costs	Costs summed up to at least 330,000 €. Ca. 80-90% of the costs were personnel costs
Source(s) of funding	The project was paid by the Province of Limburg and the Dutch Food and Safety Authority (nVWA), which is part of the Ministry of Agriculture, Nature and Food quality.

Effectiveness	Effective, the species was eradicated
Replicability	This approach can be used when eradicating squirrel species which are not widespread
Humaneness/animal welfare	Traps were regularly checked to prevent too much stress in trapped individuals
Public acceptance	The public was informed that trapped squirrels were not killed, but relocated to zoos and other animal parks
Stakeholder engagement – implementation:	All relevant stakeholders were informed: local authorities, land owners, hunters, inhabitants of the area, etc.
Dissemination	Some information evenings were organised and announced through local and regional newspapers, social media and other nature magazines. For the general public a special flyer was developed and available on request.
Innovation	Searching for signs was very effective in determining the presence of the species
Lessons learned	The focus on communication from the beginning has helped the project enormously. The general public appreciates (exotic) squirrels and often has to be convinced that these species have detrimental effects on native squirrels in the future, especially, as these effects are not visible yet.
References	La Haye (2020), Pallas's squirrel eradication in the Netherlands, p145-154. in: Robinson N & Shuttleworth CM Invasive Alien Species Colonisation Prevention: Your guide to early detection and rapid response. Dijkstra V., La Haye M. (2017). Wegvangen van Pallas' eekhoorn bij Weert. De Levende Natuur 118(4):132-133.

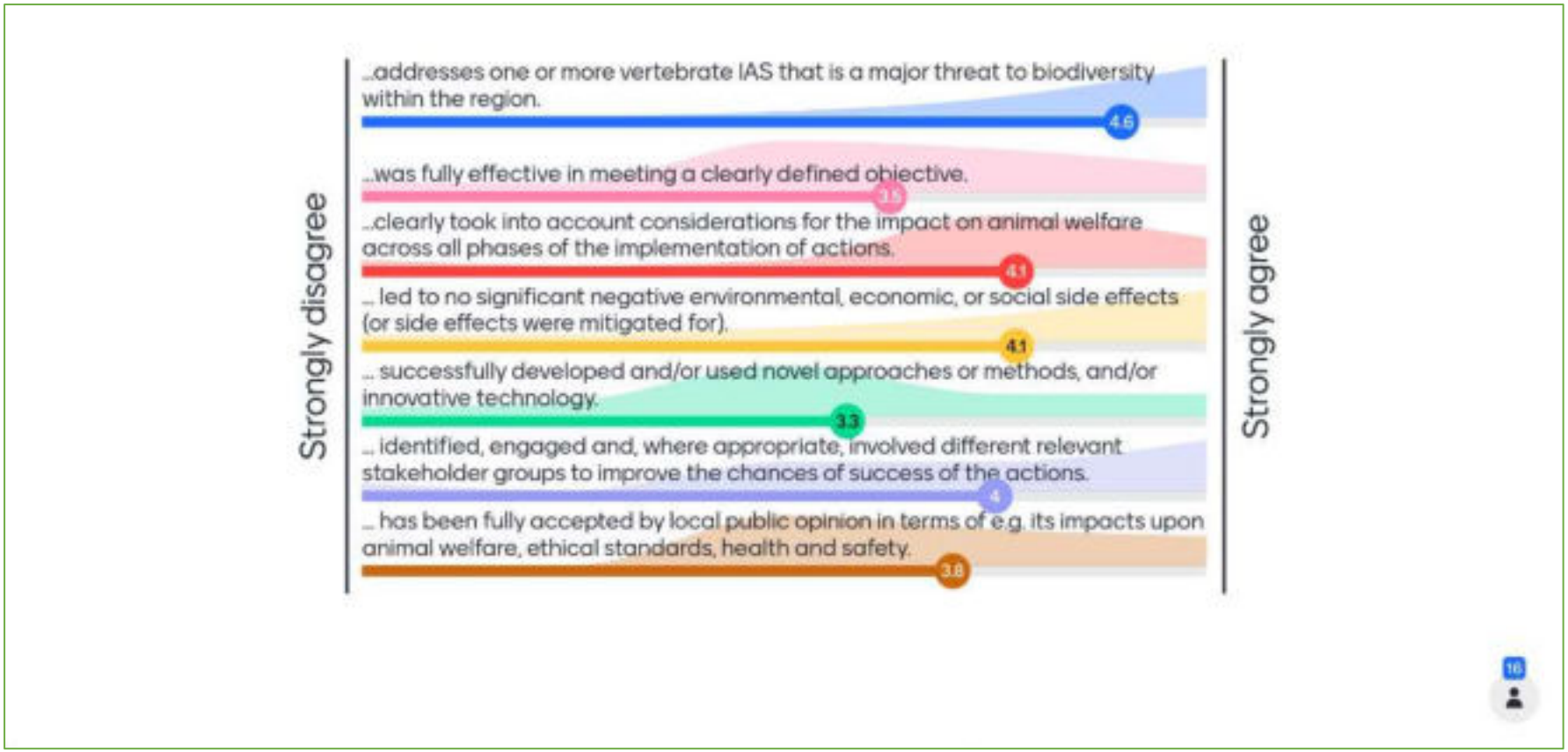


Case study 14 score. Netherlands: *Callosciurus erythraeus*

2.2.16. Case study 15. Netherlands: *Procyon lotor*

Group: Mammals	
Country: Netherlands	
Entity: Province of Limburg	
Category	**Response**
Species targeted	*Procyon lotor* (Raccoon)
Objective(s)	Rapid eradication (early stage intervention): Removal of an isolated population of 50-100 Raccoons
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	Keeping in captivity
Description of the measure	~35 wooden box life-traps, type "trigger plate" and "bait with lure" Keeping in captivity: deworming, sterilization and permanent housing in zoos Online portal for reporting sightings - Monitoring with trail cams
Time period	2 trapping periods: (1) 15/10/2019 – 15/03/2020 (5 months) (2) 15/09/2020 – 15/03/2021 (6 months)
Location and scale of application	~1/3th of the Province of Limburg: ~700 km^2 (south of province) ~50-100 Raccoons
Effort	In first trapping period: Traps on 74 locations, 4,722 trap-nights
Costs	First trapping period: 91,000 € excl. VAT. (monitoring, catching and keeping in captivity (incl. de-worming, sterilization) & setting up and managing online portal)
Source(s) of funding	Budget from the provincial government
Effectiveness	Moderately effective: First trapping period: 23 Raccoons trapped = 0.36 raccoon by 100 trap-nights
Humaneness/animal welfare	No trapping during nursing period (March 15th – September 1st). Trapping alarm on each cage.

Public acceptance	In 2019, there were plans for shooting Raccoons because housing options were limited and too expensive at that moment. The current measure is a political outcome, set in motion by public opinion. There were only a few reactions after this decision, mainly pointing at the higher costs compared to shooting by (volunteer) hunting license holders.
Side effects	Positive: less risks for human health (52% infected with Raccoon roundworm (*Baylisascaris procyonis*)) Negative: 5 Raccoons escaped from a zoo (they were de-wormed and sterilized)
Stakeholder engagement – implementation:	Wildlife management organisation, animal welfare organisations, Dutch Mammal Society
Dissemination	Online information (online portal, www.wasberenmeldpunt.nl), leaflet for public for recognizing similar species (raccoon dog & badger).
Lessons learned	Online portal is effective in getting more observations Trapping with live-traps works well, but takes time Elimination of local population is not finished Trapping in urban area is difficult
References	http://www.bionetnatuur.eu/wasbeeronderzoek-2018/wasbeer-in-de-grensregio-24okt2018/

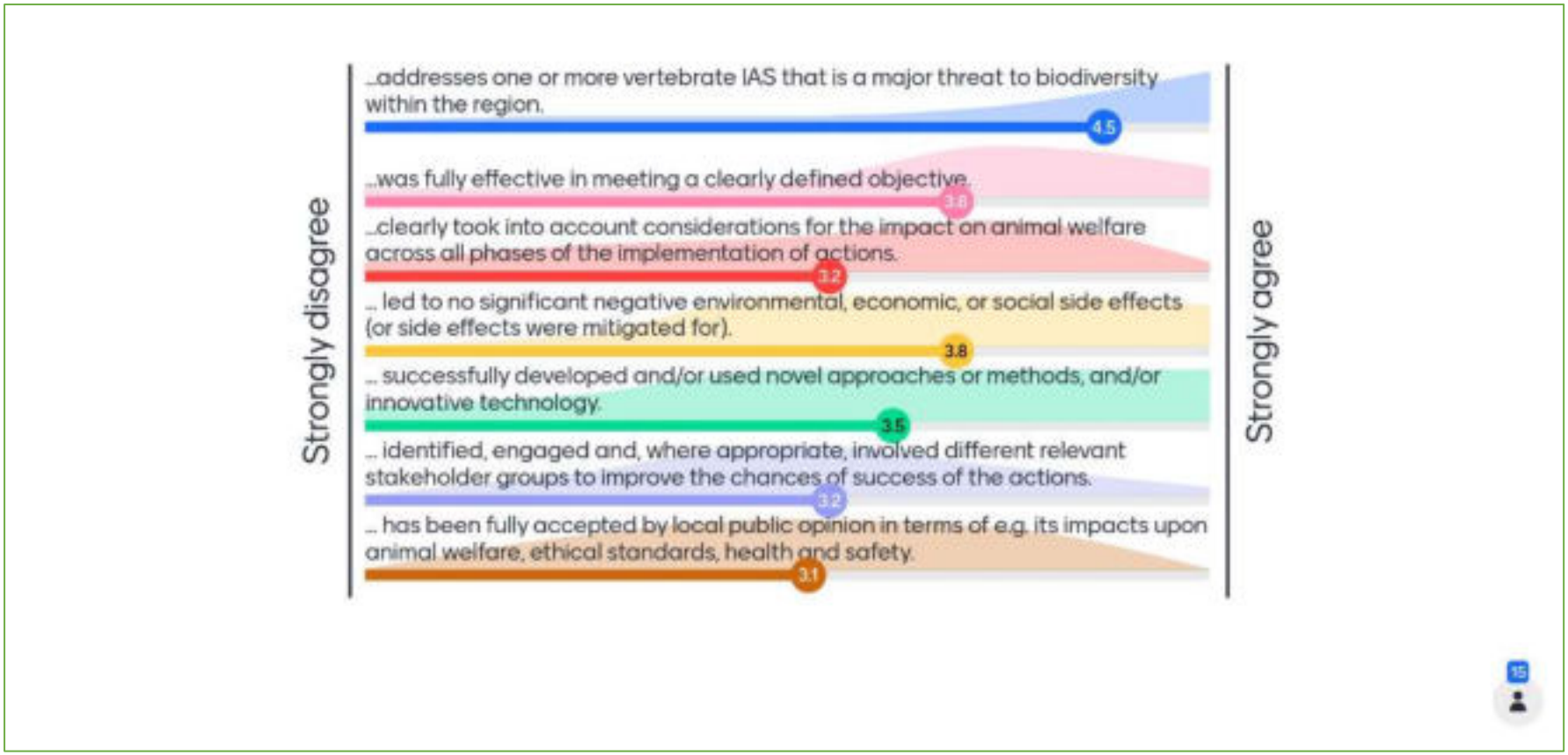


Case study 15 score. Netherlands: *Procyon lotor*

2.2.17. Case study 16. Netherlands: *Myocastor coypus* and *Ondatra zibethicus*

Group: Mammals	
Country: Netherlands	
Entity: Dutch Water Authorities	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu), *Ondatra zibethicus* (Muskrat)
Objective(s)	Control (coypu): after complete removal now controlling influx from Germany Containment (muskrat): current strategy is complete removal in 15 years, followed by control influx
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Trapping: Drowning traps • Trapping: Spring operated traps • Trapping: Cage traps • Trapping: Live decoy traps • Other methods: Hunting dogs, Judas animals
Measures used to remove (dispatch/sterilise/captivity) species	• Shooting - dispatch restrained animals
Costs	Overall costs 35.000.000 € (all included)
Additional details on costs	In 2020 the budget was 33.700.000 € for muskrat trapping and 1.300.000 € for Coypu trapping. 396 fte muskrat trappers and 18 fte coypu trappers.
Source(s) of funding	Regional water authority taxes
Effectiveness	Effective
Key evidence/results	Coypu: no own population, only influx from mainly Germany Muskrat: decreasing population, it is expected that in a period of 15 years the muskrat will be completely removed. As with the Coypu controlling influx will exist
Replicability	As part of the Life MICA project, monitoring using eDNA is being investigated on a practical scale. Traps are only used in the test areas if traces of muskrats have been found

Humaneness/animal welfare	For Coypu trapping only live trapping cages are used to avoid bycatches. 78% of the muskrats are trapped in a Conibear Trap, 2% in a life trapping cage. From 2019, only certified Conibear traps are purchased. Certification is done by the Fur Institute of Canada. Drowning traps are mainly used along the border with Germany to trap influx and during the migration season to prevent recolonization of clean areas.
Public acceptance	There is transparent communication about the method of trapping. In general, the public supports our methods of trapping. However, animal welfare organisations oppose the use of drowning traps.
Side effects	Side effects are bycatch of several species. 42% of our bycatches are desired bycatch like brown rat, American mink and invasive alien crayfish.
Stakeholder engagement – implementation:	The trapping has 100% been done by the regional water authorities
Dissemination	Several websites: https://lifemica.nl/ ; https://lifemica.eu/ ; https://lifemica.de/ https://muskusrattenbestrijding.nl/ https://www.uvw.nl/thema/veiligheid/muskus-en-beverratten/ websites of the 21 regional water authorities
Innovation	As part of the Life MICA project, monitoring using eDNA is being investigated on a practical scale. Traps are only used in the test areas if traces of muskrats have been found.
Lessons learned	https://gruene-kreistagsfraktion.de/wp-content/uploads/2019/01/Intensive-Bek%C3%A4mpfung-von-Bisam-und-Nutria-in-den-Niederlanden.pdf
References	Damage to dykes and levees in the Netherlands is extensive and increases with muskrat (*Ondatra zibethicus*) density https://muskusrattenbestrijding.nl/wp-content/uploads/2019/07/Artikel-Lutra-juni-2019.pdf Field experiment muskrat: https://muskusrattenbestrijding.nl/wp-content/uploads/2018/05/Veldproef-muskusratten.pdf Advice new control methods muskrat: https://muskusrattenbestrijding.nl/wp-content/uploads/2018/12/De-toekomst-van-het-muskusrattenbeheer-in-Nederland-De-mogelijkheden-onderzocht.pdf



Case study 16 score. Netherlands: *Myocastor coypus* and *Ondatra zibethicus*

2.3. Boreal Region: Estonia, Finland, Latvia, Lithuania, Sweden

2.3.1. Summary of case studies submitted for the Boreal region

	Country	Entity submitting	Species	Measures used to restrain, capture and/or remove (kill/sterilise) the species	Measures used to remove (dispatch/sterilise/captivity) species	Average score at workshop
1	Finland and Sweden	Swedish Association for Hunting and Wildlife Managt.	*Nyctereutes procyonoides*	Other measures: hunting dogs (tracking/baying) Other measures: Judas animals	Keeping in captivity Shooting - dispatch restrained animals Surgical sterilisation	4.3
2	Finland	Finnish Wildlife Agency	*Nyctereutes procyonoides*	Shooting Trapping: cage traps Other: hunting dogs Other: Judas animals	Shooting - dispatch restrained animals	4.4
3	Finland	Ministry of Agriculture and Forestry	*Nyctereutes procyonoides, Neovison vison**	Shooting Trapping: Goodnature self-resetting Trapping: spring operated traps Trapping: cage traps Other: hunting dogs Other: Judas animals	Shooting - dispatch restrained animals	4
4	Finland (Åland)	Government of Åland	*Nyctereutes procyonoides*	Shooting	Shooting - dispatch restrained animals	4.3
5	Latvia (and Italy, Portugal, Spain)	Riga Zoo	*Trachemys scripta, Chrysemys picta**, *Graptemys* sp.*	Habitat manipulation: physical barriers Hand removal Hand removal: physical fishing methods	Decapitation Freezing Injection euthanasia Keeping in captivity	3.5
6	Lithuania	Lithuanian State Scientific Research Institute	*Lepomis gibbosus, Perccottus glenii, Pseudorasbora parva*	Biological control: native predators Hand removal: physical fishing methods Other: electrofishing	Additional measures: put to sleep with anaesthetics	3.6
7	Sweden	Swedish Association for Hunting and Wildlife Managt.	*Alopochen aegyptiaca*	Shooting (Measures not covered) Citizen Science	N/A	4.3

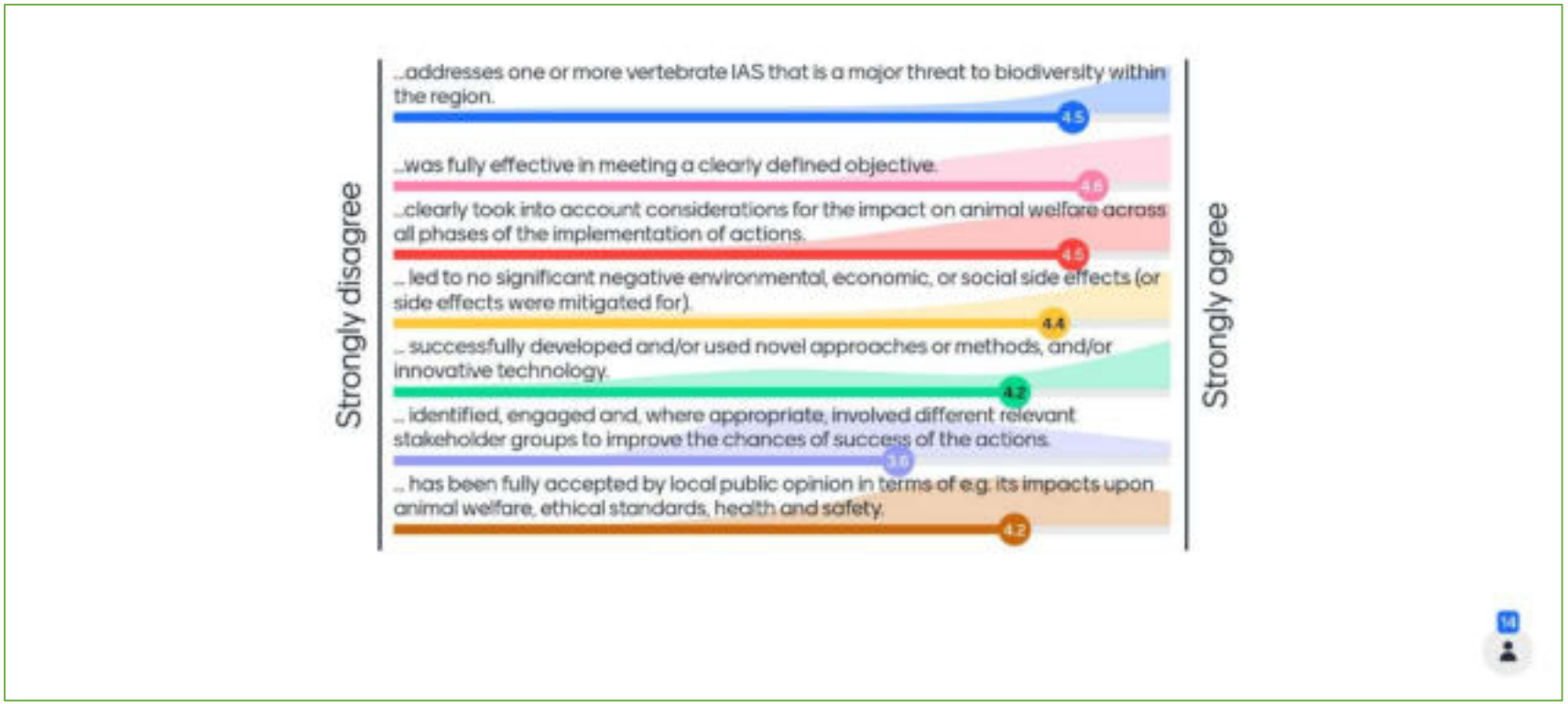
* Vertebrate IAS not on the Union list

2.3.2. Case study 1. Finland and Sweden: *Nyctereutes procyonoides*

Group: Mammals	
Country: Finland and Sweden	
Entity: Swedish Association for Hunting and Wildlife Management	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog)
Objective(s)	Rapid eradication (early stage intervention): Finding animals for Rapid Eradication/Containment Containment: Finding animals for Rapid Eradication/Containment
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Other measures: Hunting dogs (tracking/baying) • Other measures: Judas animals
Measures used to remove (dispatch/sterilise/captivity) species	• Keeping in captivity • Shooting - dispatch restrained animals • Surgical sterilisation
Description of the measure	Wild individuals of both sexes are captured, treated against diseases and fitted with a satellite transmitter. The Judas animal is released on its own and its movements are observed in real time; the transmitter sends positions to the manager. When the Judas animal stops for several days in the same area it has most likely found a partner. The Judas animal is visited in the field and any partner is captured. It may be several hours since the last transmitter position was sent, so hunting dogs are used to track, locate and keep animals at bay. Dogs are fitted with a muzzle to avoid injury to the animals. An animal control stick is used if the animal is to be captured; shooting is used if an animal kept at bay is to be culled. Sterilization is also often used to eliminate the chance of the Judas animal reproducing once released.
Time period	All times of year from 2008 and still ongoing 2021
Location and scale of application	Northern Sweden (and Finland). Approx. 150,000 km^2. Focusing on the invading population from Finland to Sweden
Effort	One full time employee will manage about 20-25 Judas animals
Costs	**Personnel costs:** Capturing of animals is included in the cost of the full time employee. Sterilization will cost approximately 200 Euro per animal.

	Equipment and infrastructure: One GSM/Satellite collar costs approximately 2,000-2,500 Euros. Depending on the settings of the positioning the battery will last between 6 months to one year. A battery replacement will cost approximately 500 Euros. A collar can last up to five years if not physically damaged. Operator costs for GSM traffic may have to be added. In total, considering that collars are able to work for five years, the cost of collars will be between 1,000-1,500 Euros per collar/year. Triangulation equipment for locating the transmitter signal in the field costs about 1,000 Euros per unit. **Other costs, including capacity building and overheads:** Additional costs include a place to keep raccoon dogs captured while waiting for sterilization, and when recovering after the surgery. Also transports, for capturing and moving animals has to be added.
Additional details on costs	It is difficult to give exact quantities and costs since the measure is integrated with other measures. One full time employee will, as mentioned above, manage about 20-25 Judas animals if working full time on this work. In practice, however, the employees in the project manage other measures at the same time as checking Judas animals, saving time and money on combining work in one travel. All six field personnel in the project work with all measures, but together they may devote one full time to Judas animal work per year.
Source(s) of funding	Governmental funding via Swedish Environmental Protection Agency
Effectiveness	Effective
Key evidence/results	At low population densities Judas animals are very efficient, but this becomes much less so at high densities. At very low densities it is almost impossible to find just a few remaining individuals, especially in a large area, with other methods, e.g. hunting dogs, with traps, with aircrafts or with game cameras. Judas animals on the other hand will constantly and continuously actively search for conspecifics every hour of every day. In high density populations most Judas animals will soon find other animals, they will get “trap saturated”. At high population densities a lot of work is required to capture wild individuals and move Judas animals; efficiency is relatively small under such circumstances. Other methods will be more cost-efficient. However, the information they allow to be collated on dispersal, habitat selection and distribution hotspots may still be very useful for the management. As expected in a medium sized population other measures have been more efficient in the case study area so far, but now the population is getting very small, the Judas animals are showing signs of increases in relative efficiency in finding new animals compared with the other measures. During 2020 the Judas animals delivered about 30% of the new individuals. When only few animals are left in a population up for eradication, Judas animals will often be the only way of finding them all. Similarly, based on the experience in the Nordic countries, it is effective as an early warning in countries (or geographical areas within countries) that do not yet have the invasive alien species, i.e. to detect immigrating individuals with Judas animals.

Replicability	Judas animals may be a useful technique for most social animals, that seeks up and associates with other individuals or groups of individuals.
Humaneness/animal welfare	The Judas technique impact on the animal's welfare is mild-moderate. They are captured, handled, collared, moved and possibly sterilised, which implies both physical and mental impacts on their welfare. Judas animals within this work will, however, live a much longer life than non-collared animals because they are not killed by other measures in this cross-border cooperation. Moreover, Judas animals are de-helminted annually keeping them in better condition than untagged conspecifics and if necessary supplementary fed during harsh winters. The Judas measure has been approved by the Swedish ethical committee for animal experiments. The Judas technique is one out of many various measures used in the raccoon dog management. Some are more humane and others less humane than the Judas technique, but all are necessary. Using only one or a couple of the measures the management would not be efficient at a whole. Without the Judas technique it would be impossible to find and cull the last individuals of a population.
Public acceptance	The raccoon dog management and the Judas technique has repeatedly been presented in media in Sweden and Finland over the past years. The technique has been thoroughly explained to the public. The public understand the importance of managing invasive species and are positive to the management.
Stakeholder engagement – implementation:	The project is managed by the Swedish Association for Hunting and Wildlife Management. Local hunters are often involved.
Dissemination	The Project is very active regarding dissemination and communication with stakeholders and the public. In 2020 approximately 300 articles were written about the raccoon dog management project in Swedish media.
Innovation	Importing and using animals from Finnish fur farms as Judas animals in Sweden. This is much faster and cheaper than capturing wild animals. The efficiency has not yet been evaluated though.
Lessons learned	It is often necessary to combine several different measures to become effective in the management.
References	Dahl, F., & Åhlén, P. A. (2017). Information on measures and related costs in relation to species included on the Union list: *Nyctereutes procyonoides*. Technical note prepared by IUCN for the European Commission.



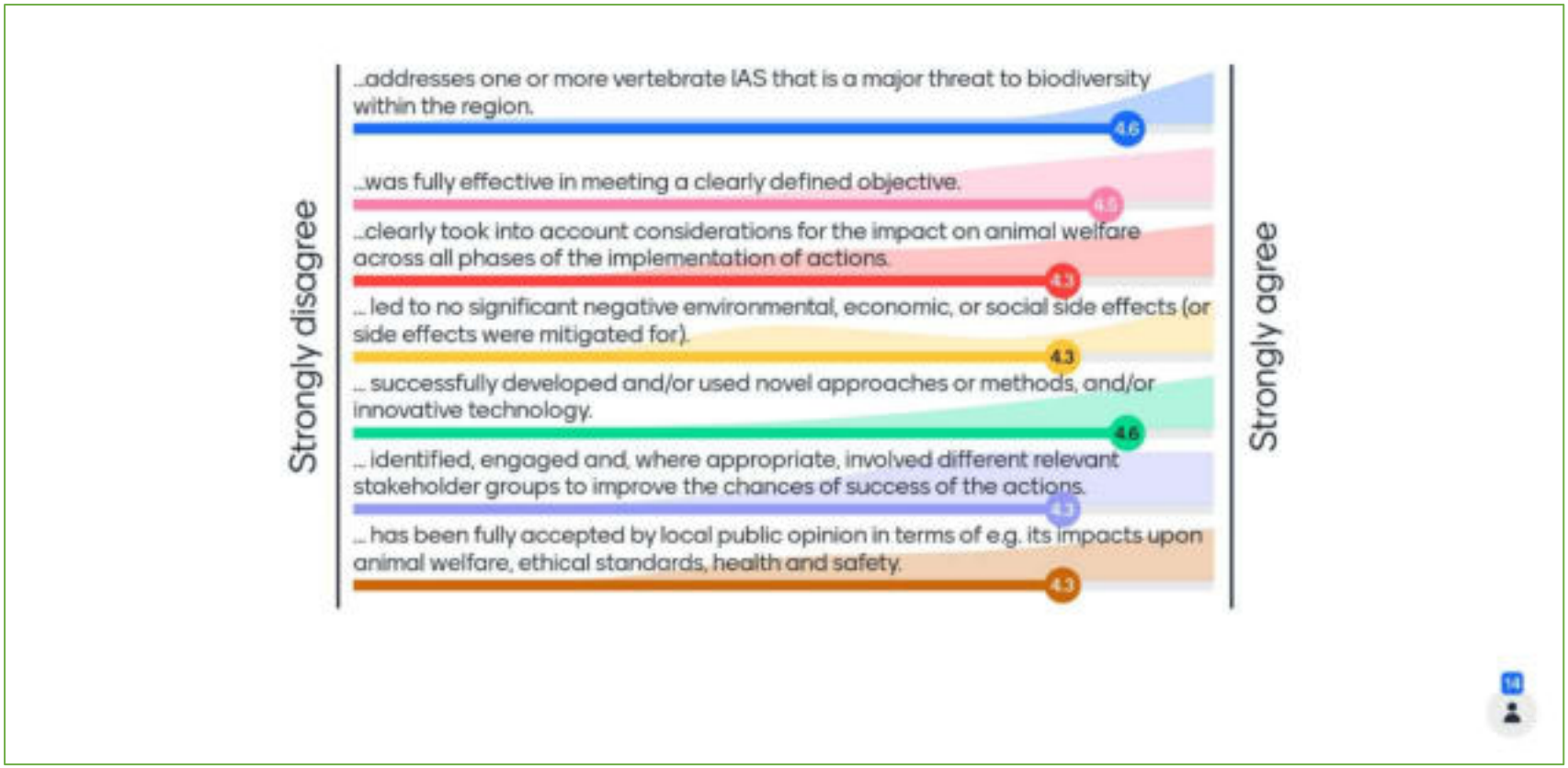
Case study 1 score. Finland and Sweden: *Nyctereutes procyonoides*

2.3.3. Case study 2. Finland: *Nyctereutes procyonoides*

Group: Mammals	
Country: Finland	
Entity: Finnish Wildlife Agency	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog)
Objective(s)	Rapid eradication (early stage intervention): The overall objective is to prevent invasion to Sweden and Norway. Relevant for Central and Northern Lapland and Valsörarna islands in Kvarken region. Eradication (of widespread population): The overall objective is to prevent invasion to Sweden and Norway. Relevant for South-Western Lapland and Korsholm Archipelago. Control: The overall objective is to prevent invasion to Sweden and Norway. Relevant to areas adjacent to previous areas
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Trapping: Cage traps • Other: Hunting dogs • Other: Judas animals
Measures used to remove (dispatch/sterilise/captivity) species	• Shooting - dispatch restrained animals
Description of the measure	The working model of the Nordic Raccoon Dog project (After Life+ of MIRDINEC) is based on a network of volunteer hunters hunting and trapping raccoon dogs with methods allowed by the legislation. Regular hunters are informed about the importance of raccoon dog removal in case the species is encountered when hunting for other animals. Volunteer hunters are provided with cage traps, trap alarms, and game cameras to support and encourage effective management. Hunting with dogs and rapid response to game camera observation is a very effective type of management. Hunting over bait sites and shooting is good option on sites where dogs cannot be used. Trapping is an effective large-scale management method, especially in the autumn for taking pups who are then little experienced and easy to catch, which will lower the breeding population in the coming spring. A specific type of cage trap is not required; many commercial products are used effectively. Traps are equipped with an electronic trap alarm (several products are used), which enables quick reaction to capture and killing of

	the target animal without unnecessary suffering, or release of non-target animals. Judas animals are used to monitor the raccoon dog situation and to locate animals far from roads.
Time period	Hunting occurs year-round. There is avoidance of non-target animals (adults that may have pups) during the period of reproduction. During summer months trapping efforts is only on the young of the year. Trapping of all animals occurs between August to April. Use of Judas animals occurs year-round, with the summer months having a specific focus on removal of pups and partner to provide targeted management.
Location and scale of application	Lapland is about 96,000 km^2. The population size very difficult to estimate. The annual known harvest was 100-120 animals during past years, showing a significant decrease compared to the project start date in 2010-2011 when the harvest was 269 individuals. A very rough estimate is that the raccoon dog population in the eradication area is in the range of 20-50 pairs. The Korsholm archipelago and Valsörarna is about 660 km^2, including sea areas. The population size very difficult to estimate. The annual known harvest is 110-140 animals during the past years. A very rough estimate is that the raccoon dog population in the eradication area is in the range of 30-60 pairs, with significant probability of immigration from the mainland.
Effort	Lapland: annual cost of ~ 160 000 Euro. This covers a full-time project worker, Judas-animal network, equipment for project worker and support and equipment to network of voluntary hunters. No up-to-date estimates of the person days/year on the voluntary effort, but it is likely at the level of several hundreds of person days/year. Korsholm archipelago is approximately 1/10 of the previous figures. Project work is based mainly on voluntary efforts, supported by the project.
Costs	180,000 € - Personnel costs: 100,000 € - Equipment and infrastructure: 65,000 € - Other, including capacity building and overheads: 15,000 €
Additional details on costs	The services for the Judas animal system is listed as infrastructure. Figures include total costs of both areas and then rounded to give an average value.
Source(s) of funding	Finnish Wildlife Agency and Metsähallitus (state funding based on hunting card and license fees), Swedish hunters association (project funding from environmental administration), Norwegian environment agency.
Effectiveness	Effective
Key evidence/results	Population has declined due to large-scale management activities at an early stage when the overall population size was still relatively small.

Replicability	This working model has a bottom-up approach with very strong links to local people and hunters. A similar approach is transferable and replicable.
Humaneness/animal welfare	When hunted, animals are shot as soon as an ethical shot can be made. Trapping is based on electronic surveillance, which enables release or killing of animals as soon as possible to reduce suffering and distress.
Public acceptance	Public acceptance has been very high and there has been hardly any negative feedback on the project approach.
Side effects	A potential positive side effect is the decreased risk of diseases transmitted by raccoon dogs, such as trichinella and fox tapeworm. These are important aspects in the context of Lapland where wild berries are still safe to eat right from the ground.
Stakeholder engagement – implementation:	Hunters are the essential stakeholder group carrying out a significant part of the management in field.
Dissemination	There is an annual press releases at the national level plus regional media work through radio etc. Annual articles in the hunters' magazine reaches ~ 340,000 registered hunters receiving the magazine. Website and social media news/posts at Wildlife Agency's channel also promote the project.
Innovation	Innovative practises developed in MIRDINEC LIFE+ and implemented thereof, also use of Judas animals, electronic trap surveillance, and involvement of voluntary hunters.
Lessons learned	Management and eradication need to start immediately after first observation. Any time lag or insufficient resourcing (like waiting for national scientific reports or impact on nature before providing the necessary resources and management) will be detrimental for effective and successful management. The Nordic project in Denmark and Finland started at the same time. The Finnish Lapland is a success story due to reasonable level of investment at early stage. In Denmark, where there was less early investment, the raccoon dog population is getting out of hand.
References	Working plan for 2019 https://riista.fi/wp-content/uploads/2020/11/raccoondog_finland_2019_plan_final.pdf Annual report 2019 https://riista.fi/wp-content/uploads/2020/11/raccoondog_finland_2019_report_saavutettava.pdf



Case study 2 score. Finland: *Nyctereutes procyonoides*

2.3.4. Case study 3. Finland: *Nyctereutes procyonoides* and *Neovison vison*

Group: Mammals	
Country: Finland	
Entity: Ministry of Agriculture and Forestry	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog), *Neovison vison* (American mink)
Objective(s)	Eradication: From the archipelago Control: Around important wetlands
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Trapping: Goodnature self setting trap • Trapping: Spring operated trap • Trapping: Cage traps • Other: Hunting dogs • Other: Judas animals
Measures used to remove (dispatch/sterilise/captivity) species	• Shooting - dispatch restrained animals
Description of the measure	Raccoon dog: cage traps (many different types), hunting with dogs both above ground and underground, Judas animals. American mink: instant kill traps and live catching traps, (many different types), hunting with dogs, using leaf blowers to get animals above ground from under seaside rocks.
Time period	Main efforts occur in spring after the snow and ice have smelt and before ground nesting waterbirds start to nest. Raccoon dogs are less active during winter. In the archipelago ice can hinder movement with boats to the IAS removal areas. The most active months for removal are March and April. Traps are kept open when animals are moving. Raccoon dogs are also hunted as a bycatch if they are encountered during the ungulate hunting in the winter period. Even though raccoon dogs are inactive during the coldest period, they can be active between the colder days, especially if there are deer feeding stations in the area. These are often monitored with wildlife cameras making a targeted removal of raccoon dogs with dogs even more effective. On the case study areas there is

	targeted feeding for raccoon dogs with wildlife camera traps. During summer, control of bird nesting areas and targeted removal of IAS predators from breeding areas occurs if they are detected. In the autumn there is removal of migrating IAS, keeping the important breeding areas empty of IAS predators. This continues until the colder period starts.
Location and scale of application	Case Area nr. 1) Archipelago; Case Area nr 2) Inland Wetlands
Source(s) of funding	Governmental funding
Effectiveness	Effective: Effectiveness in the Archipelago has been shown by long-term studies. Effectiveness on mainland wetlands is currently studied.
Replicability	Methods are easy to transfer to other areas
Humaneness/animal welfare	Animal welfare issues have been considered in the legislation that forbids unnecessary suffering. Areas needing careful consideration regarding animal welfare issues are 1. Cage traps: live traps must be checked daily and the traps have to be built so that animals are trapped correctly 2. Cage traps: instant kill traps, the killing power must be sufficient, and the function of traps tested properly 3. In the use of hunting dogs it must be considered that some dogs may get in contact with the IAS predator causing possibly suffering to the IAS or the hunting dog.
Public acceptance	Public acceptance has been rising in the recent years due to broad communication efforts. Recent scientific publications and national management plans have given necessary back up to base the work upon. Cooperation of nature and bird protection organisations has opened the doors for a wider media visibility and acceptance.
References	Nummi, P., Väänänen, V-M., Pekkarinen, A-J., Eronen, V., Mikkola-Roos, M., Nurmi, J., Rautiainen, A., & Rusanen, P. (2019). Alien predation in wetlands - the Raccoon dog and waterbird breeding success. *Baltic Forestry*, 25(2), 228-237. https://doi.org/10.46490/vol25iss2pp228 Nordström M; Hogmander J; Nummelin J; Laine J; Laanetu N; Korpimäki E, 2002. Variable responses of waterfowl breeding populations to long-term removal of introduced American mink. *Ecography*, 25:385-394.

Case study 3 score. Finland: *Nyctereutes procyonoides* and *Neovison vison*

2.3.5. Case study 4. Government of Åland: *Nyctereutes procyonoides*

Group: Mammals	
Country: Government of Åland (Finland)	
Entity: Government of Åland	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog)
Objective(s)	Eradication (of widespread population)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Shooting
Measures used to remove (dispatch/sterilise/captivity) species	Shooting - dispatch restrained animals
Measure(s) not covered	Camera equipped bait stations to find animals
Description of the measure	The raccoon dog population is established with dense populations all around the Åland Islands. To be able to implement other effective tools for final eradication of the population (for example Judas-animals), we first needed to drastically reduce the overall population. The previously prevailing methods of controlling raccoon dog numbers were trapping (with cage traps), shooting at bait stations and hunting with tracking and baying dogs, but we struggled to see significant and lasting reductions in raccoon dog densities. The problem was that it is easy to hunt raccoon dogs when there are many of them, but as numbers drop, so does the efficiency of the different hunting methods. Another issue was that without cooperation over larger areas, there were always raccoon dogs available from adjacent areas that effectively re-populated an area from one hunting season to another. However, with the introduction of cellular wildlife cameras, a new tool in raccoon dog management became available. Cooperating with landowners and highly dedicated local hunters, we established larger management units and covered them with a network of bait stations (fish works best) equipped with cellular wildlife cameras. When a raccoon dog visits the bait station, the camera sends an image to the group of hunters responsible for managing that area, and a hunter goes to the bait station and release a baying dog on the fresh track. An experienced dog usually has no problem locating the raccoon dog, keeping it at bay until the hunter catches up and quickly

	dispatches it with at 22 LR bullet to the head. The method is very effective and with the best dogs, the success rate is around 90 %. The hunting dogs will also investigate if the raccoon dog had a partner, and can usually locate the partner once the first raccoon dog is dispatched. The greatest benefits of this system have been: 1. By cooperating with local hunters and landowners to create larger management units, we can increase the hunting pressure over large enough areas to avoid having areas that function as sources from where the raccoon dogs quickly re-colonizes the area. 2. The hunters don't have to increase the effort as the population declines. Since the cameras are constantly active, regardless of raccoon dog density, the hunters are always ready to go and get a new individual. 3. The hunters are not employed by the Government of Åland, they participate because of their personal interest in conservation and because the raccoon dog poses a threat to small game, mainly waterfowl. The Government of Åland pays for the costs associated with the wildlife cameras, and travel expenses (fuel) during hunting or maintaining bait stations. This means that we can use all available resources on equipment and other expenses associated with the hunting itself. We could never manage the raccoon dog population on this level without the personal interest of hunters. Involving local hunters in the management also raises awareness on invasive species overall, which is highly beneficial for future management since hunters are more likely to observe and identify any new invasive species that might come to the Åland Islands.
Time period	When we start to manage a population from a high level, we utilize this method from 1st of August to 30th of April to avoid killing lactating females since we are not able to locate the juveniles with this method.
Location and scale of application	400-500 km^2 or about 1/3 of the total land area of the Åland Islands
Effort	We aim for one camera equipped bait station per 10 km^2 or more depending on geography and habitat. This has proven effective for rapid reduction of the population. Finding good locations, which dispersing/roaming individuals naturally are drawn to, are more important than the actual number of bait stations.
Costs	About 15,000 Euro annually
Additional details on costs	Since we are trying to encourage local engagement and cooperation in the work against invasive predators, the annual costs are dependent on the number of new management units we are able to establish since costs are mainly associated with equipment. Once a management unit is established, the annual cost is relatively low, just batteries, network subscriptions, travel expenses and replacement of broken equipment. Once an area has been "cleared", the number of bait stations required to keep the population down is also lower, reducing annual operating costs.

Source(s) of funding	Hunters license fees
Effectiveness	Moderately effective
Key evidence/results	We don´t have the resources to actively monitor the raccoon dog densities in the management units, but we know from experience that provided we have a good group of skilled and committed hunters, the method is very efficient to bring the overall population down significantly. The method will not be sufficient to eradicate the raccoon dog population, but will bring the population down to a level where it becomes meaningful to implement other methods that could result in final eradication. At the moment, we are starting to introduce Judas animals in the management in areas where we have observed a good reduction in raccoon dog densities. So far, our first experience with Judas animals looks very promising in our work to find the remaining individuals.
Replicability	This is a viable approach for us since we have a close cooperation with the local hunting communities and it is part of the hunting culture on Åland to participate in conservation and wildlife management. Because of that, we can build on that feeling of involvement to also manage invasive predators. The method per se, i.e. camera equipped bait stations and baying dogs, can be replicated, it is just a matter of scale and resources.
Humaneness/animal welfare	A raccoon dog that has been bayed by a dog is not physically attacked, the dog hinders the raccoon dog from escaping by keeping it in a defending position by barking at it. The hunter can then catch up to the location within minutes and dispatch the raccoon dog quickly and humanely with a 22 LR bullet to the head. The hunting dogs are also highly experienced so when put on the fresh raccoon dog track at a bait station, there is no risk of disturbing other wildlife. The period of hunting is also selected with respect to the lactating period of the females, to avoid leaving juveniles behind without being able to locate them. Since this method is focusing on bringing the overall population down in an already established population, and we know that we will not get all individuals during a short time anyway, we can take this into consideration without sacrificing the overall efficiency. When the population has decreased and the situation changes to where we are trying to control immigration of new individuals, this method is suitable also year round. It would also be a different situation if the objective were to manage a specific area, for example a sensitive breeding ground for some native species, and already a single raccoon dog could jeopardize the entire breeding season.
Stakeholder engagement – implementation:	Local hunters are performing all the work as described in previous sections
Dissemination	Information in media and participation in meetings with local hunters' associations have taken place. The biggest challenge is to get hunters and landowners to cooperate over large enough areas to be able to establish management units. When it comes to hunting rights and landowners, there are always some level of territorial

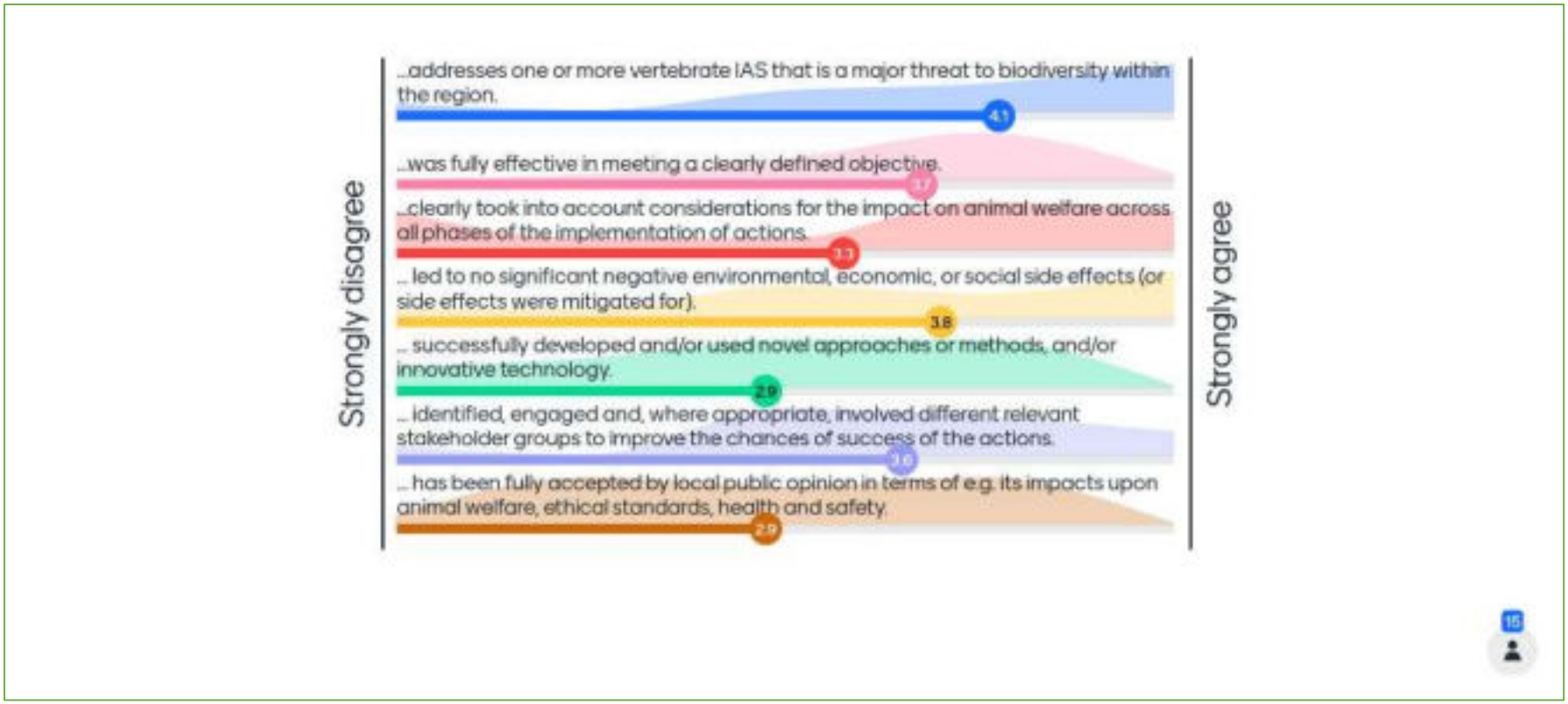
	attitudes that sometimes can be difficult to overcome, but it is important to reach people with the message that this is management of an invasive species, why it is important, and that we have to work together if we want to be able to eradicate it. We have the legislation to "overrule" a landowner, but we do not want to take that approach since we are depending on local cooperation and we don´t want to alienate anyone; it could easily backfire.
Lessons learned	The key to success has been to involve hunters that are really committed and have a personal interest. It takes a lot of dedication to hunt raccoon dogs on the level required, since it is mostly done in the middle of the night and in difficult terrain. It is a lot to ask from volunteering individuals, and if they start to lose interest after some time, the population quickly bounces back and you have just wasted money. You have to find some incentives to keep the interest up and get a good team feeling among the group of hunters working together in a management unit.

Case study 4 score. Government of Åland: *Nyctereutes procyonoides*

2.3.6. Case study 5. Latvia: *Trachemys scripta*, *Chrysemys picta* and *Graptemys* sp.

Group: Reptiles	
Country: Latvia (and Italy, Portugal, Spain)	
Entity: Riga Zoo	
Category	**Response**
Species targeted	*Trachemys scripta* (Red-eared, yellow-bellied and Cumberland sliders), *Chrysemys picta* (painted turtle), *Graptemys* sp. (Map turtle sp.)
Objective(s)	Rapid eradication (early stage intervention): Capture and euthanasia of small populations. Eradication (of widespread population): Use of traps, continuous monitoring, capture and euthanasia. Control: Census and monitoring. Containment: Creation of "sanctuaries" to collect turtles that people no longer want, avoiding the abandonment of turtles.
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Habitat manipulation: Physical barriers • Hand removal: Hand removal • Hand removal: Physical fishing methods
Measures used to remove (dispatch/sterilise/captivity) species	• Dispatch/removal: Decapitation • Dispatch/removal: Freezing • Dispatch/removal: Injection euthanasia • Dispatch/removal: Keeping in captivity
Description of the measure	Physical barriers: in this case the barrier around a waterbody serves to prevent the owners of the tortoises from abandoning the animals. Sometimes this is accompanied by camera surveillance systems (mainly in public parks). Hand removal and physical fishing methods: Depending on the size of the water body where the animals are found, one method or another can be used to capture the animals. Once the animals have been captured (or obtained from the owners), it is possible to then decide on the next management measure. The main problem encountered with injection euthanasia is the access to the bloodstream and the slow metabolism of the animals (often resulting in a slow death). Decapitation or Freezing is easier and faster to implement. Keeping in captivity is possible and the animals can be used in educational centres to talk about the issue of invasive species. However, this is only possible for a few animals.

Time period	Hand removal occurs all year round. Use of physical fishing methods depends on the weather; in general it is a valid system from late spring to early autumn. Euthanasia, decapitation, freezing, and keeping in captivity can occur all year round.
Effort	Hand removal and Physical fishing methods: depending on the size of the body of water the effort can be very high. In general, the effort should also include monitoring or censuses, without which it would be difficult to control aquatic turtle populations.
Effectiveness	Moderately effective
Replicability	All described methodologies are reproducible
Humaneness/animal welfare	For animal welfare, the three culling methodologies aim to reduce animal suffering. By providing minimum conditions (quality and temperature of water, adequate size of the water body, feeding), the animals used for educational purposes do not suffer.
Public acceptance	The culling methodologies are not well accepted by the public. Personal experiences in Spain indicate that in several wildlife centres, the adults who come to deliver the animals are informed that their turtles may eventually be culled. Children are not told about this. On the one hand it is understood (it can be very traumatic) and facilitates the family's decision to leave the turtle at the centre. But this does not educate the child, who will be able to ask for another turtle again, because once it has grown too big it can go to the wildlife centre with the others.
Side effects	The combined effort of education and control and eradication of the species can limit species trafficking by reducing breeding. Invasive turtle species have been shown to have a negative effect on the survival of the European turtle species. The negative effect (in our case, being a zoo) is that sometimes people don't understand that in order to preserve nature, some animals have to be culled. In this case, the educational function of a centre like ours is fundamental.
Stakeholder engagement – implementation:	Riga City Council and the Latvian Government (the Zoo is a public institution)



Case study 5 score. Latvia: *Trachemys scripta*, *Chrysemys picta* and *Graptemys* sp.

2.3.7. Case study 6. Lithuania: *Lepomis gibbosus, Perccottus glenii* and *Pseudorasbora parva*

Group: Fish	
Country: Lithuania	
Entity: Lithuanian State Scientific Research Institute Nature Research Centre (Gamtos Tyrimų Centras)	
Category	**Response**
Species targeted	*Lepomis gibbosus* (Pumpkin seed), *Perccottus glenii* (Amur sleeper), *Pseudorasbora parva* (Stone moroko)
Objective(s)	Eradication (of widespread population)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Biological control: Native predators • Hand removal: Physical fishing methods • Other: Electrofishing
Measures used to remove (dispatch/sterilise/captivity) species	• Additional measures: put to sleep with anaesthetics • Additional measures: 1.5–2.0 mL · L1 solution of 2-phenoxyethanol for 5 min
Description of the measure	Fish were captured using battery-powered electric fishing gear (Samus Special Electronics, Samus-725 mp). Invaded waterbodies were repeatedly stocked with native predator fish species in the spring or autumn three years in a row. The stocking material was provided by local fish farms. Up to 600 ind./ha numbers of *Esox lucius* and *Perca fluviatilis* specimens per unit area were stocked into selected water bodies. Owing to the specific structure of its snout and larger body size, *E. lucius* should be better at controlling larger *Perccottus glenii*, *Pseudorasbora parva* or *Lepomis gibbosus* specimens, while *P. fluviatilis* has proved to be able to effectively prey on small *P. glenii* individuals. Predating strategies of these two species also differ; *E. lucius* usually stays in solitude and relies on ambush predation, while *P. fluviatilis* actively seeks for prey and hunts in a group. Therefore, the use of these both predators simultaneously produced the best biocontrol effect and might be an explanation, why the eradication of *P. glenii* in waterbodies stocked solely with *E. lucius*, was not completely successful.
Time period	Biological manipulation should last at least three years in a row
Location and scale of application	Biocontrol experiments were performed in 2012–2017 in natural lakes Beržuvis, Bevardis, Cirkliskis and pond Stūgliai, located in eastern Lithuania. All the water bodies studied are similar in their physical characteristics: they are all shallow, have a thick (> 3 m) sediment (sapropel) layer and the littoral zone that is densely overgrown with

	macrophytes. All the four water bodies are subject to irregular oxygen depletion events during prolonged ice cover (see References).
Effort	See References
Replicability	See References
References	Rakauskas *et al*. 2019. Knowledge and management of aquatic ecosystems, 420, 21

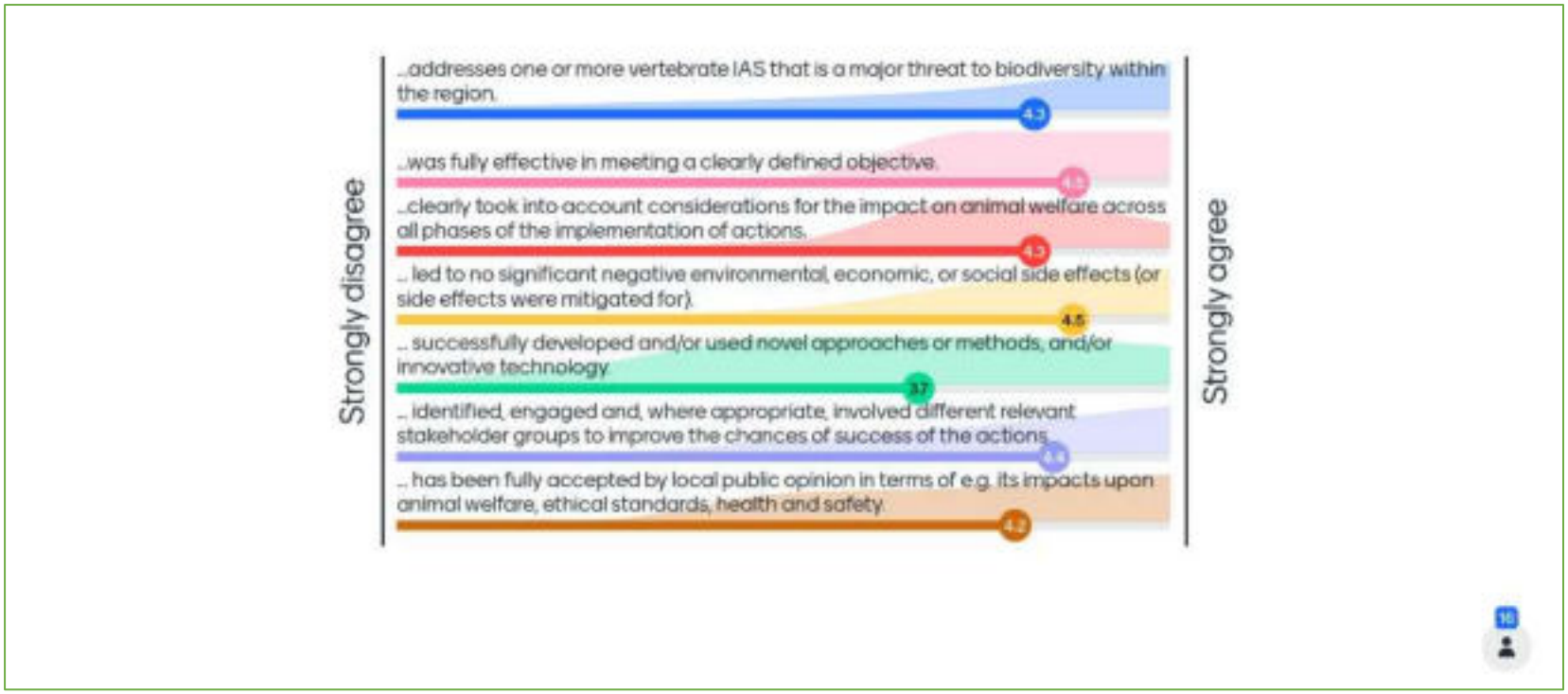
Case study 6 score. Lithuania: *Lepomis gibbosus, Perccottus glenii* and *Pseudorasbora parva*

2.3.8. Case study 7. Sweden: *Alopochen aegyptiaca*

Group: Birds	
Country: Sweden	
Entity: Swedish Association for Hunting and Wildlife Management	
Category	**Response**
Species targeted	*Alopochen aegyptiaca* (Egyptian goose)
Objective(s)	Rapid eradication (early stage intervention): To prevent reproduction of Egyptian goose in Sweden, all stationary individuals sighted are culled
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Shooting
Measure(s) not covered	Citizen Science: Ornithologists report sightings to the project
Description of the measure	The management is carried out by the Swedish Association for Hunting and Wildlife Management – Invasive Species Task Force, as directed by the Swedish Environmental Protection Agency. Ornithologists, mainly from BirdLife-Sweden and Club 300 (around 20,000 in total), report sightings of Egyptian geese to the project via formal reporting channels such as the Swedish Species Information Centres; Species Observation System, the Swedish Environmental Protection Agency's reporting channel; invasivaarter.nu, or directly to the project via telephone, email or social media. All reports on Invasive alien vertebrate species to any formal reporting channel are immediately redirected to the project. Club 300 also has an application (Bird Alarm) for its members where every member reports rare sightings in real time to the other members, so that they can quickly get there to observe the bird. Club 300 has also given access to the Bird Alarm information for free to the project, so that sighted Egyptian geese can quickly be culled. Once an alarm comes in, professional hunters, specially trained on long distance shooting, go to the observation position and cull the bird. Only secure shots are taken, considering both human safety and humanness of the bird.
Time period	All year around

Location and scale of application	All of Sweden, but over the past two years geese have only been observed in southern and mid Sweden, approximately 150,000 km^2. In 2019 we estimated that seven unique birds landed in Sweden, in 2020 there were eight.
Effort	Three days per culled individual
Costs	€ per culled individual Overall costs; 1,600 € - Personnel costs: 600 € - Equipment and infrastructure: 800 € - Other, including capacity building and overheads: 200 €
Additional details on costs	The cost of detection is zero thanks to the cooperation with ornithologists. If the cost of detecting the birds should be included the amount of money would be sky high.
Source(s) of funding	Governmental funding. Swedish Environmental Protection Agency.
Effectiveness	Effective
Key evidence/results	Year 2019 the project culled six out of seven geese. In 2020 the project culled two out of eight geese. In 2020 many of the geese were observed in flight, or when temporarily resting, compared with 2019 when the observed geese often were stationary for several days. Sometimes it may not be possible to shoot them the first day due to many people around or bad weather or other conditions.
Replicability	All other invasive alien bird species detected by the ornithologists
Humaneness/animal welfare	Using only well-trained professional hunters ensures that the targets are hit, or the shot will not be taken. Moreover, we use varmint ammunition that fragments on impact and that makes the method very humane because the bullet leaves all its energy into the bird instead of passing through. The use of varmint ammunition also takes away problems with ricochets risking hitting other individuals behind the targeted bird.
Public acceptance	Overall there is a very high public acceptance for control and eradication of invasive species in Sweden and shooting Egyptian goose is no exception. The ornithologists defend this work when people argue on social media for no management measures for this species.
Side effects	The efficiency of the staff in culling the geese, and the widespread support of the management methods by ornithologists, have helped increase public awareness on invasive species in general, and improved public acceptance of IAS management, further facilitating the management of several other IAS.

Stakeholder engagement – implementation:	The Swedish Association for Hunting and Wildlife Management is leading the project and performing the culling. Ornithologists are very engaged in detecting and reporting the species.
Dissemination	Before the culling started, we had meetings with the board of Birdlife Sweden and Club 300 to inform about the upcoming work. Both organizations communicated this upcoming work within their organizations and publications.
Innovation	Real time reporting of killed birds in Bird Alarm and Swedish Species Observation System provides quick feedback that the observers have successfully contributed to the IAS management, and actually have made a nature conservation effort by reporting the Egyptian Goose. It also minimizes the risk that bird watchers travel for dead birds.
Lessons learned	If a pair of Egyptian goose are sitting together and one of them are shot from a distance with a rifle, the surviving partner will have no chance of knowing where the danger is. If you stay in shelter there is a high chance that the surviving partner will return to land beside the dead bird to see what happened, offering another possibility for a shot.
References	Swedish raccoon dog project, including additional tasks on raccoon (NV-03794-15), muskrat (NV-01089-18), water turtles (*Trachemys scripta* S.p) and Egyptian goose (NV08788-18), and Siberian chipmunk (NV-02057-19). (2020). https://jagareforbundet.se/contentassets/f110ce2f2e8643d083259c1d1d24d7f2/arsrapport-svenska-mardhundsprojektet-2019.pdf



Case study 7 score. Sweden: *Alopochen aegyptiaca*

2.4. Continental (West) Region: Denmark, Germany, Luxembourg

2.4.1. Summary of case studies submitted for the Continental (West) region

	Country	Entity submitting	Species	Measures used to restrain, capture and/or remove (kill/sterilise) the species	Measures used to remove (dispatch/sterilise/captivity) species	Average score at workshop
1	Denmark	The Danish Environmental Protection Agency	*Muntiacus reevesi, Myocastor coypus, Nasua nasua, Nyctereutes procyonoides, Ondatra zibethicus, Procyon lotor*	Shooting Trapping: Cage traps Other approaches: Judas animals	Shooting - dispatch restrained animals	3.8[1]
2	Denmark	DTU sudhedsteknologi/ Technology University of Denmark	*Nyctereutes procyonoides*	Live decoy traps	Shooting - dispatch restrained animals	3.8[1]
3	Denmark	Copenhagen Zoo	*Trachemys scripta*	Hand removal	Injection euthanasia	3.8
4	Germany	JLU Giessen	*Procyon lotor*	Hand removal: Physical fishing methods Trapping: spring traps	Shooting - dispatch restrained animals	4.4
5	Germany	Landwirtschaftskammer Niedersachsen	*Myocastor coypus, Ondatra zibethicus*	Trapping: Spring traps Trapping: Neck-hold traps Trapping: Drowning traps Trapping: Cage traps Shooting	Shooting - dispatch restrained animals	3.6
6	Germany	Ministry of Environment, Climate and Energy, BadenWuerttemberg	*Lithobates catesbeianus*	Hand removal Hand removal: Physical fishing methods Shooting	Freezing Shooting - dispatch restrained animals	N/A[2]
7	Luxembourg	LWV asbl c/o GROTZ Roland	*Procyon lotor*	Shooting Trapping: Cage traps Hunting dogs	Shooting - dispatch restrained animals Slaughter with a knife	2.9

[1] Case studies 1 and 2 are linked, so they were voted together (same score)

[2] Case study not presented and scored at the workshop, as it was submitted after the workshop took place

2.4.2. Case study 1. Denmark: *Muntiacus reevesi, Myocastor coypus, Nasua nasua, Nyctereutes procyonoides, Ondatra zibethicus* and *Procyon lotor*

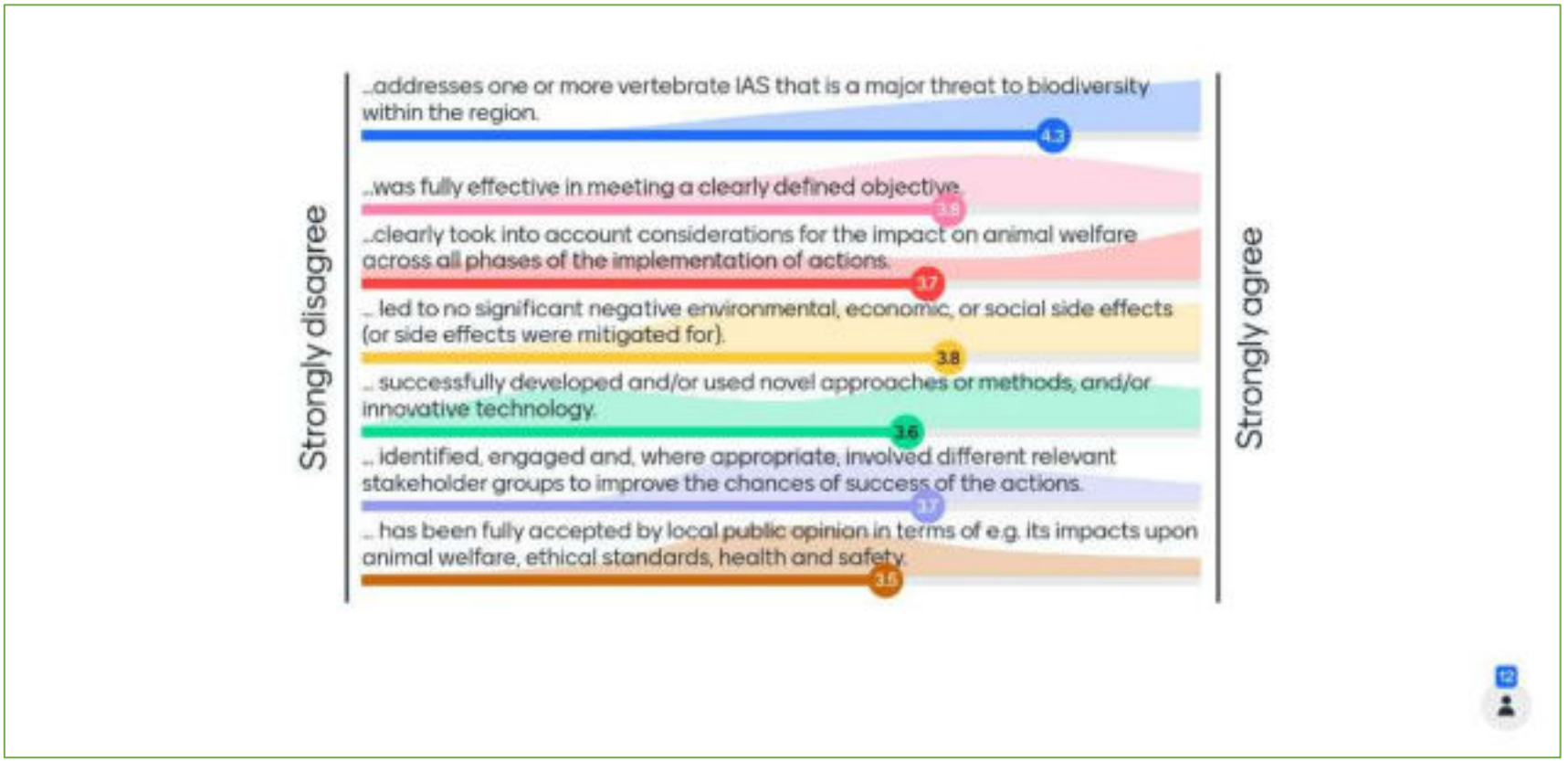
Group: Mammals	
Country: Denmark	
Entity: The Danish Environmental Protection Agency	
Category	**Response**
Species targeted	*Muntiacus reevesi* (Muntjac deer), *Myocastor coypus* (Coypu), *Nasua nasua* (Coati), *Nyctereutes procyonoides* (Raccoon dog), *Ondatra zibethicus* (Muskrat), *Procyon lotor* (Raccoon)
Objective(s)	Rapid eradication (early stage intervention): Stopping German racoons from establishing in Denmark. As well as shooting the muntjac deer and coati by informing hunters about animals on unrestricted game courses. Containment: Stop the spread of breeding racoon dogs to Funen (Fyn – large island in the centre of Denmark).
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Cage traps • Other approaches: Judas animals
Measures used to remove (dispatch/sterilise/captivity) species	• Shooting - dispatch restrained animals
Description of the measure	The racoon dogs are trapped using both wire traps, box traps, pipe traps, puppy traps (during the summer period) and GPS-collared racoon dogs (only on Funen). Authorized bait is also used on shooting ranges with rifles using night vision.
Time period	Racoon dogs: Trapped all year around.
Location and scale of application	Denmark. Racoon dog: Jutland (breeding number); 29,777 km^2. 2019: approx. 8,000 individuals brought down. Funen: (a few individuals); 3,099 km^2
Effort	Unknown for racoon dogs. However, it is known that about 2,000 authorized bait-spots exist, where traps or shooting ranges (for night vision rifles) exist.
Costs	800,000 € - Personnel costs: 400,000 € - Equipment and infrastructure: 300,000 €

	- Other, including capacity building and overheads: 100,000 €
Source(s) of funding	Ministry of Environment of Denmark
Effectiveness	Moderately effective. The hunters report less/no racoon dogs in local areas. Less/no road kills are also reported in local areas.
Replicability	Every species must be fought with different methods. It is difficult to generalise on the methods used.
Humaneness/animal welfare	Racoon dog: There is a limit (12 hours) as to how long it can take from the time the animal is caught to the time it must be put down or released (if the species caught is resident). Also, the use of night vision increases the precision and lowers the number of bullets needed. Furthermore, it is not allowed to use any kinds of snares. Finally, all lactating females should be released unless it is possible to track and kill the offspring.
Public acceptance	Danish hunters welcome both precise guidelines and welfare suggestions. Only very few Danish hunters wish for more hunting methods.
Side effects	The compliance with the methods is generally very high. Night vision is used by very few hunters to hunt resident species (by their own statement).
Stakeholder engagement – implementation:	Hunters are widely engaged – when it comes to trapping, hunting in game ranges using authorised bait. A few citizens report findings of racoon dogs.
Dissemination	Knowledge can be obtained through the webpages of both the Danish Hunters' Association and the Ministry of Environment and Nature Agency. The Danish Hunters' Association are in contact with the Ministry of Environment with respect to training hunters for responsible regulation of invasive species.
Innovation	Using tube traps in sensitive nature areas is being tested from 2020-2022. Food examinations from racoon dogs killed in sensitive nature areas are conducted (Stomach content, faeces from individuals and latrines as well as collection of DNA from the samples)
Lessons learned	The permission of using night vision in collaboration with authorized bait has resulted in more effective efforts. Courses aimed at securing the spread of efforts to more hunters increases the commitment and opportunities for joined activities in local areas.

2.4.3. Case study 2. Denmark: *Nyctereutes procyonoides*

Group: Mammals	
Country: Denmark	
Entity: The Healthcare Technology programme at the Technical University of Denmark (DTU)	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog)
Objective(s)	Control: testing of a new type of trap
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Live decoy traps
Measures used to remove (dispatch/sterilise/captivity) species	Shooting - dispatch restrained animals
Description of the measure	A total of 80 new tube traps (four different types) has been placed all around Jutland.
Time period	June 2020 to June 2022
Location and scale of application	Traps have been placed in 80 different spots around Jutland
Effort	80 traps during a 2-year time-period. We expect to catch 600 racoon dogs.
Costs	Overall costs: 97,321 € - Personnel costs: 59,538 € - Equipment and infrastructure: 37,783 €
Additional details on costs	80 new traps have been purchased
Source(s) of funding	Danish Environmental Protection Agency
Effectiveness	Unknown, since the project is still ongoing
Replicability	The project can be replicated
Humaneness/animal welfare	All traps are monitored electronically to ensure that the racoon dogs do not spend more than 12 hours in the traps

Side effects	Other species than racoon dogs are also caught in the traps
Stakeholder engagement – implementation:	The units of the Danish Nature Agency maintain the traps. Volunteer racoon dog hunters hand in hunted individuals as control animals.

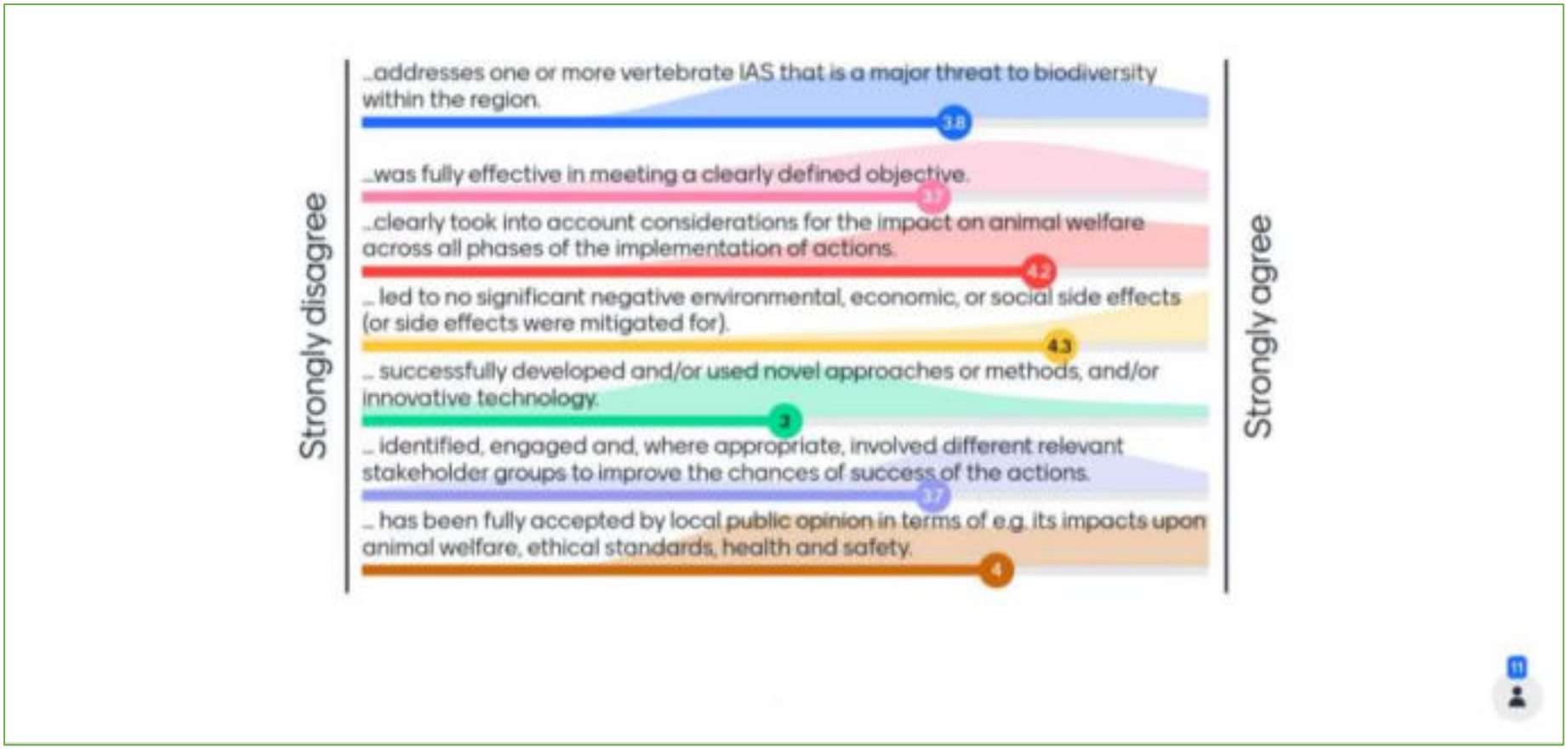


Case studies 1 and 2. Denmark: *Muntiacus reevesi, Myocastor coypus, Nasua nasua, Nyctereutes procyonoides, Ondatra zibethicus* and *Procyon lotor*

2.4.4. Case study 3. Denmark: *Trachemys scripta*

Group: Reptiles	
Country: Denmark	
Entity: Copenhagen Zoo	
Category	**Response**
Species targeted	*Trachemys scripta* (Red-eared, yellow-bellied and Cumberland sliders)
Objective(s)	Control: Contact with private people who catch the species without knowledge on what to do with them. Containment: When the species is delivered to the zoo, it will either be euthanised or used in research as samples is collected from the animal.
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Hand removal
Measures used to remove (dispatch/sterilise/captivity) species	Injection euthanasia
Description of the measure	Individuals are delivered at the staff entrance and then moved to the veterinarians for a quick and ethically responsible euthanasia. Next samples can be extracted for research (if it is relevant).
Time period	Typically, deliveries occur during the summer and late summer periods and almost never in the spring. (Typically, during sunny periods).
Location and scale of application	Zealand and Funen, together with the Southern part of Jutland
Effort	Very few hours since the individuals are handed over by the finder
Costs	Veterinary operating costs
Source(s) of funding	
Effectiveness	Moderately effective: In average two individuals are handed over each year.
Replicability	It should be possible to replicate the management to many other species

Humaneness/animal welfare	Euthanasia is only conducted by veterinarians using ethically responsibly methods. This means, that the animal welfare is not affected.
Public acceptance	The common understanding that “all animals should be saved” is the largest side effect on the management. It requires large-scale and thorough education about the management to make people understand the actions and methods used.
Side effects	The negative side effect is that people handing in individuals to the zoo want to (after hearing about prospects of the animal) want to take it back and release it back into nature. And by doing that, contributing to the preservation of the species as invasive in the Danish nature.
Stakeholder engagement – implementation:	Only in-house staff
Dissemination	None
Innovation	None
Lessons learned	History tells us that people think twice when they hear about what will happen to the species, but they usually accept it.



Case study 3 score. Denmark: *Trachemys scripta*

2.4.5. Case study 4. Germany: *Procyon lotor*

Group: Mammals	
Country: Germany	
Entity: JLU Giessen, Deutschland	
Category	**Response**
Species targeted	*Procyon lotor* (Raccoon)
Objective(s)	Containment Life - catch according to animal welfare regulations in a concrete – life - trap
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Hand removal (Physical fishing methods) and spring traps
Measures used to remove (dispatch/sterilise/captivity) species	Shooting - dispatch restrained animals
Description of the measure	Live traps are established in pest control, fishing and hunting, but they are discussed to compromise animal welfare due to inadequate construction and control of the trap. To assure animal welfare, the Agreement on International Humane Trapping Standards (AIHTS) demands for legal regulations regarding trapping devices. According to AIHTS, the certification of each trap is based on evaluation in 20 individuals of a specific animal species (target species). To this end, more than 80% of the animals must not show specific alterations of physiology and behaviour or potential injuries. The aim of this study was to evaluate the 'Krefelder Fuchsfalle', equipped with an electronic trap system, according to AIHTS standards. The raccoon (Procyon lotor) was chosen as target species, as it is an invasive species in urban regions of Central Europe, a potential vector for zoonotic pathogens, and a skilful animal, which potentially is most difficult to meet the AIHTS requirements. The behaviour of the trapped animal was evaluated, before shooting it and performing radiographical, pathological and histological examination. In total, 20 raccoons were trapped within 10 months in a hunting district in Hesse, Germany. Mean period of stay within the trap were 6.39 h. Despite of 14 animals, which demonstrated low-grade excoriations (superficial skin layer) at the paws and rhinarium, no other injuries or alterations of physiology and behaviour were detected. Therefore, this study demonstrates that the 'Krefelder Fuchsfalle' fulfilled the AIHTS standards and accomplished trapping according to animal welfare.

Time period	2015 - 2016
Location and scale of application	County Giessen, Germany, population density unknown, traps were put in an area of approximately 300 hectares.
Effort	4 traps/ 300ha 60 days for staff in research position (TVL-13)
Costs	Overall costs: 15,000 € - Personnel costs: 10,000 € - Equipment and infrastructure: 5,000 €
Source(s) of funding	Contribution of the clinic (Eigenleistung)
Effectiveness	Effective
Key evidence/results	During hunting season for raccoons in Hesse, two traps were used between 1 October 2014 and 28 February 2015, and four traps between 1 October 2015 and 28 February 2016. In summary, 20 raccoons were trapped, composed of 16 males and four females, 13 adults and seven juveniles. The weight of the animals ranged from 2.5 to 8.8 kg. The nutritional condition ranged from moderate (n = 3), to good (n = 15), and very good/obese (n = 2). The mean duration of the raccoons staying inside the trap was 6.39 h (1.1–15.0 h). General examination did not reveal altered behaviour, apparent injuries or abnormal movements in any animal. No abnormal findings were detected in 17 raccoons radiographically, besides fractures caused by the head shot. However, fractures due to head shot did not affect the assessment of alterations of the gingiva and the outer skin of nose, and mouth. Fractures of the Os penis (n = 1) and the Fibula (n = 1) and chronic, arthritic alterations in the tail region (n = 1) were observed in single animals. However, the fractures of these thin bones occurred most likely post mortal (during transport or storage of the dead animal), as hemorrhages or any tissue response were absent. Pathological examination revealed alterations of the teeth in one adult and one juvenile animal, most likely associated to physiologic dentition in the juvenile animal. In the adult animal, multifocal teeth lesions and chronic inflammation of the gingival were detected and classified as not trap-associated. One raccoon demonstrated low-grade mucosal bleeding right above one of its incisor teeth. This was also classified as not trap-related, as there were plant components impaled causing chronic lesions. Superficial, trapping associated excoriations were found at the paws in 6/20 individuals, at the rhinarium in 4/ 20 animals, and at both locations in 4/20 animals. In histopathology, all these alterations were classified as low-grade excoriations, as they did not affect the subcutis but only the epidermal keratin layer. All trapping-associated alterations were limited to lowgrade skin lesions or superficial lesions of the gingiva, thus pain or suffering of the animals seems unlikely, as deeper skin layers were not affected. These findings correspond to studies on foxes in which the caught animals showed no increased activity inside the trap (White *et al*. 1991).

	Nevertheless, it is discussed if physiological responses can be used as indicator for stress during restraint of wildlife species exclusively In sum, none of the listed AIHTS indicators for negative trapping effects were detected. The construction of 'Krefelder Fuchsfalle' may prevent the animal from injuring itself at mechanical components by placing the trigger mechanism outside the trap. Furthermore, after triggering the trap by stepping on the compensator, the compensator locks. Therefore, there are no edges to hurt and no instability of the bottom to irritate the animal. Additionally, the doors are directly caved in slots, making the trap completely dark and thus not inducing scratching or digging towards a lighted exit. Moreover, this did not allow sticking of claws or toes beneath the doors, which is regarded as important for trapping such skilful animals as raccoons. As slots are located between the outer lying concrete pipes the distance between the doors and the outside of the trap is 1 m. This minimizes the chance of obstacles like sticks or soil to pollute the interior parts of the trap, preventing the doors from closing. However, it is conceivable that any deviation of special installations of the trap may lead to divergent results and interpretations by AIHTS in the evaluation of the trap. Even so there was no relation between the duration the animal stayed in the trap and the quantity or grade of detected lesions, this time should be reduced as much as possible. In the present study, the average period of stay of the animals inside the trap was 6.39 h. Installation of electronic trapping sensors assisted in these regards and both tested electronic trap sensor systems worked reliably. 'MinkPolice' seemed to work more effectively, using its central server to coordinate the signals and error messages of all trigger mechanisms, especially when using more than one trap within one hunting district simultaneously. In any way, the implementation of such systems is recommended when using live traps (Santos *et al*. 2017). For the present study, no bait was placed inside the trap, but nevertheless, 20 raccoons were trapped in a short period of time in the same hunting district. Possibly the construction of the trap, based on a dark tunnel, animated the raccoons instinctively to explore and therefore to enter the trap. This especially applies to male individuals exploring their or a new territory, which may explain the excess number of male individuals trapped in this study.
Replicability	For additional regions, not for additional species
Humaneness/animal welfare	The project was focused on animal welfare of life traps
Public acceptance	Public lectures were given on the project. The acceptance was very high, because not only the catch itself, but especially animal welfare was in the foreground and that this was considered in reduction measures.
Stakeholder engagement – implementation:	Hunters, Animal Welfare organisations
Dissemination	Publication: European Journal of Wildlife Research (2018) 64:17 https://doi.org/10.1007/s10344-0181176-z Publications in hunter magazines and lectures in local hunting associations and animal welfare organisations

References	European Journal of Wildlife Research (2018) 64:17 https://doi.org/10.1007/s10344-018-1176-z

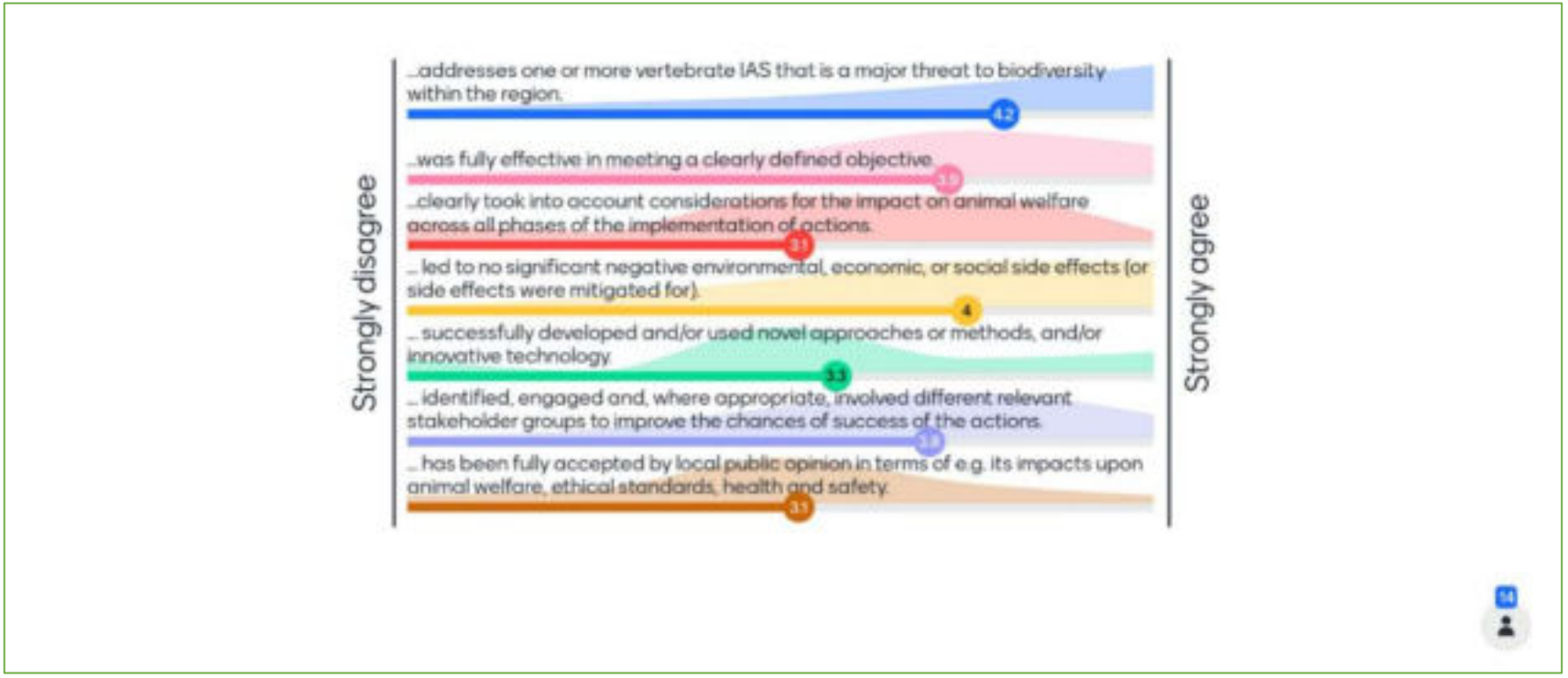
Case study 4 score. Germany: *Procyon lotor*

2.4.6. Case study 5. Germany: *Myocastor coypus* and *Ondatra zibethicus*

Group: Mammals	
Country: Germany	
Entity: Landwirtschaftskammer Niedersachsen	
Category	**Response**
Species targeted	*Myocastor coypu* (Coypu (nutria)), *Ondatra zibethicus* (Muskrat)
Objective(s)	Control: population control by cage trapping and population monitoring Containment: decrease in exponential growth
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Spring traps • Neck-hold traps • Drowning traps • Cage traps • Shooting-hunting
Measures used to remove (dispatch/sterilise/captivity) species	• Shooting
Description of the measure	Muskrat: drowning traps, killing traps; nutria: live cage traps with trap alarm, then shot in a basket; Shooting by those authorized to hunt
Time period	Muskrat: 850 private trappers set traps in spring (late February - early April) and autumn (mid September - mid November). During the rest of the time, full-time muskrat hunters (six) or private trappers set traps for infestation reports, e.g. nutria ponds: LWK - Lower Saxony provides 750 live traps for the hunters and monitors them. Hunters are advised on trapping for nutria. Further traps are made available by some counties and water maintenance associations. Hunting all year round
Location and scale of application	Muskrat: all of Lower Saxony, strongly declining in the east and south; The main infested areas are the marshes and the Dutch border region. Catch number in 2020: 67,793 pieces (2015: 124,260) Nutria: all of Lower Saxony, although not all regions are populated yet. Nutria continues to spread, especially to the south and into the marshland, focal points in the districts of Emsland, Grafschaft Bentheim, LK Cloppenburg, LK Osnabrück, LK Vechta, LK Celle, LK Lüneburg, LK Lüchow Dannenberg. Number of catches hunting year 2019/20 41,369 (JJ 2015/16 10,387)

Effort	9 full-time muskrat / nutria hunters, 1 coordinator full-time, 0.5 Administrative staff: local hunters, number not known, approx. 850 private catchers for muskrat, number of traps for muskrat not known. Traps for nutria cared for by LWK 750, further traps by hunters, or by water maintenance associations and counties not known. Km per full-time muskrat / nutria hunter approx. 30,000, plus km hunters and private catchers (PF) Hunters and PF receive a premium of 3 - 8 euros (regionally different depending on the population size in the UHV) per animal hunted.
Costs	790,000 Euro costs for full-time hired staff for muskrat control and nutria-hunting, private trappers and hunters not included. - Personnel cost: approximately 500,000 € - Equipment and infrastructure: 210,000 € - Other, including capacity building and overheads: approximately 80,000 €
Additional details on costs	One-time: Procurement of live traps € 250,000 in 2019
Source(s) of funding	Ministry of Environment, Energy, Building and Climate Protection (Muskrat), Ministry of Food, Agriculture and Consumer Protection (Nutria); Bonuses: water entertainment associations.
Effectiveness	Moderately effective - Muskrat catches are declining. Nutria catches continue to rise.
Replicability	Support / advice for those involved (hunters, private catchers, entertainment associations) effective on site, as nobody else feels responsible for the problem. Rewards e.g. for raccoons, Egyptian goose, raccoon dogs make sense, as they provide an incentive for control.
Humaneness/animal welfare	Killing traps muskrat: Reduction of bycatch using otter rings and drowning traps, killing traps have peck protection. Nutria: Use of live traps with trap alarms and thus prompt removal
Public acceptance	There is regular information in the press about the need to catch muskrat and nutria. Acceptance is mostly available, especially in areas at risk of flooding. Reports of infestation are regularly received from the population. Nevertheless, traps are stolen or destroyed again and again.
Side effects	Regular monitoring of the receiving waters also provides information on, for example, particularly protected species such as beavers or otters or new, potentially invasive species such as Egyptian goose. By using killing traps occasionally bycatch of non-target species e.g. coot, mallard, but mostly brown rat.
Stakeholder engagement – implementation:	Water maintenance association holding with more than 100 water maintenance associations, Lower Saxony federal hunters, regional hunting, and nature conservation authorities (ministries) as well as authorities of the districts and independent cities.
Dissemination	Internet via the website of the LWK Lower Saxony. Press: Articles, radio, and television broadcasts. Exhibitions: Open house at UHV, hunting fairs. Lectures: at local and district hunter meetings.

Innovation	Use of darkened live traps with detectors without internal metal parts, no cage traps. Development of fishing systems with otter rings. Procurement of 750 live traps and care of the hunters by full-time trappers
Lessons learned	Challenge to organize and sustainably establish a control system with volunteers. In the Netherlands fighting only with full-time trappers so the catch is given all year round. Volunteers cannot be required to fight / hunt, as the number of catches falls, motivation decreases. Problem of responsibilities: Nutria is subject to hunting law: responsible Lower Saxony Ministry of Food and Agriculture, muskrat is subject to free catch: responsible Ministry Nds. Ministry of the Environment, Energy, Building and Climate Protection



Case study 5 score. Germany: *Myocastor coypus* and *Ondatra zibethicus*

2.4.7. Case study 6. Germany: *Lithobates catesbeianus*

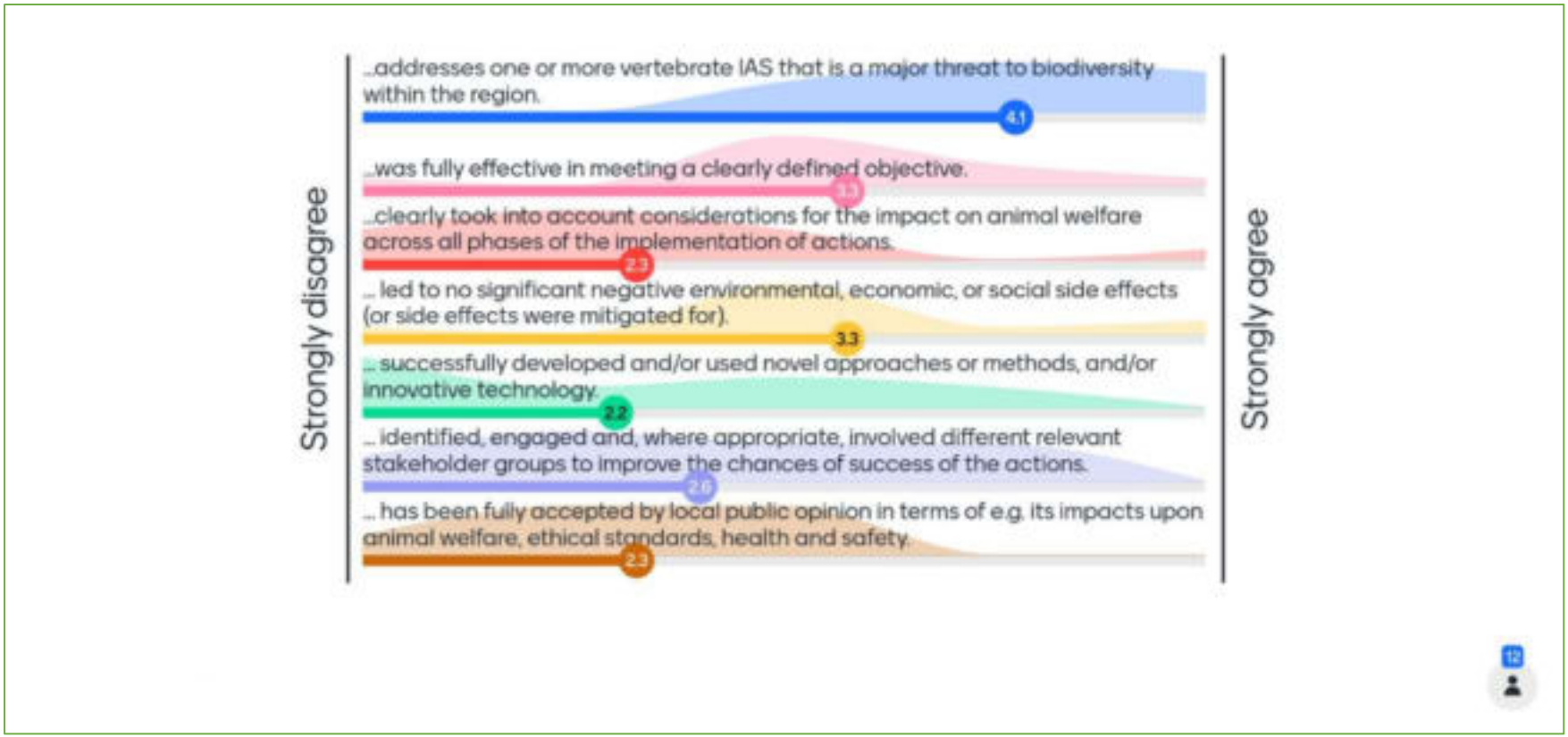
Group: Amphibians	
Country: Germany	
Entity: Ministry of Environment, Climate and Energy, Baden-Wuerttemberg	
Category	**Response**
Species targeted	*Lithobates catesbeianus* (North American bullfrog)
Objective(s)	Control: no further spread to significant habitats of other amphibian species Containment
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Hand removal • Physical fishing methods: including aquatic nets • Shooting
Measures used to remove (dispatch/sterilise/captivity) species	• Freezing • Shooting - dispatch restrained animals
Description of the measure	Since 2001, the (partial) populations of the bullfrog have been combated with various methods, including the use of a blowpipe and a bow and arrow. Since 2017, adult and sub-adult animals have been shot at night with a small-caliber rifle (modified special weapon) from the boat. At the same time, tadpoles are removed by divers (also in the winter months).
Time period	Shooting from May-October. Tadpole removed during the whole year
Location and scale of application	North-east of Karlsruhe in the Rheinaue (Baden-Württemberg, Germany)
Effort	Waters over a length of approx. 25 - 30 km. Thereby large quarry ponds, but also oxbow lakes of the Rhine and connecting canals between waters.
Costs	130,000 EUR
Additional details on costs	Assignment to a specialized office. Equipment etc. not broken down separately, but priced in at the hourly rate.
Source(s) of funding	Nature conservation funds of the state of Baden-Württemberg (financed by the landscape conservation directive).
Effectiveness	Moderately effective - Since the application of the shooting method with a small-caliber firearm, much more effective

Replicability	In principle also applicable in other areas (already practiced in France for bullfrog management)
Humaneness/animal welfare	After testing, it became apparent that shooting with a small-caliber weapon would result in immediate death and avoid injury or agony.
Public acceptance	Is known and accepted by the public, the committees concerned and hunting tenants. Every year a special permit for fighting by shooting is issued by the responsible lower hunting authority.
Side effects	The shooting is carried out by specially trained specialists with very good knowledge of the species, so that no non-target species are accidentally shot down. They are shot down with silenced weapons in order to keep disturbances to other sensitive species, such as breeding bird species, as low as possible. So far, no negative effects of the fight against other protected objects have been determined.
Stakeholder engagement – implementation:	Commissions, hunting tenants, fishing clubs, State Museum for Natural History Karlsruhe and Stuttgart, various authorities in the area of responsibility concerned.
Dissemination	Annual jour fixe with everyone involved. Now and then reporting in the press.
Innovation	Nocturnal combat with small-caliber special weapons by qualified personnel from the boat
Lessons learned	After several years of attempts at various methods of fighting and containment, night-time fighting with small-caliber special weapons by specialist personnel from the boat has proven to be the most effective. However, this is very time-consuming and personnel-intensive and therefore also cost intensive.
References	Annual reports of the commissioned offices (office for ecological expert reports (Daniel Hoffmann) and Dr. Tobias Wirsing, Dipl.-Geoökol. And faunistic expert reviewer.

2.4.8. Case study 7. Luxembourg: *Procyon lotor*

Group: Mammals	
Country: Luxembourg	
Entity: LWV asbl c/o GROTZ Roland	
Category	**Response**
Species targeted	*Procyon lotor* (Raccoon)
Objective(s)	Eradication Containment On the feeding places of farm animals
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Cage traps • Hunting dogs
Measures used to remove (dispatch/sterilise/captivity) species	• Shooting • Slaughter with a knife
Description of the measure	A racoon cage trap associated with a trapmaster detector and transmitter, which immediately informs user when an animal is caught.
Time period	The cage is activated about 3 months in a year, especially during the winter period.
Location and scale of application	Racoons are spread all over Luxembourg, especially in the North called "Éisleck". The use of a trap in Luxembourg is only admitted to the landowner (i.e. for use on their property) and only for the racoon and the muskrat. As racoons are night active animals and as night hunting is forbidden in Luxembourg, the hunting success is very limited.
Effort	1 single cage-trap
Costs	1,000 EUR (Equipment and infrastructure)
Additional details on costs	Trap-cage 500 EUR + transmitter 500 EUR
Source(s) of funding	Only by my own means

Effectiveness	Effective on property - The feeding places for farm and the "Kirrung" for wild animals were deemed to be free of racoons after 3 to 4 months.
Replicability	Hunters and farmers would like to apply the cage trapping with emitters, but most landowners are not informed that they can use the traps. If hunters could use traps, the widespread reduction of a lot of invasive species could be possible.
Humaneness/animal welfare	The cage-trap is equipped with an emitter and regularly visited
Stakeholder engagement – implementation:	Engagement with the "Lëtzebuerger Wëldschutz Verband asbl (LWV)", also known as Association des Gardes et Gestionnaires de chasse et de pêche asbl, RCS No F3939 (case study submitter is the secretary of this group). The association accounts 40 active members with a Facebook-site https://www.facebook.c/om/LWVlu, which has 1.100 followers.
Innovation	Use of transmitters on cage traps like Trapmaster.de
References	LWV asbl facebook page: https://www.facebook.c/om/LWVlu



Case study 7 score. Luxembourg: *Procyon lotor*

2.5. Mediterranean (East) Region: Cyprus, Greece

2.5.1. Summary of case studies submitted for the Mediterranean (East) region

	Country	Entity submitting	Species	Measures used to restrain, capture and/or remove (kill/sterilise) the species	Measures used to remove (dispatch/sterilise/captivity) species	Average score at workshop
1	Greece	Decentralized Administration of Epirus – Western Macedonia	*Neovison vison**	Trapping: cage traps	Shooting - dispatch restrained animals	N/A[1]
2	Greece	Democritus University of Thrace	*Neovison vison**	Trapping: cage traps	Shooting - dispatch restrained animals	N/A[1]
3	Greece	Decentralized Administration of Macedonia and Thrace	*Myocastor coypus*, *Neovison vison**	Hand removal Trapping: cage traps	Shooting - dispatch restrained animals	N/A[2]

* Vertebrate IAS not on the Union list

[1] Case study presented at the workshop but not scored, as it refers to a species not on the Union list

[2] Case study presented at the workshop but not scored, as implementation of the project has been delayed due to Covid-19

2.5.2. Case study 1. Greece: *Neovison vison*

Group: Mammals	
Country: Greece	
Entity: Decentralized Administration of Epirus – Western Macedonia	
Category	**Response**
Species targeted	*Neovison vison* (American mink)
Objective(s)	Eradication (of widespread population) Control

Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	Shooting - dispatch restrained animals
Description of the measure	In the wetlands where the project is being implemented, 150 floating rafts have been installed with a special clay container for capturing tracks of mink. The technique of (i) tracking, (ii) trapping, (iii) tracking will be followed. (i). Initially, on the floating rafts, the special container with the clay will be checked for the presence of tracks of mink daily for a period of 7-10 days. (ii). In case of track recording, cage traps of live capture with odor bait from mink glands will be placed on the raft with the tracks and in both adjacent ones, and will be checked daily for a period of 7-10 days. (iii). After trapping, the clay containers will be placed and inspected daily for 7-10 days. This process will be repeated 3 times in autumn (i.e. after the end of reproduction and when the young leave their natal areas, from the second fortnight of August until the end of October) and 4 times in spring (before the beginning of reproduction, from mid-February by the end of April).
Time period	Dispersal period: August-September-October Breeding period: February-April
Location and scale of application	The research will be carried out in the areas of the Natura 2000 network: SPA Lake Orestia (Kastoria) (GR1320003) and SPA National Park of Prespa (GR1340001), as well as in the Regional Units of Kastoria, Florina, Grevena, Kozani, Pieria, Imathia, Pella, Kilkis and Thessaloniki.
Source(s) of funding	Green Fund – European Union
Effectiveness	Moderately effective
Replicability	There is a possibility of repeatability of the measure in other areas
Humaneness/animal welfare	An airgun was used to kill the mink, which is believed to cause less stress to trapped individuals
Public acceptance	Informative events, Media, Internet
Stakeholder engagement – implementation:	Foresters, Gamekeepers, Fur Federation, NGOs, Fur farmers, Local authorities, Scientific and academic stuff, Hunters, Ministry of Environment and Energy
Dissemination	Informative events, Media, Internet, Seminars, brochures
References	European Commission, Council of Europe

2.5.3. Case study 2. Greece: *Neovison vison*

Group: Mammals	
Country: Greece	
Entity: Democritus University of Thrace	
Category	**Response**
Species targeted	*Neovison vison* (American mink)
Objective(s)	Eradication (of widespread population): mink population decrease and protection of biodiversity
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	Shooting - dispatch restrained animals
Description of the measure	Use of cage traps (17 X 17 X 65 cm) for live capture with the use of odor bait from male mink glands
Source(s) of funding	European Union
Stakeholder engagement – implementation:	Universities, Forest Service, Hunting Federation
References	European Commission, Council of Europe

2.5.4. Case study 3. Greece: *Myocastor coypus* and *Neovison vison*

Group: Mammals	
Country: Greece	
Entity: Decentralized Administration of Macedonia and Thrace	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu), *Neovison vison* (American mink)
Objective(s)	Rapid eradication (early stage intervention): Addressing the threat of invasive alien species in North Greece, using early warning and information systems for mammals Eradication (of widespread population): Census and management of the American mink population (*Neovison vison*) in the wider region of Western and Central Macedonia, inside and outside of the Natura 2000 Protected Areas, by installing a system for early detection and immediate response to invasive alien species in Greece.
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Hand removal: Hand removal • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Shooting - dispatch restrained animals
Description of the measure	Floating mink rafts and land traps cages will be used to attract mink from the odor emitted by mink gland. The traps will be checked daily and caught mink will be transported out of protected areas and killed by airguns. Trapping will always be preceded by a tracking period of seven (7) days, followed by a trapping of seven (7) days and again tracking of seven (7) days.
Time period	It is planned to start the implementation of the action in Greece at the end of August - September 2021
Location and scale of application	The action will be applied in the lake of Kastoria, along the river Aliakmonas and its tributaries, in areas of Western Macedonia where there were reports and recordings of mink individuals and in areas of mink farms. In Lake Vegoritida and other areas of Central Macedonia, where the presence of mink individuals will be detected.
Source(s) of funding	LIFE 18/NAT/GR 000430 , LIFE ATIAS, E.U. and Green Fund
Replicability	It can be applied for the control of Coypu in many areas of Greece where problems have occurred (Regional Unit of Evros, Central and Western Macedonia and Thessaly).

Humaneness/animal welfare	It was suggested the use of airguns in order to shoot the captive individuals or the killing with Modified atmospheres.
Public acceptance	The public was informed with announcements in local media and websites, organizing seminars on the actions and objectives of the LIFE ATIAS program in the areas to be implemented. Questionnaires were also distributed and supplemented with personal interviews to record the public's views and attitudes towards specific management practices of the American mink and alien species in rural and urban populations. The prevailing public opinion found was the management with capturing and killing at a significantly higher rate than the other proposed treatment with capture - sterilization and release.

2.6. Mediterranean (West) Region: Italy, Malta, Portugal, Spain

2.6.1. Summary of case studies submitted for the Mediterranean (West) region

	Country	Entity submitting	Species	Measures used to restrain, capture and/or remove (kill/sterilise) the species	Measures used to remove (dispatch/sterilise/captivity) species	Average score at workshop
1	Italy	Università degli Studi dell'Insubria	*Sciurus carolinensis*	Other measures: cage traps	Modified atmospheres - dispatch restrained animals	3.2
2	Italy	Università degli Studi dell'Insubria	*Callosciurus erythraeus*	Other measures: cage traps	Modified atmospheres - dispatch restrained animals	3.1
3	Italy	Università degli Studi dell'Insubria	*Procyon lotor*	Other measures: cage traps Other measures: eggs-traps	Modified atmospheres - dispatch restrained animals	3.6
4	Italy	ISPRA / OIKOS Institute	*Sciurus carolinensis*	Trapping: Cage traps	Modified atmospheres Surgical sterilisation	N/A[1]
5	Portugal	Faculty of Sciences, University of Lisbon	*Xenopus laevis**	Aquatic habitat management: pond drying/draining Hand removal: Physical fishing methods Trapping: Cage traps	Native predators Electrofishing Injection euthanasia Keeping in captivity Other measure: euthanasia by immersion on anaesthetic	3.8[2]
6	Spain	Complutense University Madrid	*Pseudorasbora parva*	Physical barriers	Chemical treatment of habitats	2.7
7	Spain (Canary Islands)	Gesplan	*Mustela furo**	Trapping: Cage traps Other measures: Live decoy traps	Injection euthanasia Shooting - dispatch restrained animals Shooting - hunting	N/A[2]
8	Spain	Invasive Bird Management (INBIMA)	*Acridotheres* spp.*, *Pycnonotus* spp.*, *Psittacula krameri**, *Myiopsitta monachus**	Other measures: Live decoy traps	Other measures: poisons and toxins in bait Other measures: cranial depression	3[3]

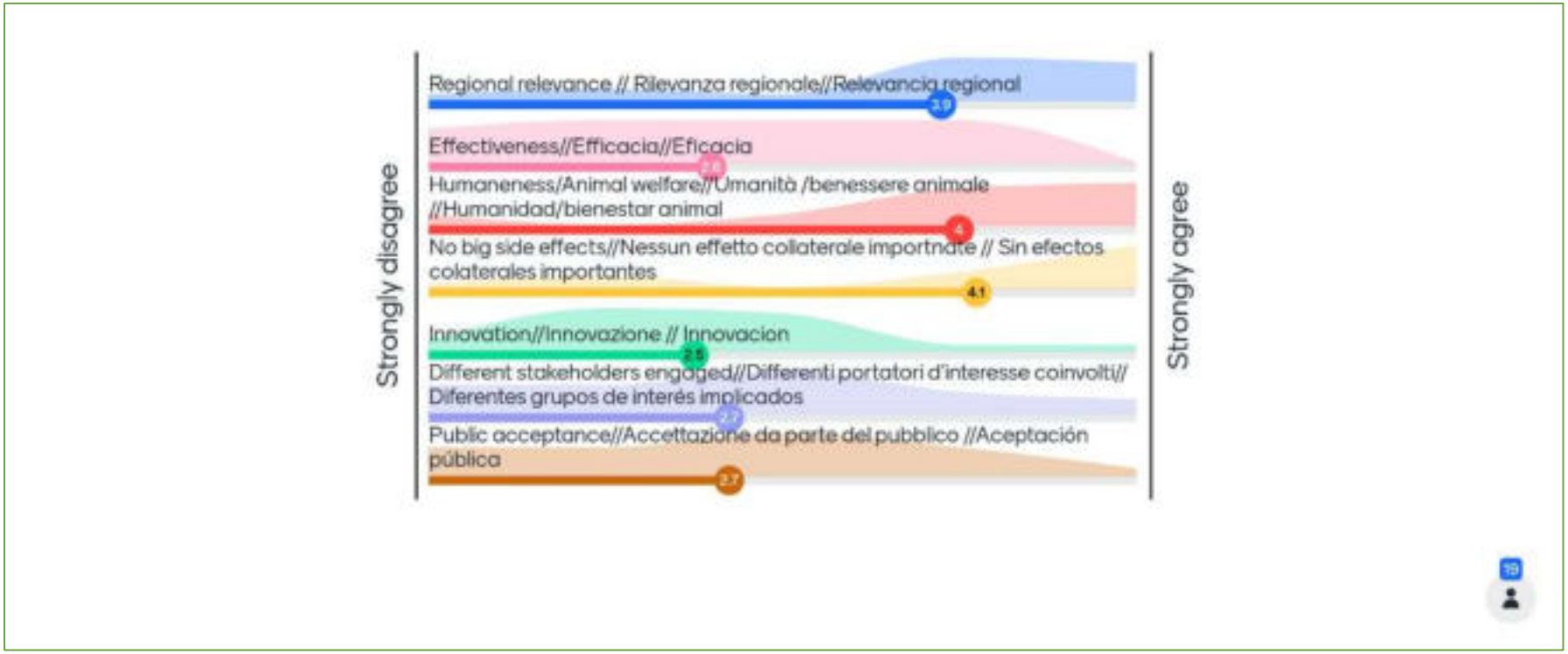
* Vertebrate IAS not on the Union list as of 2021

[1] Case study not presented at the workshop and therefore not scored | [2] Case study presented at the workshop but not scored, as it refers to a species not on the Union list at time of submission

[3] Case study scored, as management of this species is similar to that of other listed species

2.6.2. Case study 1. Italy: *Sciurus carolinensis*

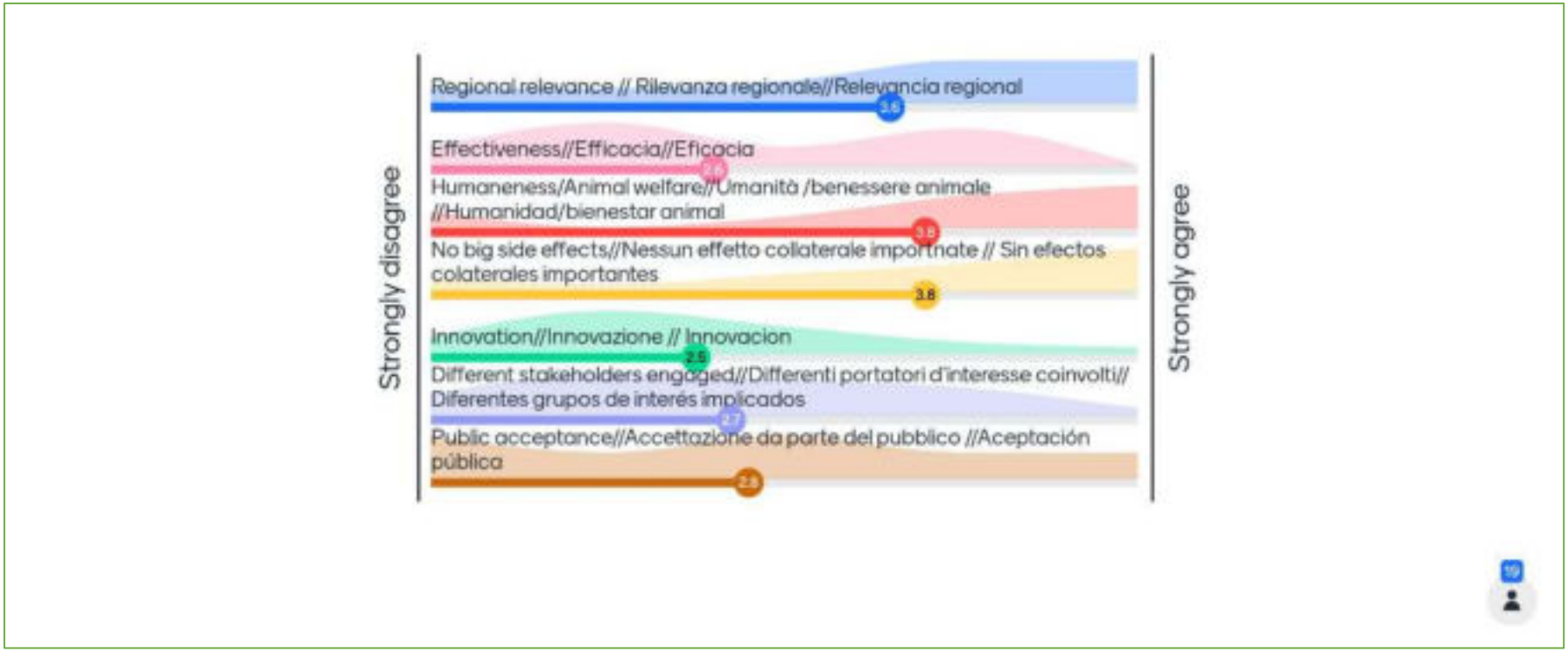
Group: Mammals	
Country: Italy	
Entity: Università degli Studi dell'Insubria	
Category	**Response**
Species targeted	*Sciurus carolinensis* (Eastern grey squirrel)
Objective(s)	Rapid eradication (early stage intervention): For some specific cases of settlement of new grey squirrel nuclei in areas with the presence of red squirrel
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Other measures: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	Modified atmospheres - dispatch restrained animals
Description of the measure	Use of adequately sized Tomahawk live-traps for squirrels
Time period	An activity concentrated between September and March
Location and scale of application	Adda Nord Regional Park, Vanzago Reserve and some local area for new nucleo removal
Effort	Squirrel: 2 pers./7 day per month
Effectiveness	Not very effective for squirrels: little effort put into the field than necessary
Humaneness/animal welfare	Each operator attended a training course on animal welfare
Stakeholder engagement – implementation:	Province and Regional administrations, parks
Lessons learned	In some cases, avoid communicating interventions until eradication is complete. This limits the conflicts especially if the intervention areas are not in populated urban or peri-urban areas



Case study 1 score. Italy: *Sciurus carolinensis*

2.6.3. Case study 2. Italy: *Callosciurus erythraeus*

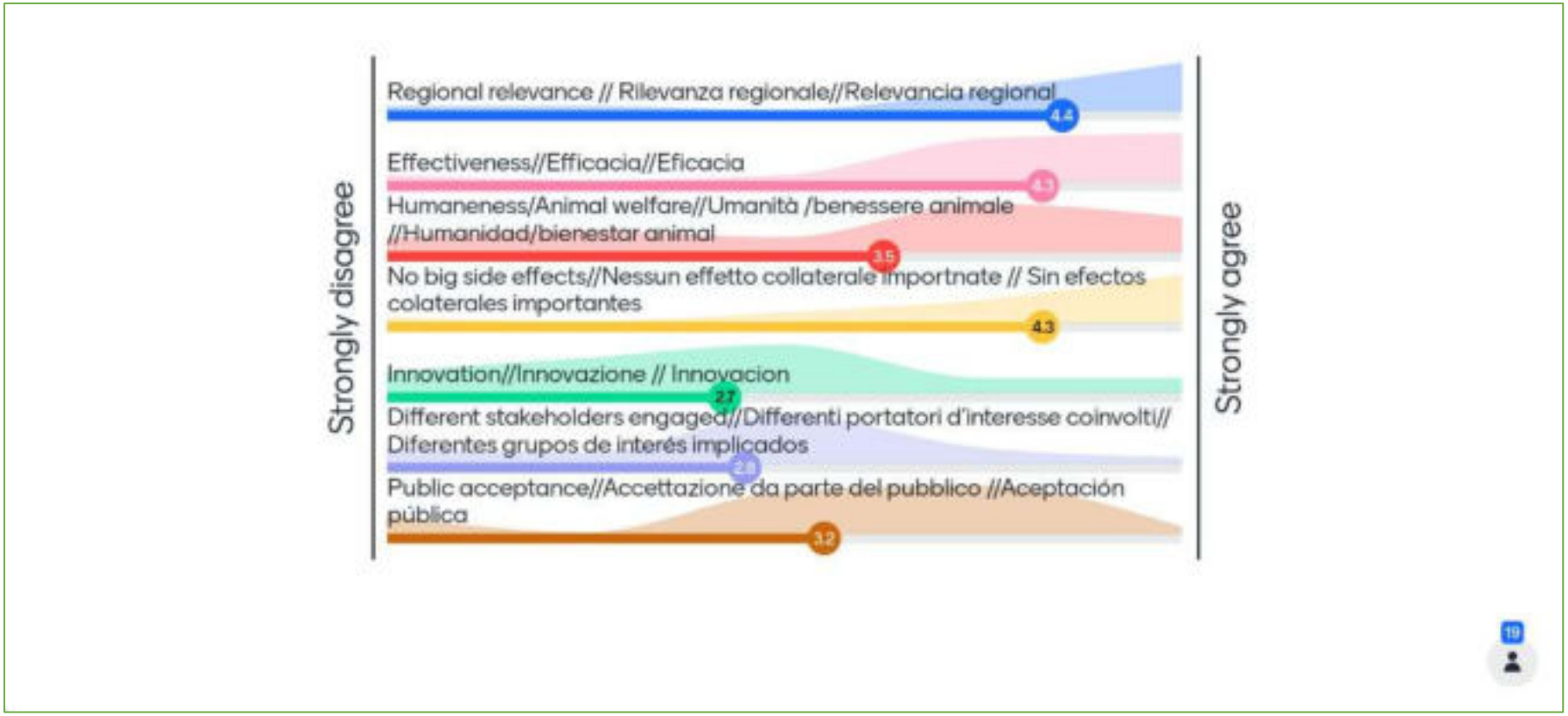
Group: Mammals	
Country: Italy	
Entity: Università degli Studi dell'Insubria	
Category	**Response**
Species targeted	*Callosciurus erythraeus* (Pallas's squirrel)
Objective(s)	Control / Eradication: Pallas's squirrel control aimed primarily at avoiding population expansion, but with the ultimate goal of removal (difficulty in achieving the objective due to lack of cooperation from local authorities)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Other measures: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	Modified atmospheres - dispatch restrained animals
Description of the measure	Use of adequately sized Tomahawk live-traps for squirrels
Time period	An activity concentrated between September and March
Location and scale of application	Northern part of Varese Province, close to the Swiss border
Effort	Squirrel: 2 pers./7 day per month
Effectiveness	Not very effective for squirrels: little effort put into the field than necessary
Humaneness/animal welfare	Each operator attended a training course on animal welfare
Stakeholder engagement – implementation:	Province and Regional administrations, parks
Lessons learned	In some cases, avoid communicating interventions until eradication is complete. This limits the conflicts especially if the intervention areas are not in populated urban or peri-urban areas



Case study 2 score. Italy: *Callosciurus erythraeus*

2.6.4. Case study 3. Italy: *Procyon lotor*

Group: Mammals	
Country: Italy	
Entity: Università degli Studi dell'Insubria	
Category	**Response**
Species targeted	*Procyon lotor* (Raccoon)
Objective(s)	Eradication: removal of a population of raccoons in Lombardy reported since the beginning of the year 2000
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Other measures: Cage traps • Other measures: Eggs-traps
Measures used to remove (dispatch/sterilise/captivity) species	• Modified atmospheres - dispatch restrained animals
Description of the measure	Use of adequately sized Tomahawk live-traps and use (moderate) of eggs-traps
Time period	The whole year
Location and scale of application	Adda Nord regional Park, Lombardy (North Italy)
Effort	1 pers./10 day per month
Effectiveness	Very effective intervention for the raccoon (population removed)
Humaneness/animal welfare	Each operator attended a training course on animal welfare
Stakeholder engagement – implementation:	Province and Regional administrations, parks
Lessons learned	In some cases, avoid communicating interventions until eradication is complete. This limits the conflicts especially if the intervention areas are not in populated urban or peri-urban areas



Case study 3 score. Italy: *Procyon lotor*

2.6.5. Case study 4. Italy: *Sciurus carolinensis*

Group: Mammals	
Country: Italy	
Entity: Institute for Environmental Protection and Research (ISPRA) / OIKOS Institute	
Category	**Response**
Species targeted	*Sciurus carolinensis* (Eastern grey squirrel)
Objective(s)	Eradication: The objective was to eradicate or remove at least 80% of the invasive alien grey squirrels present in the city of Perugia and surrounding areas (total area of approx. 50 km^2), where they settled in the early 2000s
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Modified atmospheres • Surgical sterilisation
Description of the measure	For live captures, we used Tomahawk live capture traps (mod. 202.5, 48x15x15 cm). Live capture trapping was carried out by paid staff, but landowners and citizens were also involved because, in the Perugia area, the grey squirrel thrives in urban parks and small private properties within the suburban areas (private gardens andorchards). Landowners were asked to grant access to their properties for the positioning of traps and to readily notify the project technical staff in case of capture of grey squirrels or other non-target species. Most trapped animals (1002) were euthanised by carbon dioxide inhalation. The suppressed individuals were transferred to the local zoo-prophylactic institute both for sanitary investigations and for their disposal. Council Regulation (EC) no. 1099/09 was considered for the euthanasia of the animals. Surgical sterilisation and subsequent release were also applied for a limited number of animals (68). The Department of Veterinary Medicine, University of Perugia - Veterinary Teaching Hospital was entrusted with animals' sterilisation. The sterilised animals were released in 3 urban parks managed by the Perugia Municipality or by wildlife associations on behalf of the Municipality. Feeders were placed in the park to facilitate the settlement of the released animals.
Time period	The trapping started in March 2016 and ended in September 2018. Captures were carried out all year round, although with temporally and spatially varying trapping effort.

Location and scale of application	Perugia and surrounding areas (Umbria, Italy) –approximately 50 km^2
Effort	4 traps/km^2/year
Costs	€ 180,419 - Personnel costs: € 89,668 - Equipment and Infrastructure: € 12,571 - Other: € 78,180
Additional details on costs	The costs reported above are for the C.1 Action, LIFE U-SAVEREDS Project. They include 7% overheads and the funding for the equipment (traps) and the entrustment to the veterinary clinic for the sterilization.
Source(s) of funding	LIFE+ Programme
Effectiveness	Effective
Key evidence/results	The grey squirrel was accidentally introduced in the city of Perugia (Umbria, Italy) in the early 2000s. Since then, it has spread to a range of approximately 50 km^2. As a consequence of the alien species introduction, the local red squirrel population seemed to decline. Grey squirrel management activities started in 2016 and 2018. Following the removal of 1070 animals, the invasive alien species (IAS) range was reduced to an area of approximately 3 km^2. Through distance sampling, we estimated a grey squirrel density of 3.37 ind/ha in 2015 (A.3 data) and0.31 ind/ha in 2017. This reduction was later confirmed by additional data, collected in 2017 and 2018. After-LIFE monitoring data also demonstrate an extreme reduction of the grey squirrel. Only 17 individuals were captured in 2 years (2019 and 2020). At the same time, the number of red squirrel sightings increased. At the end of the project, the range of the red squirrel was 57 km^2, while in 2015 it was recorded only on 19 km^2. Thanks to these results, we could state that the main objectives of the project were met. We produced a sharp reduction in the grey squirrel density, and the invasive alien species is now restricted to a minimal area. In contrast, the red squirrel population seems to recover.
Replicability	For the first time, the LIFE project tackled the management of an invasive and very charismatic alien species in a strongly anthropized environment - Perugia is a town of 160000 inhabitants. The grey squirrel has a strong emotional impact on citizens, and stakeholders and citizens do not readily accept interventions that require the capture and removal of animals in general. Therefore, the project has developed management techniques for the alien species, verifying its applicability and effectiveness in an urban socio-ecological context. Although it was the first structured and coordinated experience of this type, alien squirrels can occur in urban contexts worldwide. Only in Italy we can mention the cases of Maratea, Catanzaro, some sightings in Venice Mestre, Padua, and groups of grey squirrels also in Milan and obviously in Turin. Therefore, the operating and communication methods

	adopted in Perugia can be a reference for the management of the species in all these realities. In particular, the methodologies experimented within the LIFE U-SAVEREDS project could be easily transferred to the management of alien squirrel populations in Maratea and Catanzaro. From a technical point of view, the procedures tested to contact citizens and gain access to private properties have allowed us to highlight the strengths and weaknesses of the different approaches proposed, from sending institutional letters, to direct campaign through door-to-door up to telephone contacts. On the whole, these approaches constitute an information and authorization process that can be adopted as a reference model in similar situations and obviously in the activities foreseen in the After-LIFE. The experience gained by the staff of LIFE U-SAVEREDS in managing relationships with collaborating citizens can certainly be transferred to the wildlife technicians who will operate in similar conditions. This will also be possible thanks to the networking and transfer of skills foreseen by the After-LIFE Communication Plan and thanks to the Alien Squirrel Emergency Team's future activity. The latter is a permanent technical support group for managing alien squirrel species in Italy, established during the LIFE U-SAVEREDS project. As far as the practical implementation of captures is concerned, the LIFE U-SAVEREDS project has also faced some critical situations linked to the intense urbanization of the territory and groups of stakeholders strongly opposed to the project. This situation has resulted in some episodes of sabotage of the traps, which occurred mainly during the capture at Pian di Massiano, the main urban park of Perugia. Also, in this case, the project has developed approaches aimed at minimizing the impact of sabotage on the removal of animals, experimenting the use of aerial platforms for the positioning of traps on trees at heights otherwise impossible to reach. Another strategy implemented here was the regular foraging of selected sites (bait stations) to accustom the animals and then proceed quickly to their capture. The traps were positioned during the night, and in the morning, we proceeded to capture them. Even these experimentations can undoubtedly be helpful in other cases of population management in urban environments. The project has then produced several guidelines that will facilitate the transfer of good practices to other contexts: the guidelines for the implementation of rapid response systems in cases of new alien squirrel foci (Early Warning System and Rapid Response, Action F.2), the guidelines for the management of the new foci (Action F .3), and the Guidelines for the support and restocking of red squirrel populations containing indications for improving urban habitats and trophic availability for the red squirrel. All of these guidelines may in future be adopted by other public entities that will face similar situations.
Humaneness/animal welfare	We defined operational details for the in vivo capture and euthanasia with carbon dioxide and the capture, sterilization, and release of animals, taking into account national and European legislation. We also considered technical and ethical reference documents, such as guidelines developed by the Panel of the American Veterinary Medical Association (AVMA Guidelines for the Euthanasia of Animals: 2013 Edition) and the experience gained

	from the previous LIFE EC-SQUARE project. Council Regulation (EC) no. 1099/09 was considered for the euthanasia of the animals. The traps were placed on the ground or tree branches and baited with walnuts. Traps were checked by the personnel at least twice a day. Euthanasia suppression was performed immediately in the field. Concerning the number of traps per unit area and the timing of trapping, we followed an adaptive strategy, taking into account the features of the removal area (private properties or not, the density of squirrels and so on). For the sterilization of the animals, to evaluate all the possible issues related to the surgery and the stalling stages and to set up a standardized procedure for the sterilization, we contacted the Veterinary Clinic San Martino (Genoa), charged of surgical sterilization of the animals in the previous LIFE EC-SQUARE Project. For the sterilization phase, we verified that the following conditions were met: -the entrusted institutions possessed the relative regional and national authorizations necessary to sterilize the animals; -the squirrels were captured by personnel specifically appointed, who also took care of the transport of the squirrels from the site of capture to the veterinary clinic and from there to the place of release; -in the clinic, the squirrels were maintained with all respect for their welfare and, in particular, they were kept in the dark in single cages and the absence of acoustic or visual stress and separated from other species; -sterilizations were be carried out on all specimens, male and female, removing the gonads. The sterilized animals, during the intervention, were taken a quantity of at least 2 cc of whole blood and applied an ear tag on the right ear (in the case of males) or the left ear (in the case of females). -we used sutures with resorbable thread to avoid the subsequent recapture for the removal of stitches; concerning the skin suture, it was necessary to adopt techniques to prevent removing the stitches themselves by the sterilized head (for example, introspective suture). A broad-spectrum, delayed-action antibiotic coverage was provided. -after the surgery, the sterilized animals were hospitalized in the clinic, in dedicated rooms, separated from other species, in single cages, for a maximum of three days, consistent with the needs of postoperative course and the organization of transport to the sites of release. For the entire duration of hospitalization, we ensured welfare conditions following current regulations. Adequate nutrition and water distribution were guaranteed.
Public acceptance	The awareness-raising campaign implemented during the LIFE Project was crucial to generate accurate information and broad support for the Project or at least to contain and manage the oppositions. The reasons for the choice of the measures were presented to the public mainly through press conferences. We also explicitly targeted animal welfare organizations, involving them in a panel discussion organized in Perugia at the beginning of the Project. The actual implementation of planned activities partly depended on the reaction and availability of landowners. In several zones, the lack of collaboration from citizens delayed the captures of grey squirrels. We also encountered difficulties in removing the grey squirrels through euthanasia from the main Perugia urban park. In this case, problems were due to the opposition of animal rights groups that tried to obstruct Project activities by damaging traps.

Side effects	Positive side effects include: -avoidance of potential health problems, which can be hypothesized given the urban distribution of the species and its confident behaviour towards humans -avoidance of potential economic damage to treecrops (hazelnuts) and orchards - contacts and exchanges with animal welfare and environmental associations at the local and national level; increased awareness of stakeholders concerning the project conservation objectives and, at the same time, attention of the project staff to animal welfare issues
Stakeholder engagement – implementation:	The LIFE U-SAVEREDS communication campaign targeted citizens, landowners, environmental associations, students, teachers and environmental educators. We also explicitly targeted animal welfare organizations. Landowners were directly engaged and involved in the implementation of measures. They were asked to grant access to their properties to position traps and to notify the project technical staff in case of capture of grey squirrels or other non-target species.
Dissemination	Regarding the dissemination activities, the project's primary goal was to obtain a broad consensus (hopefully active, or at least not preventing) by the public opinion for management actions. The consensus was considered fundamental since in Umbria the presence of alien species was also recorded in several types of human settlements, such as high human population density areas in the suburbs and the city centre. The implemented communication and dissemination activities can be roughly classified into three groups, from their specific aims, the stakeholder target and, subsequently, the adopted methodologies: - awareness-raising campaign; - environmental education; - networking.
Innovation	From a technical point of view, the project had many innovative aspects. About the removal of the animals, the project provided the first real example of integration, in the same area, of methodologies that involved the suppression and surgical sterilization. The use of photo trapping during the project was innovative. We placed the GSM camera trapsat the bait stations/foraging points. These cameras allowed us to promptly detect the animals and set up the trap for the subsequent capture. The real-time monitoring of the capture activities was also crucial since it allowed a prompt intervention of the project staff once an animal was captured. The project also represents an experiment aimed at evaluating the general public's reaction to the strategies proposed for the removal of charismatic alien species. The results obtained have led to the conclusion that the integrated methodology, rather than the eradication carried out only through euthanasia suppression, has certainly favoured a more serene working environment within the project, even if there were some discussions concerning the number of animals subjected to sterilization.
Lessons learned	From the application of the measures in our context, we learnt important lessons about permission to enter private properties. Indeed, we first attempted to gather support for Project activities through institutional communication to citizens. While this undoubtedly helped in the subsequent phases, we also realized that an increase in the

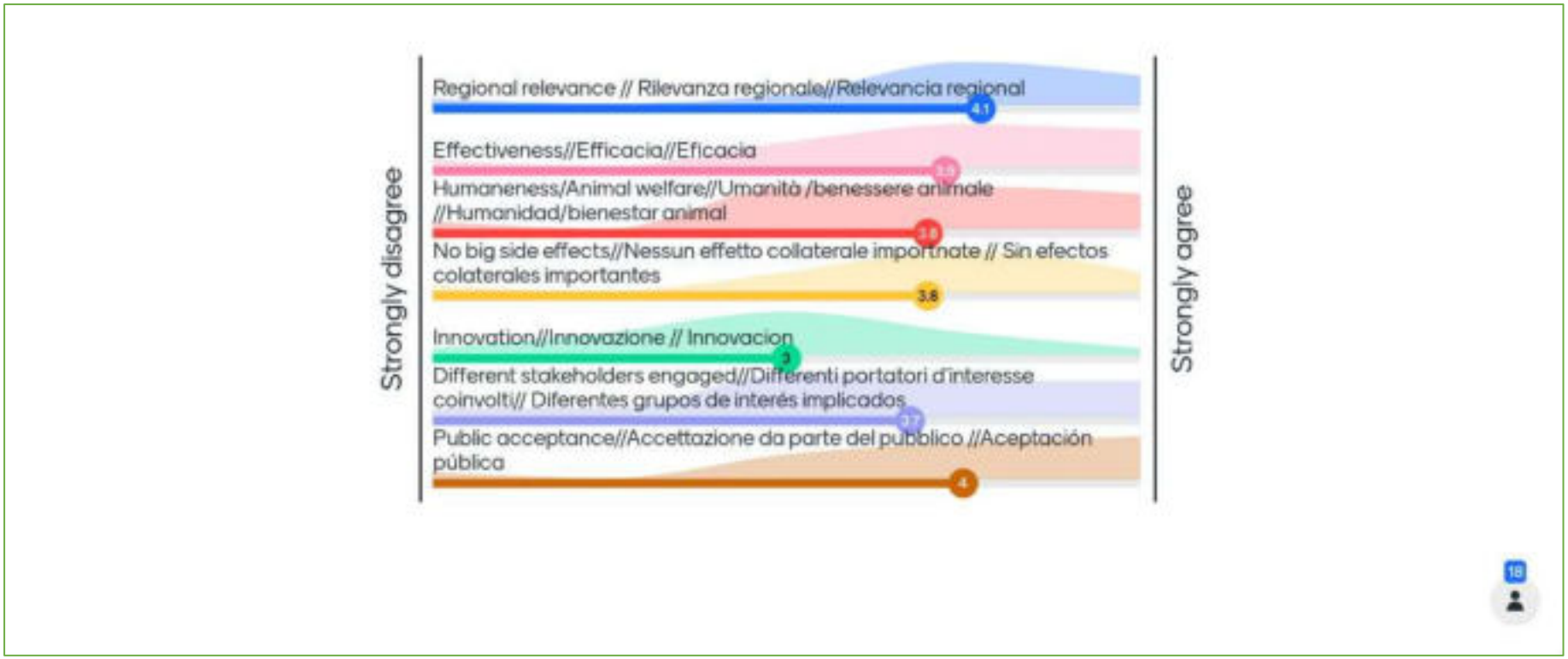
	communication effort was needed. Thus, we worked to establish a direct communication line with landowners through a door-to-door campaign. Finally, we realized that when access to properties was not granted, a careful monitoring of the area and the recurring placement of baits and trap just outside of the inaccessible properties (or wherever it was feasible) was a much more valuable approach than stopping the removal and wait for more extensive support by the citizens. A similar lesson was learnt following the few attempts of animal right activists to hinder the project activities. In this case, we also continued with removing the animals, although we had to revise our field procedures adaptively. In this respect, another lesson learnt was that communication and awareness-raising campaigns should be started well in advance than active IAS management. Finally, dissemination activities conveyed basic information about the project, but it remains almost impossible to activate a participatory process with external stakeholders. The maintenance of a low communication profile reduced the risk of conflicts with animal welfare groups at the beginning of the project. Nevertheless, dissemination activities conveying positive messages should consistently be implemented to avoid unexpected outbreaks of social conflicts with the general public.
References	AA.VV. 2018 LIFE U-SAVEREDS "Management of grey squirrel in Umbria: conservation of red squirrel and preventing loss of biodiversity in Apennines -Lay-man's report. https://usavereds.eu/it_IT/download/laymans-report/ Capizzi, D., Paoloni, D. (2016) Early Warning System and Rapid Response per la prevenzione della diffusione dello scoiattolo grigio e di altri scoiattoli alloctoni nell'Italia centrale. PROGETTO LIFE13 BIO/IT/000204 U-SAVEREDS Management of grey squirrel in Umbria: conservation of red squirrel and preventing loss of biodi-versity in Apennines. Azione F.2 -Creazione ed implementazione di un Early Warning System and Rapid Response extra-regionale. 48 pp. https://usavereds.eu/it_IT/download/opuscolo-early-warning-system-and-rapid-response/ La Morgia, V., 2019. LIFE U-SAVEREDS project, in: Invasive Alien Species Colonisation Prevention: Your Guide to Early Detection and Rapid Response. The Royal Society of Wildlife Trusts, pp. 69–80. La Morgia V, Aragno P, PaoloniD, Bertolino S, Martinoli A, Wauters L, Genovesi P (2018). Nuclei di scoiattoli alloctoni: dal rilevamento alla gestione. Documento eleborato dall'Alien Squirrel Emergency Team (ASET), Progetto LIFE U-SAVEREDS, Azione F.3. https://usavereds.eu/it_IT/download/nuclei-di-scoiattoli-alloctoni-dal-rilevamento-alla-gestione-linee-guida-prodotte-dall-alien-squirrel-emergency-team-aset/ La Morgia, V., Paoloni, D., Genovesi, P., 2017. Eradicating the grey squirrel *Sciurus carolinensis* from urban ar-eas: an innovative decision-making approach based on lessons learnt in Italy. *Pest. Manag. Sci*. 73, 354–363. doi:10.1002/ps.4352 Signorile, A.L., Paoloni, D., Reuman, D.C., 2014. Grey squirrels in central Italy: a new threat for endemic red squirrel subspecies. *Biological Invasions* 16, 2339–2350. doi:10.1007/s10530-014-0668-3

2.6.6. Case study 5. Portugal: *Xenopus laevis*

Group: Amphibians	
Country: Portugal	
Entity: Faculty of Sciences, University of Lisbon	
Category	**Response**
Species targeted	*Xenopus laevis* (African clawed frog)
Objective(s)	Two established populations, but over a small geographic range. Eradication seems possible
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Aquatic habitat management: Pond drying/draining • Physical fishing methods: including aquatic nets • Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Native predators • Electrofishing • Injection euthanasia • Keeping in captivity • Other measure: Euthanasia by immersion on anaesthetic, MS 222 solution
Description of the measure	Small baited fyke nets, anchored at the banks. Animals captured alive. electrofishing - low voltage, enough to make the species visible when trying to escape. Capture with hand net. All individuals carried (on cooler storage boxes) to a lab or house. Immersion in MS222 followed by rapid freezing at -20°C. Trapping has been regular over ten years. Each trap is set on site and checked in the next day or every other day during 3 weeks, in the summer months. Electrofishing takes place during the same 3 weeks, scattered along the summer months.
Time period	Trapping has been regular over ten years. Each trap is set on site and checked in the next day or every other day during 3 weeks, in the summer months. Electrofishing takes place during the same 3 weeks, scattered along the summer months.
Location and scale of application	Portugal, Oeiras county, 2 small river basins covering 30 km^2 about 16,000 adult frogs captured over 10 years
Effort	60 person/day per year, over 10 years. Trapping is irregular 43 hours of electrofishing per year

Costs	Overall: 11,000 € - Personnel costs: 9,000 € - Equipment and infrastructure: 2,000 €
Additional details on costs	There have been several sources of funding (and some had overheads). Besides salaries paid by the municipality and Governmental Institute for Conservation of Nature, there have also been some short term grants. Other costs - about €1,000 for gas / car and €1,000 for traps, baits, nets, etc
Source(s) of funding	Portuguese Government, Oeiras municipality, several research projects (including a EU-funded Biodiversa)
Effectiveness	Effective - Reduction from an annual catch of several thousand frogs to the current 4-5 adult frogs per year
Replicability	Transferable to other amphibians, as long as they are restricted to a relatively small area. Most important - living on streams, with a large majority of the stream course accessible on foot.
Humaneness/animal welfare	We did not use any type of poison, but mostly due to the potential impacts on non-target species. The same reasoning for the choice of the trap and of the electrofishing method. The choice of the method for euthanasia was driven by what was acceptable by the humans participating on the campaign - this species is very difficult to kill using conventional physical methods.
Public acceptance	It was described just like I did in a previous box. There were no problems - people accept it as normal (although some ask why could we not keep them alive in the lab).
Side effects	Besides some accidental deaths of non-target species on the traps or on the electrodes of the electrofishing gear (very rare), there were some positive reactions by local people, that see the actions in the streams as a proof of concern with the quality of those streams (usually very polluted and crossing urbanized areas)
Stakeholder engagement – implementation:	Oeiras municipality - responsible for the maintenance of the riverbed and banks. Partner in the program Institute for Conservation of Nature and Forests (Governmental) - responsible for the program and for issuing the permits Centre for Ecology, Evolution and Environmental Changes/ University of Lisbon - scientific supervision and participation
Dissemination	Regular appearances in the national media (e.g. https://www.wilder.pt/?s=xenopus) / open days at the Faculty of Sciences, University of Lisbon. Dissemination to Oeiras citizens on regional newspapers and on an exhibition
Innovation	In 2020 we used eDNA for the first time, to detect possible sites where the species is present, but undetected (none; it was detected indeed, but the presence was known on the sites), as well as to assess the success of the eradication attempts on isolated ponds (success in all but one). As far as I am aware, this is the only case where this species was controlled along lotic systems (the particularities of the site enabled this)

Lessons learned	Control and nearly-eradication of an invasive vertebrate is possible along Mediterranean-type streams, using electrofishing and probing virtually the entire length of the stream. The key to successful control, though, was the discovery that the species uses side pools and ponds as its most important breeding habitat. Draining those sites is sometimes feasible, which eliminates almost the entire yearly reproductive output of local populations.
References	Ginal, P., Moreira, F. D., Marques, R., Rebelo, R., & Rödder, D. (2021). Predicting terrestrial dispersal corridors of the invasive African clawed frog *Xenopus laevis* in Portugal. *NeoBiota*, 64, 103–118. https://doi.org/10.3897/NEOBIOTA.64.60004 Bento, S., Egeter, B., Rebelo, R., Chaves, C., & Pinto, J. (2021). eDNA is a useful tool to evaluate the success of the eradication program of *Xenopus laevis* in Portugal. ARPHA Conference Abstracts, 4, 10–11. https://doi.org/10.3897/aca.4.e65055 Moreira, F. D., Marques, R., Sousa, M., & Rebelo, R. (2017). Breeding in both lotic and lentic habitats explains the invasive potential of the African clawed frog (*Xenopus Laevis*) in Portugal. *Aquatic Invasions*. https://doi.org/10.3391/ai.2017.12.4.12 Sousa, M., Maurício, A., & Rebelo, R. (2018). The *Xenopus laevis* Invasion in Portugal: An Improbable Connection of Science, Mediterranean Climate and River Neglect, 133–148. https://doi.org/10.1007/978-3-319-74986-0_6 Rebelo, R., Amaral, P., Bernardes, M., Oliveira, J., Pinheiro, P., & Leitão, D. (2010). *Xenopus laevis* (Daudin, 1802), a new exotic amphibian in Portugal. *Biological Invasions*, 12(10). https://doi.org/10.1007/s10530-010-9757-0



Case study 5 score. Portugal: *Xenopus laevis*

2.6.7. Case study 6. Spain: *Pseudorasbora parva*

Group: Fish	
Country: Spain	
Entity: Complutense University, Madrid	
Category	**Response**
Species targeted	*Pseudorasbora parva* (Stone moroko)
Objective(s)	Eradication (of widespread population), Control. It is a pilot project in the Peral stream (Guadiana basin)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Physical barriers
Measures used to remove (dispatch/sterilise/captivity) species	Chemical treatment of habitats
Description of the measure	Application of a product based on rotenone piscicide (CFT Legumine 3.3%). The fish were collected dead once the rotenone was applied. The measure consists of applying a product based on rotenone in the Peral stream, with a Mediterranean regime, which has previously been isolated from the river where it empties (Alcollarín river) by means of a gabion damp. Although initially the measure was designed to be applied in season of low water and in times of circulating flow, finally it was only carried out in low water. The pools of the riverbed, the livestock ponds close to or directly connected to the riverbed and a small tributary from a livestock pond were treated.
Time period	Considerations for planning and timings - Laying period of *P. parva* (March-September) (Gozlan *et al*. 2010). The fish spawn are more resistant than the larval, juvenile and adult stages to treatment with rotenone. Knowing this and given that the spawn of *P. parv*a in the area where it originates occurs between April and August, and can extend from March to September in areas where it has been introduced (Gozlan *et al*. 2010), it was proposed to carry out the treatment in autumn, before the start of the rains, to take advantage of the maximum dry season. In this way, the effect on the larval stages of the spring spawning of native aquatic species would also be avoided. It was not necessary to adjust this period to avoid significant damage to the larval stages of autumn clutches, especially in amphibians, as indicated by the experts.

	Reproductive season of aquatic fauna (e.g. herpetofauna, larval period in winter and spring). In principle, two treatments were designed: in low water, which was carried out between the months of September and October, where the riverbed, tributaries and livestock ponds connected with the riverbed would be treated; and continuously in January when the water flows through the stream and tributaries, 2-3 km downstream from Arroyo del Peral. Finally, the treatment was only carried out in the dry season between October 18 and 21, 2016 and November 21 and 22, 2016.
Location and scale of application	The treatment area selected to carry out the pilot test was the Peral stream basin (Figure 1). It is a stream of about 8 km in length that is a tributary to the left of the Alcollarín river (Figures 2 and 3). They converge upstream of the Alcollarín reservoir. It has a Mediterranean regime (and is classified within Type 1. Siliceous plains rivers of the Tagus and Guadiana, as well as the Alcollarín river (Toro et al. 2009). In addition to the stream, its tributaries and cattle rafts were taken into account, especially those closest to the channel and directly connected, for which an inventory was made. An inventory of livestock ponds was carried out using the National Topographic Base 1: 25,000 (BTN25), completing this information with aerial photography from TRAGSATEC With all this, 59 bodies of water were identified.
Effort	2 workers per day during the planning and treatment phases. 13 workers per day during the treatment phase. 3 workers per day during the post-treatment and follow-up phase.
Costs	220.000 €
Source(s) of funding	The source of funding is the Sub-Directorate General for the Natural Environment of the Ministry of Agriculture and Fisheries, Food and Environment (MAPAMA), which develops, in coordination with the Autonomous Communities, the basic legislation relating to invasive alien species at the national level and is the representative of the Spanish State in front of the European institutions. This subdirectorate has commissioned TRAGSATEC's Quality, Environmental Assessment and Natural Environment Management to develop a pilot project for the eradication of the invasive fish species P. parva through the use of a piscicide that has rotenone as a substance. The objective of the pilot project is to obtain the knowledge and experience of this method of control of fish species in fluvial environments that can facilitate, where appropriate, the establishment of management, control and possible eradication guidelines that can be reflected in a possible future strategy.
Effectiveness	Moderately effective - The result of applying the measure was moderately effective, although we have indications that the rotenone treatment worked, the follow-up could only be carried out for a short period of time. The weir, built downstream to isolate the river from the rest of the basin, was poorly designed and poorly constructed, so it was permeable to the movements of *Pseudorasbora parva* to the Peral stream when the rains began.

Replicability	This measure is replicable for freshwater fish species in Mediterranean streams in the dry season and in cattle rafts.
Humaneness/animal welfare	Before carrying out the treatment, specimens of native fish (colmilleja, calandino, chub and pardilla) were captured in the Alcollarín river and in the Peral stream, which were kept in oxygenated tanks, cared for by aquaculture specialists, under the conditions until they could be reintroduced once the rotenone concentrations in the water fell to non-toxic concentrations compatible with animal life (<2 ppb of active rotenone). 2. Livestock ponds and stream ponds treated to prevent livestock access were limited until rotenone concentrations in the water were compatible with use.
Public acceptance	In the meetings held with the interested parties, the measure was explained to them and it was well accepted.
Side effects	1. Regarding the native fish species, the species that was affected was the tusk, *Cobitis vettonica*. It should be noted that along with the reduction of specimens of *Pseudorasbora parva* there was also a significant reduction of specimens of gambusia, *Gambusia holbrooki*. 2. Regarding the species of amphibians and reptiles, the following species were not affected: *Pleurodeles waltl*, *Triturus pygmaeus* and *Epidalea calamita*. *Lissotriton boscai* was not affected, although this result must be viewed with reservations. There are doubts about the affection of *Alytes cisternasii, Pelobates cultripes* and *Mauremys leprosa*. *Hyla meridionalis* has been seen in the only treated pond in which it was found, but not in the stream, and *Pelophylax perezi*. 3. Regarding odonates, more species and specimens of *Sympetrum striolatum* and *Chalcolestes viridis* were observed after applying rotenone treatment, but it cannot be stated categorically that there has not been a negative influence of rotenone on the development of dragonfly communities because the increase may be due to the elimination or reduction of populations of their possible predators and, on the other hand, dragonfly adults are very good fliers and can easily recolonize aquatic environments. 4. Regarding the benthic macroinvertebrates, an impact on the IBMWP 'index was not observed, although the number of dipterans did increase but that of ephemeropterans decreased. 5. Regarding the beetles and aquatic hemiptera, in principle, no impact was observed.
Stakeholder engagement – implementation:	State bodies and those of the Extremadura Board with powers, the Guadiana CCAA Hydrographic Confederation, the Zorita, Alcollarín and Conquista de la Sierra municipalities, positions of the Zorita and Campo Lugar Civil Guard and owners, mainly cattle ranchers
Dissemination	Meetings were held with stakeholders to inform about the project and there was continuous coordination with the owners directly affected to be able to manage the watering of livestock. During the treatment and until the

	rotenone concentration in the water was compatible with the uses, informational posters of the project were posted with the limitations of the uses.
Innovation	It is the first time that rotenone treatment has been carried out in a stream with a Mediterranean regime, at least in Spain. There are previous experiences in lagoons such as Zóñar carried out by the University of Córdoba
Lessons learned	1.1. Request for authorizations for this type of treatment. It is necessary to request them in time to resolve any doubts and objections that the administrations may communicate. 1.2. Regarding the management of the CFT Legumine 3.3% ® product: 1.2.1. The purchase is complicated and needs to be planned in advance. 1.2.2. Containers can be damaged in transit and a suitable storage place with ventilation and cool temperature is needed. 1.3. The cleaning of the channel before the treatment can be a determining factor in time for its realization in addition to requiring specific permits. 1.4. In the case of wanting to waterproof the sections of river treated by means of the construction of dams, these must have a suitable design to the flows that can circulate through the river and they must be of good construction. 1.5. It is necessary to coordinate the treatments with the owners (ranchers) of the lands adjacent to the river or where the cattle rafts are located, which is a temporary and economic determining factor. 1.6. Regarding prevention and personal safety, it should be said that up to now there is no specific training in Spain for this type of biocide. In addition, it is necessary to have adequate Personal Protective Equipment (PPE) and a good use of them. 1.7. Difficulties have arisen in reaching the desired concentration in livestock ponds. The problem has not occurred in the bodies of water present in the channel. More research is needed regarding the kinetics of rotenone in these types of systems (adsorption to suspended solids, distribution and metabolism). 1.8. Regarding the measurement of the concentration of rotenone in water, it is important to point out that the samples require careful conservation until they arrive at the laboratory. On the part of the laboratories, there is a limitation in the number of samples that can measure what influences the treatments, monitoring and restoration of uses. 1.9. It is necessary to obtain the experience to carry out the treatment continuously. It could not be carried out on this project. Drip stations for continuous treatment have not been tested. Special material is required for the application that must be purchased and / or manufactured. 1.10. It is necessary to plan the maintenance of the fish based on the treatment. There are native species that are difficult to maintain, such as the tusk that requires specific conditions such as the presence of a suitable substrate.

	1.11. Workers must be insisted on correctly registering the bodies of water treated and the amount of product used. 1.12. Recording the number of specimens killed during the treatment is not feasible (especially if there are very small specimens such as shrimp and fingerlings of other species) so it is proposed to record biomass. In any case, it is considered necessary to train workers in the recognition of species. 1.13. The management of the containers and absorbent material that have been in contact with the product must be managed by an authorized manager. Dead animals must be treated as SANDACH Type C1 waste (fish) and treated by an authorized manager. 2. The conclusions obtained from the work carried out so far are the following: 2.1. Knowledge and experience have been acquired in the treatment with a rotenone-based piscicide in a typically Mediterranean river environment in the dry season. 2.2. The knowledge and experience of continuous treatment when water flows through the river are lacking.
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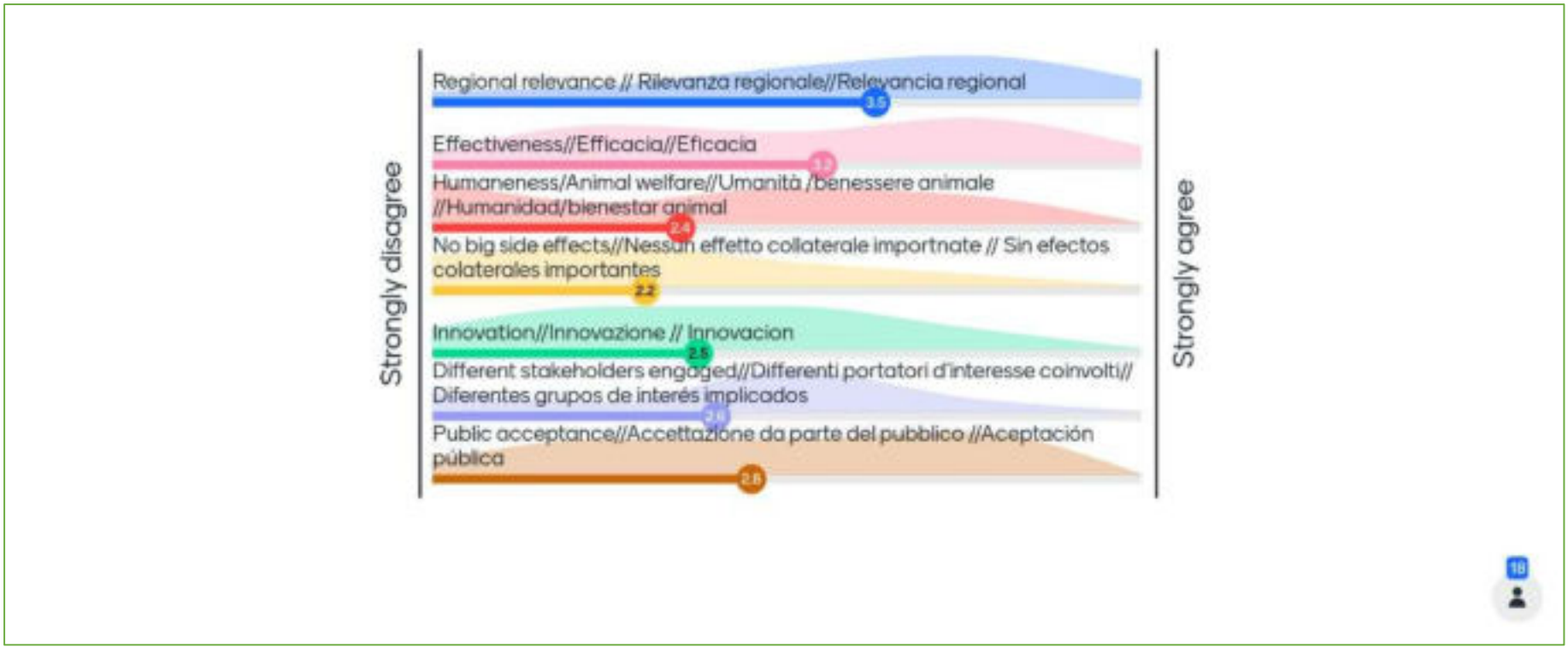


Case study 6 score. Spain: *Pseudorasbora parva*

2.6.8. Case study 7. Spain (Canary Islands): *Mustela furo*

Group: Mammals	
Country: Spain (Canary Islands)	
Entity: Gesplan (Public company in the Canary Islands)	
Category	**Response**
Species targeted	*Mustela furo* (Ferret)
Objective(s)	Eradication Control
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Cage traps, live decoy traps First, control and distribution are implemented to later begin with long-term capture tasks until their eradication. Eradication is complicated because there is no estimated census data. Tracking of the species and control by zones
Measures used to remove (dispatch/sterilise/captivity) species	• Injection euthanasia • Shooting – dispatch restrained animals • Shooting
Description of the measure	Capture methods using collapsible Tomahawk traps 205 with non-live bait. The capture of feral ferrets is very complicated by the high availability of natural resources in the environments where they have been found feral. Once captured, due to difficult handling and aggressiveness of the individuals, they are immobilized in an immobilizing cage and dispatched in situ by shooting with a compressed air gun in the central area above the eyes. Death occurs instantly without suffering of the animal. Subsequently, the corpse is frozen and sent for stomach content analysis
Time period	'n' [author's note: possibly 'one') year of total duration, currently underway. Difficult species to capture for various reasons. The traps are checked daily and positioned for a period of 15 days per zone. Autumn will be the best time for trapping.
Location and scale of application	No population data available. A distribution is estimated for almost the entire island (>200 km^2)
Effort	Each trapping station 15 days, assembly of 5-10 traps with a minimum separation of 50 meters and a maximum of 150. From Monday to Friday. 2 people. Daily check.

Costs	Overall costs: €250,000 per year - Personnel: €160,000 - Equipment and Infrastructure: €74,000 - Other: €22,000 One biologist, two forement nd two operators. Two 4x4 vehicles, traps, veterinary expenses, infrastructure, environmental education, PPE, etc.
Effectiveness	Still in process, it is early to give a result
Replicability	In a pilot project
Humaneness/animal welfare	The maintenance of animals for a period of 20 days by animal welfare law increases costs and stress to the animals for being in cages. The slaughter in situ by means of compressed air shot is effective and instantaneous death, no symptoms of suffering are observed.
Public acceptance	Animal groups always oppose any method of sacrifice. The scientific community approves.
Side effects	The expense is multiplied between 500-1000% if slaughter is not carried out on site. Stress increases if slaughter is not performed on site. We are studying parasites and diseases in feces.
Stakeholder engagement – implementation:	Public administration
Dissemination	Animation video and radio spots
Innovation	Start-up of footprints for detection and monitoring. Test of different types of non-live bait.
Lessons learned	Ferrets are very suspicious when it comes to entering traps, which are always activated first by rats.

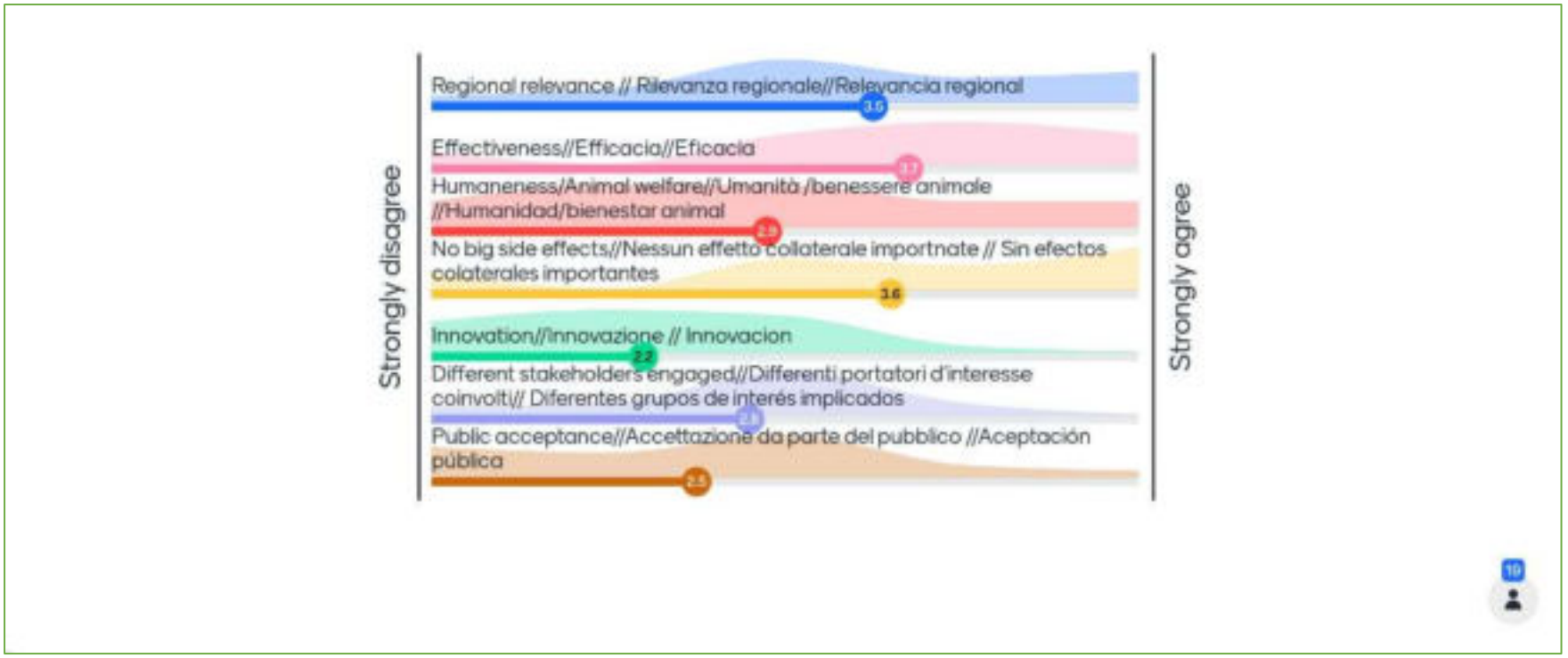
2.6.9. Case study 8. Spain (and additional islands): *Acridotheres* spp., *Pycnonotus* spp., *Psittacula krameri* and *Myiopsitta monachus*

Group: Birds	
Country: Spain (and additional islands)	
Entity: Invasive Bird Management (INBIMA) – Consultancy	
Category	**Response**
Species targeted	*Acridotheres cristatellus* (Crested myna), *Acridotheres javanicus* (Javan myna), *Acridotheres fuscus* (Jungle myna); *Pycnonotus cafer cafer* (Red-vented bulbul), *Pycnonotus cafer bengalensis; Psittacula krameri* (Rose-ringed parakeet), *Myiopsitta monachus* (Monk parakeet)
Objective(s)	The goal was to test different trap models and Starlicide© for Common myna management on UKOT
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Other measures: Live decoy traps
Measures used to remove (dispatch/sterilise/captivity) species	• Other measures: Poisons and toxins in bait • Other measures: Cranial depression
Description of the measure	Trapping: Handmade designed decoy traps based on Larsen, modified to get custom made to any of the selected targeted species (ranging from birds to mammals), adjusted to local people's requirements (staff and/or volunteers) dealing with the traps, and tailored to the terrain and environment conditions. Dropping doors: - Square trap, 70 cm sized, with a central decoy compartment and 4 catching compartments each capable of catching one (or more) myna, dependent upon individuals tripping a door release for catching. Weight: 6 Kg. Funnel traps: - A rectangular trap with a 50 x 40 x 40 cm high catching area with 2 entrance funnels, each fitted with bob wires to prevent escape through the funnels. This trap also had a holding compartment 40 x 40 x 70 cm high, which the birds accessed by another horizontal funnel. This trap can catch numerous mynas. Weight: around 4 or 5 Kg. Poisoning or toxicants Starlicide © was tested in both UKOT islands of Saint Helena and Ascension in 2009. The avicide selected for investigation was Starlicide (also called DRC-1339, 3-chloro-p-toluidine hydrochloride). This is an American product, developed initially to kill European Starlings and North American blackbirds (Icteridae) (APHIS 2001). Following a risk analysis on native species and ecosystems, the poison DCR-1339 was distributed on cooked rice in the rubbish dumps on each of the islands.

	Mynas were killed either by hitting their heads hard 3-4 times on the edge of a concrete wall, or by placing them individually in a holding bag (pillowcase) and hitting the entire body hard against a concrete floor.
Time period	St Helena (2009): June 2009. 28 trapping days. Ascension (2009): between 10th July and the 6th August (27 days). 53 working days.
Location and scale of application	French Polynesia (Tahiti), UKOT's (Ascension and St Helena), Cook Islands (Atiu), American Samoa (Tutuila). Spain: Spanish Outermost Regions: Canary Islands (Tenerife, Gran Canaria and Fuerteventura), Balearic Islands (Mallorca). The islands are constituent parts of the British Overseas Territory. - Saint Helena Island: is 122 km^2 (47 sq mi) in area, while the climate is tropical, marine and mild, tempered by the Benguela Current and trade winds. Much of the island has been identified by BirdLife International as being important for bird conservation, especially the endemic Saint Helena plover or wirebird, and for seabirds breeding on the offshore islets and stacks, in the north-east and the south-west Important Bird Areas. Estimated myna census at that time: 10.000 birds. - Ascension Island: (07º 57´ S, 14º 24´ W, 97 km^2) has an area of approximately 88 km^2, and presents a hot desert climate. The territory is an Important Bird Area (reference number SH001). The island falls in the Red List habitat category of "shrubland subtropical/tropical dry" (Hughes, Martin and Reynolds, 2009). Estimated myna population at that time: 1.000 to 1.200 birds.
Costs	As freelancer, budgets are normally managed by Leader partners or by funding institutions, and I am only aware on my own payments and requirements
Source(s) of funding	Saint Helena 2009: Funded by Royal Society for the Protection of Birds. Ascension 2009: Volunteer work done in my spare time, while working as field officer on Mexican thorn (*Prosopis juliflora*) control.
Effectiveness	Effective
Key evidence/results	Saint Helena: Total birds trapped: 262 Estimative poisoned birds: 80 or more Total type of traps: 5 Total traps available: 3 Total persons: 2 A total of 342 were managed in 28 working days. Ascension: Total birds trapped: 623 Birds trapped by hand: 3 Birds caught with traps: 620 Total days for the 3 phases: 53 Total type of traps: 3 Total traps available: 4 Total persons: 1 A total of 623 mynas were trapped and euthanatized in 53 days.
Replicability	Replicable, already proved. North Atlantic (Tenerife, Gran Canaria and Fuerteventura - Canary Islands) and South Atlantic Ocean islands (St. Helena and Ascension - UKOT). Pacific Ocean nations (Tahití -French Polynesia, Atiu - Cook Islands, Tutuila - American Samoa) and in Mediterranean islands as Mallorca, from the Balearic archipelago. Transferability between species ranging from birds to mammals (not listed here) and from islands to continental areas.

Humaneness/animal welfare	Saint Helena: Mynas were killed either by hitting their heads hard 3-4 times on the edge of a concrete wall, or by placing them individually in a holding bag (pillowcase) and hitting the entire body hard against a concrete floor. These techniques were regarded as the most rapid and humane methods of euthanasia of trapped mynas, and were approved by the Royal Society for Protection of Birds (RSPB) and the South Atlantic Invasive Species (SAIS) for the St Helena pilot project (2009). Ascension: All the trapped mynas during the control campaign were killed by placing them individually in a holding bag and hitting the entire body hard against a concrete floor. This technique was regarded as one of the most rapid and humane methods of euthanasia, amongst others, of trapped mynas, and was approved by the Ascension Royal Society for Preventing Cruelty to Animals (RSPCA) team after a meeting held in the Conservation Office. It was already used and approved by the Royal Society for Protection of Birds (RSPB) and the South Atlantic Invasive Species (SAIS) for the St Helena Strategy.
Public acceptance	For Saint Helena Island, the pilot control project and activities were broadcasted in public presentations, open to anybody, and open to any questions that the public may have had. There is a divergent way of vital positioning regards to invaders euthanasia, when working with humans living in the North or in the South Hemispheres, and even further, these differences deepens if the human do live in rural or urban areas. Concerning animal welfare, both with staff or volunteers trainings, or even in public presentations, cruelty is the first thing to prevent, as people's ignorance on animal welfare issues is found widely and at a planetary scale. Regarding animal right activists, their point of view just gets focused in "their" preferred species, either being cats, rabbits, iguanas, parakeets or goats; and it does become their main weakness. When confronted to the absence of "native species" rights vs. exotic species (either being prone to become invasive or not) they lost their arguments. Is here, where motivation volunteers to participate in IAS control programs becomes so vital; for any new volunteer willing to help to reduce invaders, one animal right activist person could become neutralised.
Side effects	Positive outcomes found: threat reduction to agriculture and crops, minimising any secondary threat posed by the species to become a vector of change in the ecosystem by either spreading invasive seeds, becoming a nuisance to humans in both, rural (crop loss) and urban areas (roosting sites aggregations), or preventing or slowing further spreads. IAS management activities with adequate strategies, methods combination and targeting several IAS species on each project, have become an international new trend, powerfully combined with local communities' commitment.
Stakeholder engagement – implementation:	Saint Helena: Local Government for authorizations to apply chemical and mechanical methods. Police, to help to protect the traps against any possible vandalism, Agriculture Department to point out faced farmer's threats and risks under targeted IAS, local media (radio and newspaper) to inform the local people on activities and the Saint Helena National Trust as local host. Synergy is promoted between stakeholders and any other groups involved in the projects, pursuing equality and sorority as well.

Dissemination	Communication is vital in any IAS management program. The basis should be to gain trust and confidence of the local communities where the project is going to be implemented, by sharing information, results, problem solving, and caring of giving feedback to people's requirements. Staff training, public presentations, volunteer workshops and sharing clear information are very important issues for IAS managers to care about.
Innovation	Traps were handmade and used before 2009 by this manager, starting in year 1999 in Tenerife, Canary Islands. In Saint Helena and Ascension, trap design innovations were done to adapt the trap to the environment and weather conditions, and to make them bigger and wider in order to trap much more birds.
Lessons learned	Myna roost sites can be managed by both, applying individual methods, or combining them, and make the roost site disappear due strategic efficient procedures. - If a long term control is needed, a combination of different methods like trapping, poisoning and shooting is recommended. - Coordination protocol must be in place when using all this management tools to avoid disturbances between methods.
References	https://www.linkedin.com/in/susana-saavedra-5a690734/ www.inbimaworldwide.com



Case study 8 score. Spain: *Acridotheres* spp., *Pycnonotus* spp., *Psittacula krameri* and *Myiopsitta monachus*

2.7. Continental (Central) & Pannonian: Croatia, Czechia, Hungary, Poland

2.7.1. Summary of case studies submitted for the Continental (Central) & Pannonian region

	Country	Entity submitting	Species	Measures used to restrain, capture and/or remove (kill/sterilise) the species	Measures used to remove (dispatch/sterilise/captivity) species	Average score at workshop
1	Croatia	Sveučilište u Zagrebu Agronomski Fakultet	*Lepomis gibbosus, Pseudorasbora parva*	Other: electrofishing Additional measure: prohibition of (anglers, fishermen) re-releasing into the environment once caught	N/A	N/A[1]
2	Poland	Park Narodowy "Ujście Warty"	*Procyon lotor, Neovison vison**	Shooting Trapping: cage traps	Modified atmospheres Shooting - dispatch restrained animals	3.6
3	Poland	Drawa National Park	*Nyctereutes procyonoides, Procyon lotor, Neovison vison**	Shooting Trapping: cage traps	Injection euthanasia Shooting - dispatch restrained animals	3.6
4	Poland	Poleski National Park	*Nyctereutes procyonoides, Procyon lotor, Neovison vison**	Shooting	N/A	N/A[1]
5	Poland	Bieszczadzki National Park	*Nyctereutes procyonoides*	Biological control: native predators	N/A	N/A[1]
6	Poland	Roztoczański Park Narodowy	*Nyctereutes procyonoides*	Shooting	N/A	3.6
7	Poland	Narew National Park	*Neovison vison**	Hand removal: physical fishing methods Trapping: cage traps	Modified atmospheres	N/A[1]
8	Hungary	Danube-Drava National Park Directorate	*Lepomis gibbosus*, *Ameiurus nebulosus**	Hand removal: physical fishing methods	Freezing	3.7
9	Hungary	Danumbe-Ipoly National Park Directorate	*Lepomis gibbosus*	Other: electrofishing	Freezing	3.8
10	Hungary	MME BirdLife Hungary	*Trachemys scripta*	Hand removal Trapping: live decoy traps	Keeping in captivity	4.2

	Country	Entity submitting	Species	Measures used to restrain, capture and/or remove (kill/sterilise) the species	Measures used to remove (dispatch/sterilise/captivity) species	Average score at workshop
11	Hungary	Ministry of Agriculture	*Alopochen aegyptiaca*	Shooting	N/A	3.5
12	Hungary	Balázs Pók (Hunter)	*Myocastor coypus*	Shooting Trapping: cage traps	Cervical dislocation Cranial depression Shooting - dispatch restrained animals	3.4
13	Hungary	Fertő-Hanság National Park Directorate	*Myocastor coypus*	Shooting	N/A	3.5
14	Hungary	Komárom-Esztergom Megyei Kormányhivatal	*Myocastor coypus*	Shooting Trapping: cage traps	Shooting - dispatch restrained animals	N/A[2]
15	Hungary	Bács-Kiskun County Government Office	*Procyon lotor*	Shooting	N/A	3.5
16	Hungary	Bükk National Park Directorate	*Nyctereutes procyonoides*	Trapping: spring operated traps	N/A	3.4
17	Hungary	Kiskunság National Park Directorate	*Platalea leucorodia**	(Measures not covered) Cannon-net: This is a process that uses small cannons that shoot projectiles, attached to a net	N/A	N/A[1]

* Vertebrate IAS not on the Union list

[1] Case study presented at the workshop but not scored, as it refers to a general measure or to a species not on the Union list

[2] Case study not presented at the workshop and therefore not scored

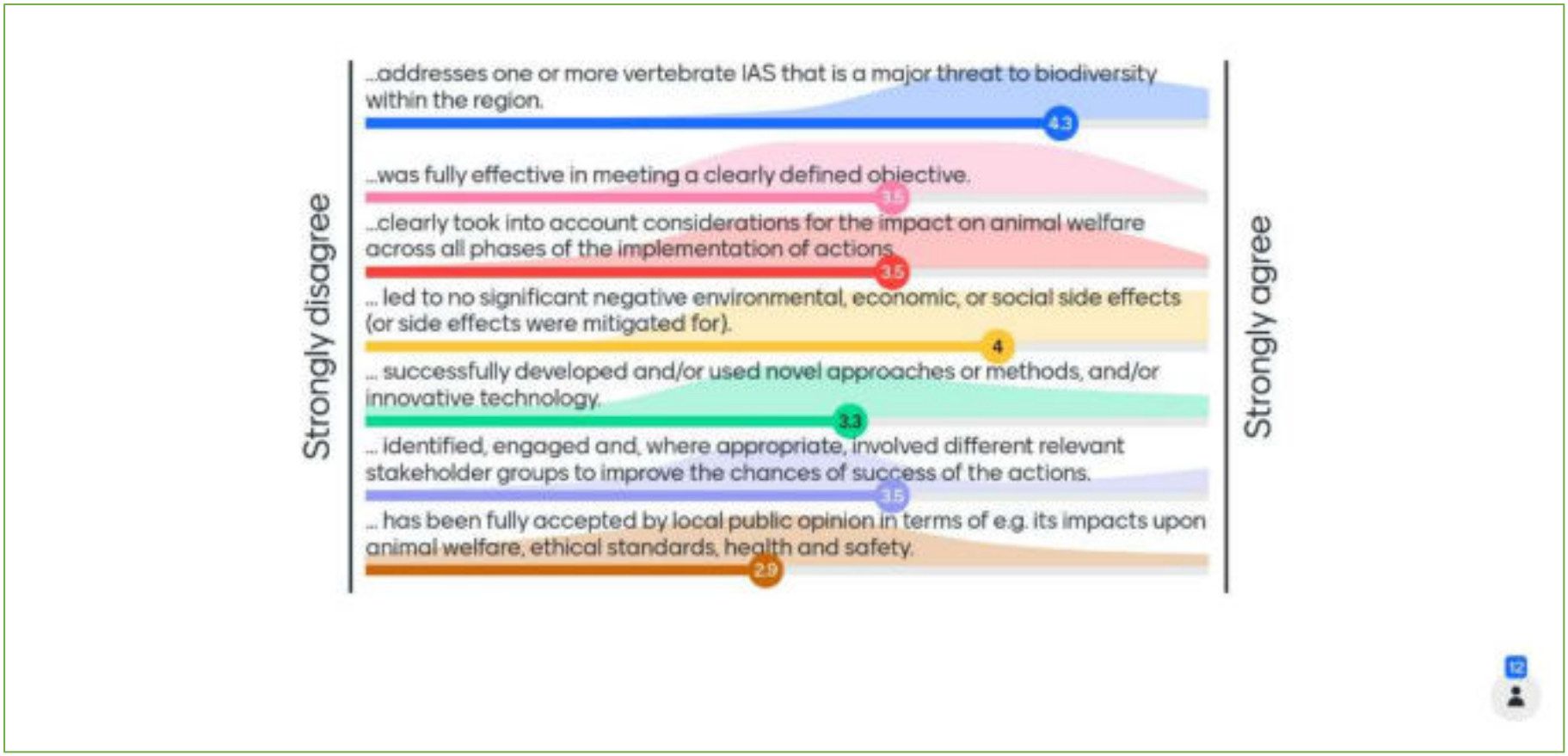
2.7.2. Case study 1. Croatia: *Lepomis gibbosus* and *Pseudorasbora parva*

Group: Fish	
Country: Croatia	
Entity: Sveučilište u Zagrebu Agronomski fakultet	
Category	**Response**
Species targeted	*Lepomis gibbosus* (Pumpkinseed), *Pseudorasbora parva* (Stone moroko)
Objective(s)	Control: Population monitoring
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Other: Electrofishing • Additional measure: Prohibition of (anglers, fishermen) re-releasing into the environment once caught because of the classification as alien and invasive fish
Description of the measure	It is prohibited by law to re-release alien invasive species once caught into the environment. At the same time, there is no indication of methods for killing or removing caught fish.
Stakeholder engagement – implementation:	Measure implemented by anglers and fishermen, without top-down central coordination
References	Piria, M., Ćaleta, M., Špelić, I., Zanella, D., Marčić, Z., Buj, I., Mustafić, P., & Karlović, R. 2021. Program Praćenja za Invazivne Strane Vrste Slatkovodnih Riba-Bezribica i Sunčanica. Hrvatsko Ihtiološko društvo; naručitelj: Ministarstvo gospodarstva i održivog razvoja, 36 pp.

2.7.3. Case study 2. Poland: *Procyon lotor* and *Neovison vison*

Group: Mammals	
Country: Poland	
Entity: Warta Mouth National Park	
Category	**Response**
Species targeted	*Procyon lotor* (Raccoon), *Neovison vison* (American mink)
Objective(s)	Containment: Limiting the number of raccoons in the Warta Mouth National Park by catching individuals in live-traps and putting the animals to sleep with CO_2. The aim is to reduce the population size and improve the breeding conditions for wetland birds nesting in the Park, related to the predation of individuals in nest boxes by raccoons. Eradication (of widespread population): Fighting the American mink by trapping animals with traps placed along the park's watercourses and putting them to sleep with CO_2, in order to reduce the pressure on native species of birds, which results in reducing the negative impact of this species on rare species of birds nesting in the Warta Mouth National Park.
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Trapping: Cage-traps
Measures used to remove (dispatch/sterilise/captivity) species	• Modified atmospheres • Shooting - dispatch restrained animals
Description of the measure	For catching specimens of invasive alien species, live traps, open on one side, are used. The bait used for catching is smoked fish.
Time period	Harvesting of animals usually takes place in the months before the birds' breeding season. It is usually 3-4 months a year - months: November-December, March-April.
Location and scale of application	Catches are carried out in the Warta Mouth National Park with an area of 80.74 km^2
Effort	Approx. 90 person-days/year, approx. 1,000 trap-nights/year
Costs	Overall costs: 60,000 € - Personnel costs: 15,000 € - Equipment and infrastructure: 45,000 €

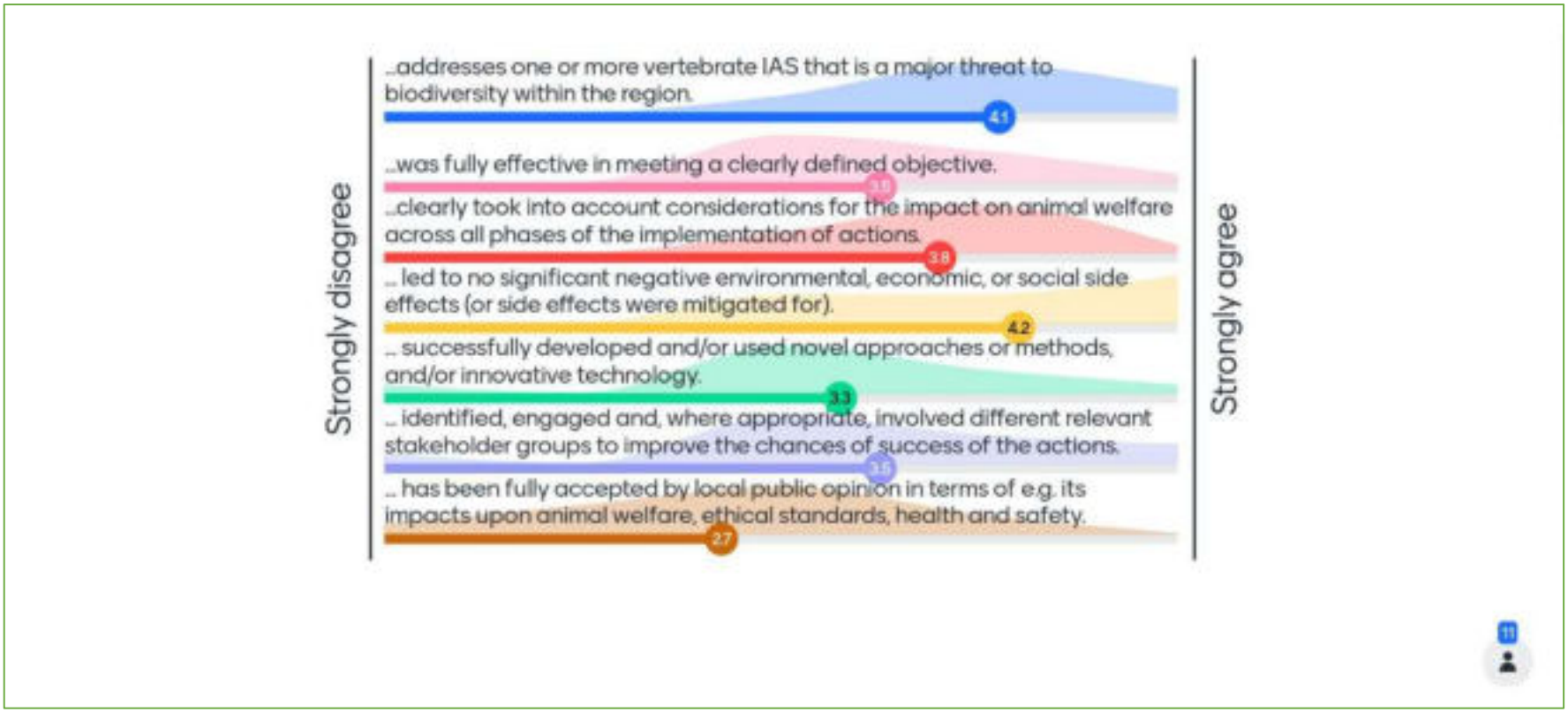
Additional details on costs	Bait, traps, boat and car fuel costs. Personnel costs come from the funds covering the remuneration of people working in the project.
Source(s) of funding	LIFE/own resources
Effectiveness	Moderately effective: Reduced number of captured American mink in the following years, reappearance of muskrat in the Park areas - the species was caught in traps.
Replicability	Reproduction to other areas possible. The experiences gathered during the project are the basis of good practices in combating invasive species.
Humaneness/animal welfare	In order to reduce the stress of animals, the method of stupefying animals was changed by degrading with carbon dioxide. This limited the amount of time the animals spent in the cage from capture to the time of a lethal injection by the veterinarian.
Stakeholder engagement – implementation:	Employees of national parks, the Regional Directorate for Environmental Protection, the General Directorate for Environmental Protection, landscape parks, State Forests.
Dissemination	Conference summarizing the project
References	Personal communication



Case study 2 score. Poland: *Procyon lotor* and *Neovison vison*

2.7.4. Case study 3. Poland: *Nyctereutes procyonoides, Procyon lotor* and *Neovison vison*

Group: Mammals	
Country: Poland	
Entity: Drawa National Park	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog), *Procyon lotor* (Raccoon), *Neovison vison* (American mink)
Objective(s)	Containment: reduction shot and euthanasia by administering a sedative
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Trapping: Cage-traps
Measures used to remove (dispatch/sterilise/captivity) species	• Injection euthanasia • Shooting - dispatch restrained animals
Description of the measure	*Nyctereutes procyonoides* - reduction shooting; *Procyon lotor* - reduction shooting and catching in live traps, followed by euthanasia; *Neovison vison* - reduction shooting and catching in live traps, followed by euthanasia.
Time period	Reduction shooting - all year round, catching in live traps - twice a year, i.e. spring and autumn period
Location and scale of application	Drawa National Park
Effectiveness	Moderately effective
References	Personal communication



Case study 3 score. Poland: *Nyctereutes procyonoides, Procyon lotor* and *Neovison vison*

2.7.5. Case study 4. Poland: *Nyctereutes procyonoides, Procyon lotor* and *Neovison vison*

Group: Mammals	
Country: Poland	
Entity: Poleski National Park	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog), *Procyon lotor* (Raccoon), *Neovison vison* (American mink)
Objective(s)	Control: Population size monitoring Containment: Reduction shooting-hunting
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Shooting
Effectiveness	Moderately effective
References	Personal communication

2.7.6. Case study 5. Poland: *Nyctereutes procyonoides*

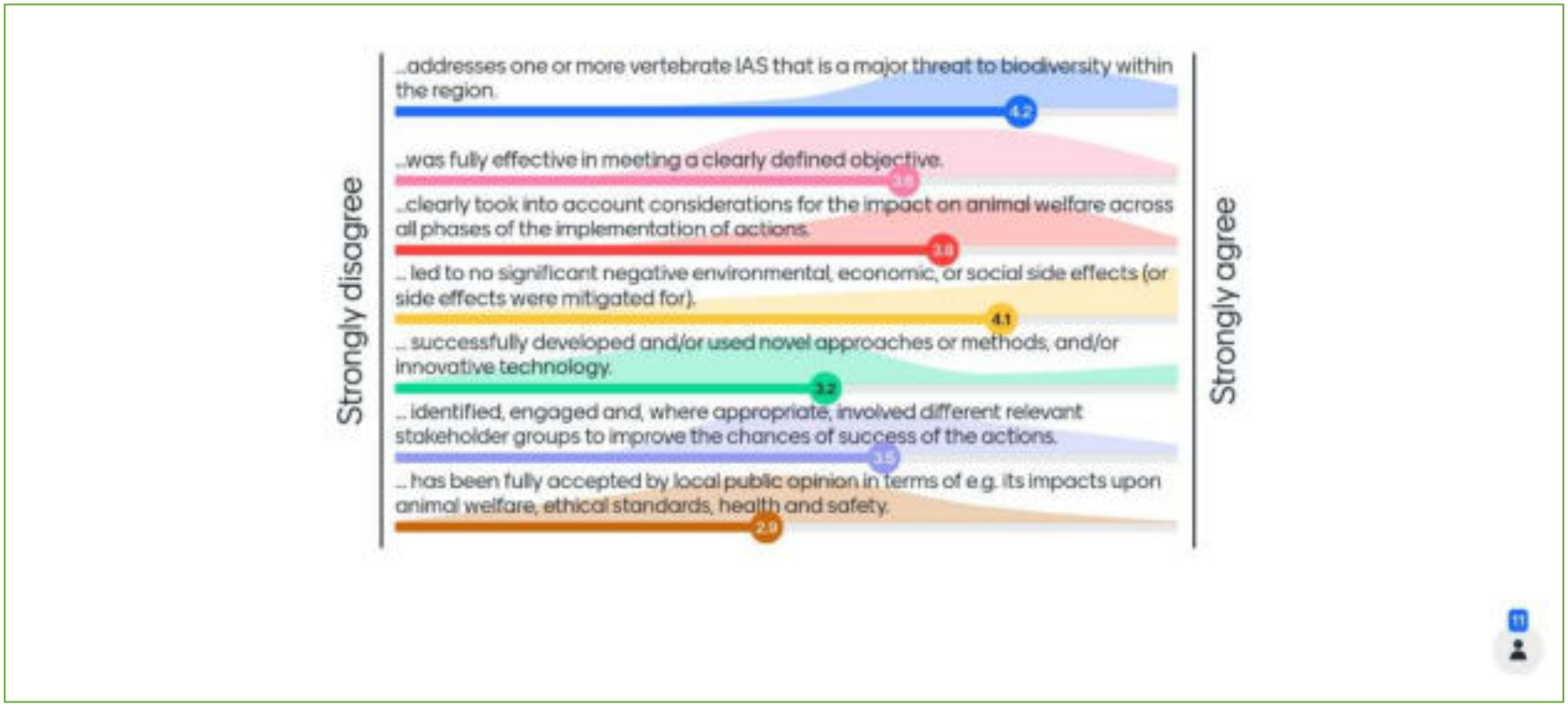
Group: Mammals	
Country: Poland	
Entity: Bieszczady National Park	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog)
Objective(s)	Control: monitoring of the presence of the species

Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Biological control: Native predators
Description of the measure	Very few records of the species in the area of the National Park. A species eliminated naturally, probably by wolves.
Time period	2009-2021
Location and scale of application	Bieszczady National Park, 49ON 22OE, 300 km^2
Effectiveness	Effective: Incidental findings of the species presence
Replicability	Natural spread of wolf populations and an increase in the number of wolves in the country
Humaneness/animal welfare	Non-invasive method
Stakeholder engagement – implementation:	Bieszczady National Park, routine fauna monitoring
Lessons learned	The sporadic species seems to be effectively pushed out of the monitoring area based on natural processes (predation, territorialism, food competition).
References	Personal communication

2.7.7. Case study 6. Poland: *Nyctereutes procyonoides*

Group: Mammals	
Country: Poland	
Entity: Roztocze National Park	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog)
Objective(s)	Eradication (of widespread population)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Shooting
Description of the measure	All individuals found during animal reduction are shot
Time period	The shooting was initiated as soon as the first individuals of the species were identified in the Roztocze National Park.
Location and scale of application	Roztocze National Park - 85 km^2
Effort	The species has been eliminated since 2000, but due to its secrecy and wide distribution throughout the country, complete elimination is unlikely.
Costs	7 EUR/ animal
Additional details on costs	Costs - in the form of an equivalent per shot individual
Source(s) of funding	Own funding
Effectiveness	Effective: 10 individuals
Stakeholder engagement – implementation:	Hunters
Dissemination	Creating protective/conservation tasks under "Building a Protection Plan for the Roztocze National Park" document.

References	Personal communication



Case study 6 score. Poland: *Nyctereutes procyonoides*

2.7.8. Case study 7. Poland: *Neovison vison*

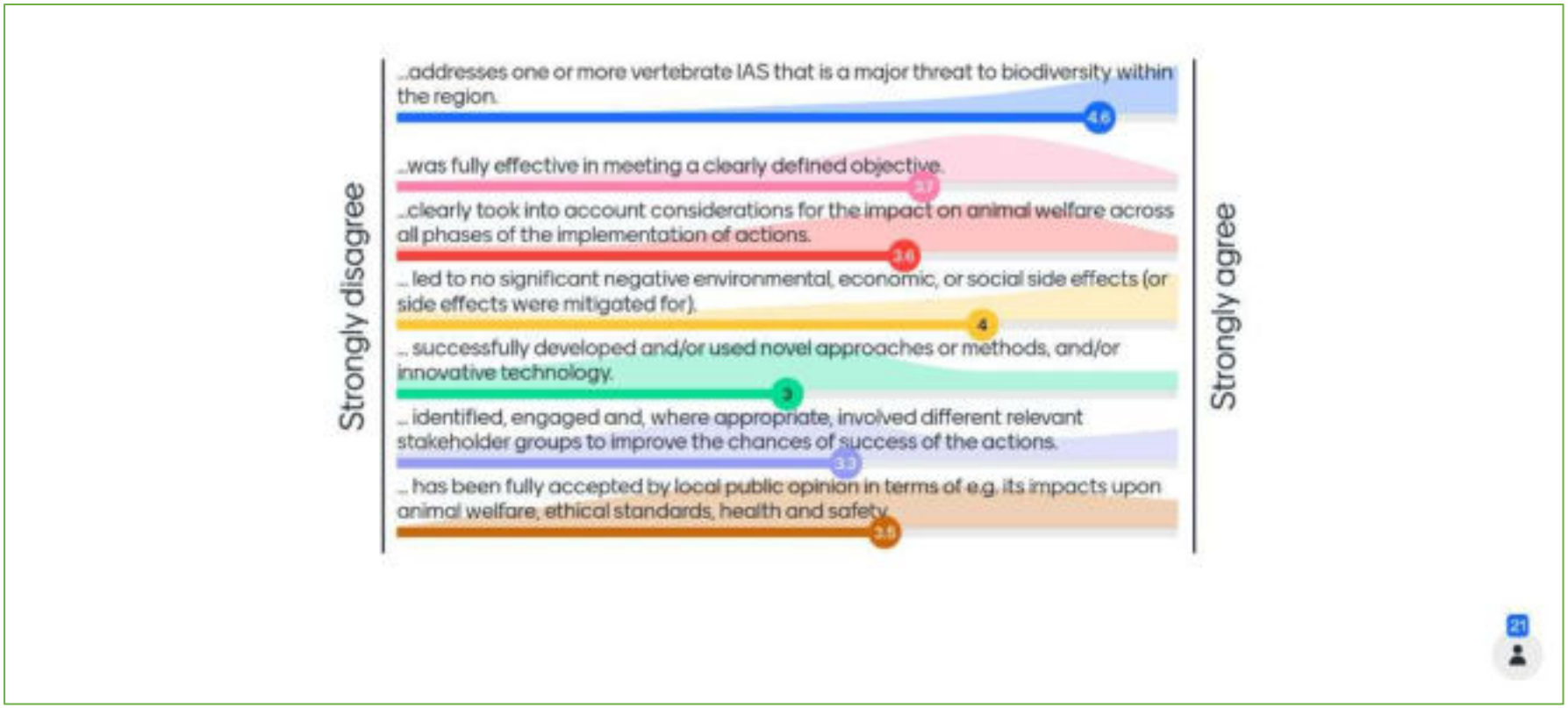
Group: Mammals	
Country: Poland	
Entity: Narew National Park	
Category	**Response**
Species targeted	*Neovison vison* (American mink)
Objective(s)	Eradication (of widespread population) Containment
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Physical fishing methods - including aquatic nets • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	Modified atmospheres
Description of the measure	Catch with live cage traps. Putting asleep with carbon dioxide (CO_2) in the gas chamber
Time period	The harvesting started in 2010 and has been continued until today
Location and scale of application	Area of the Narew National Park – 6,810 ha, North-Eastern Poland
Effort	Approx. 120 person-days / approx. 140 traps twice a year
Costs	Overall costs: 1,160,140 PLN (249,053 €) - Personnel costs: 153,600 PLN (32,974 €) - Equipment and infrastructure: 1,006,540 PLN (216 079 €)
Additional details on costs	The above-mentioned costs apply to the years 2016-2021
Source(s) of funding	2011 -2014 – EU LIFE+, 2016-2021 - Centre for Coordination of Environmental Projects
Effectiveness	Effective: An almost tenfold decrease in the number of American mink in the Park
Humaneness/animal welfare	The monitoring carried out indicates an increase in the number of non-IAS species and numbers of wetland birds as well as an increase in their breeding success.

Public acceptance	Promotional and information campaigns (training, information materials, study visits) are used. No negative public opinion.
Dissemination	Cooperation (implementation of a joint project in 2011-2015 with LIFE +) with 5 national parks in the country
Lessons learned	It is necessary to continue the elimination of the species from the area of the Park, the species has a great ability to rebuild the population in a short time.
References	Zalewski, A., & Brzeziński, M. 2014. Norka amerykańska. Biologia gatunku inwazyjnego. Instytut Biologii Ssaków PAN. Białowieża

2.7.9. Case study 8. Hungary: *Lepomis gibbosus* and *Ameiurus nebulosus*

Group: Fish	
Country: Hungary	
Entity: Danube-Drava National Park Directorate	
Category	**Response**
Species targeted	*Lepomis gibbosus* (Pumpkinseed), *Ameiurus nebulosus* (Brown bullhead)
Objective(s)	Control: Largest possible reduction of brown bullhead's population by fishing methods
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Hand removal: Physical fishing methods
Measures used to remove (dispatch/sterilise/captivity) species	Freezing
Description of the measure	Special fishing traps made for trapping pumpkinseed and brown bullhead were used. They were placed on the bottom of the waterbody throughout the year. In autumn and winter they were placed at the breeding sites (concentrated occurrence). It is a non-selective trap; other species are released after the trap is picked up. Trapped individuals are frozen.

Time period	During the year until the water freezes
Location and scale of application	Oxbow lakes of the Danube floodplain. Area: 35 ha.
Effort	2018: 4 occasions (about 3-6 hours/occasion) 2019: 101 occasions (about 3-6 hours/occasion) 2020: 33 occasions (about 3-6 hours/occasion)
Costs	Overall costs: 110,000 HUF (302 €) - Equipment and infrastructure: 100,000 HUF (275 €) - Other, including capacity building and overheads: 10,000 HUF (27 €)
Additional details on costs	Costs include special fishing traps, petrol and freezing cost
Source(s) of funding	Budget of Danube-Drava National Park Directorate
Effectiveness	Moderately effective
Key evidence/results	2018. **pumpkinseed**: 0 kg **brown bullhead**: 100 kg (we trapped them only in December) 2019. **pumpkinseed**: 45,5 kg **brown bullhead**: 4585 kg (April-December) 2020. **pumpkinseed**: 1 kg **brown bullhead**: 1068 kg (September-December)
Replicability	The method is repeatable and it continuously done until the number of individuals decreases to the desired number or it disappears. It also could be used on other oxbow lakes in the surrounding areas. Other invasive alien species for which the method is applicable to spiny-cheek crayfish, (*Orconectes limosus*) and Prussian carp (*Carassius auratus gibelio*).
Humaneness/animal welfare	During the catching process, animals were stored in water and then immediately frozen
Public acceptance	The activity was carried out as part of nature conservation management. This work meets the needs of the local fishing community.
Side effects	Both species consume eggs and offspring, so their population reduction has contributed to improve the reproduction of native species. Decreased food competition and habitat improvement are also significant. No birds or mammals were caught in the fishing traps.
Lessons learned	The problem cannot be solved in one year. By increasing the number of fishing traps/experts, the reduction in the number of individuals can be increased.
References	Personal communication

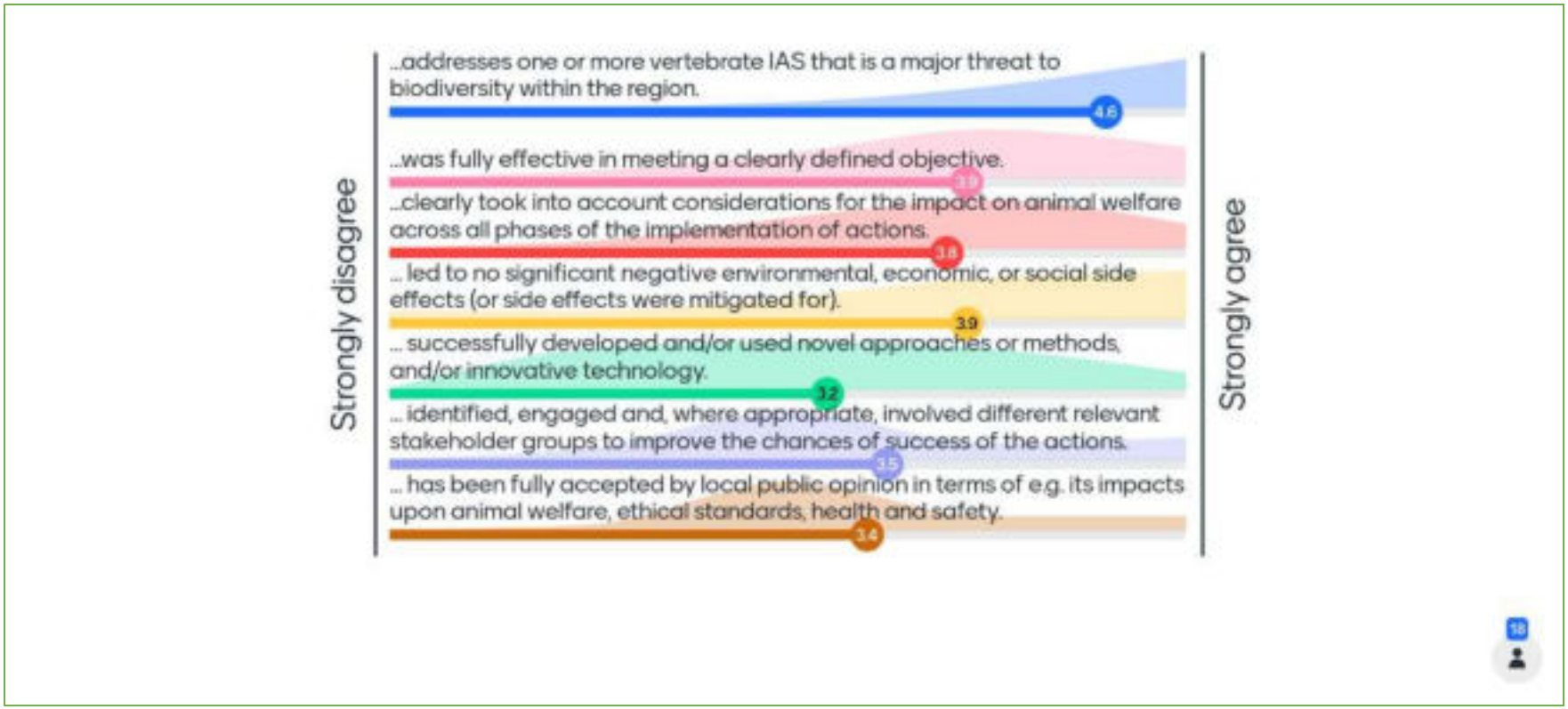


Case study 8 score. Hungary: *Lepomis gibbosus* and *Ameiurus nebulosus*

2.7.10. Case study 9. Hungary: *Lepomis gibbosus*

Group: Fish	
Country: Hungary	
Entity: Danube-Ipoly National Park Directorate	
Category	**Response**
Species targeted	*Lepomis gibbosus* (Pumpkinseed)
Objective(s)	Rapid eradication (early stage intervention): Within a year dredged lake of less than 1 hectare with electrofishing Eradication (of widespread population): Pre-spawning electrofishing in a 30-hectare fishing pond
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Other: Electrofishing
Measures used to remove (dispatch/sterilise/captivity) species	Freezing
Description of the measure	Pumpkinseeds were caught by electrofishing and after that were given to a fish farming organization. We only have experience of one year with two lakes: On the 1 hectare lake we caught the pumpkinseeds only one time, we do not know the results yet as there hasn't been a re-checking opportunity. On the 30 hectares lake, before the management (electrofishing) we defined the most abundant areas of the pumpkinseeds. We caught the fish two times. We experienced decreased pumpkinseed's population, and beside this, two raptor fish species, the zander (*Sander lucioperca*i) and the European perch (*Perca fluviatilis*) population are increasing. Those individuals which were removed by electrofishing before the reproducing period did not spawn, thus pumpkinseed numbers were significantly reduced. Eggs and offspring of spawned pumpkinseeds were predated by zander and European perch.
Time period	Pumpkinseed should be caught twice during their spawning seasons (May and August), because during these periods pumpkinseeds gathered near the shore, thus they can be caught in larger numbers, and we disturbed their spawning.
Location and scale of application	30 hectares fishing lake. Based on preliminary surveys, the relative abundance of pumpkinseed was 10.23%

Effort	Two full days
Costs	Overall costs: 500 € - Personnel costs: 400 € - Other, including capacity building and overheads: 100 €
Additional details on costs	The estimated costs are without the equipment such as boat, boat engine and electrofishing device. Acquisition of these equipment is minimum 5,000 EUR.
Effectiveness	Unknown - The work was started on both lakes in 2020, so there are no long-term results yet
Replicability	The measures can be repeated however, it can be a problem if there are valuable native species in the given habitat and the disturbance can cause damage to them.
Humaneness/animal welfare	Electrofishing is acceptable with the right tools and the right settings
Side effects	The rarefaction of invasive fish species in fishing waters is favourable for the species targeted by the fishery
Stakeholder engagement – implementation:	Fish farming organization, university, national park
Dissemination	Scientific dissertation
Lessons learned	Regular electrofishing (twice a year) before the spawning seasons is justified to avoid mass reproduction
References	Personal communication



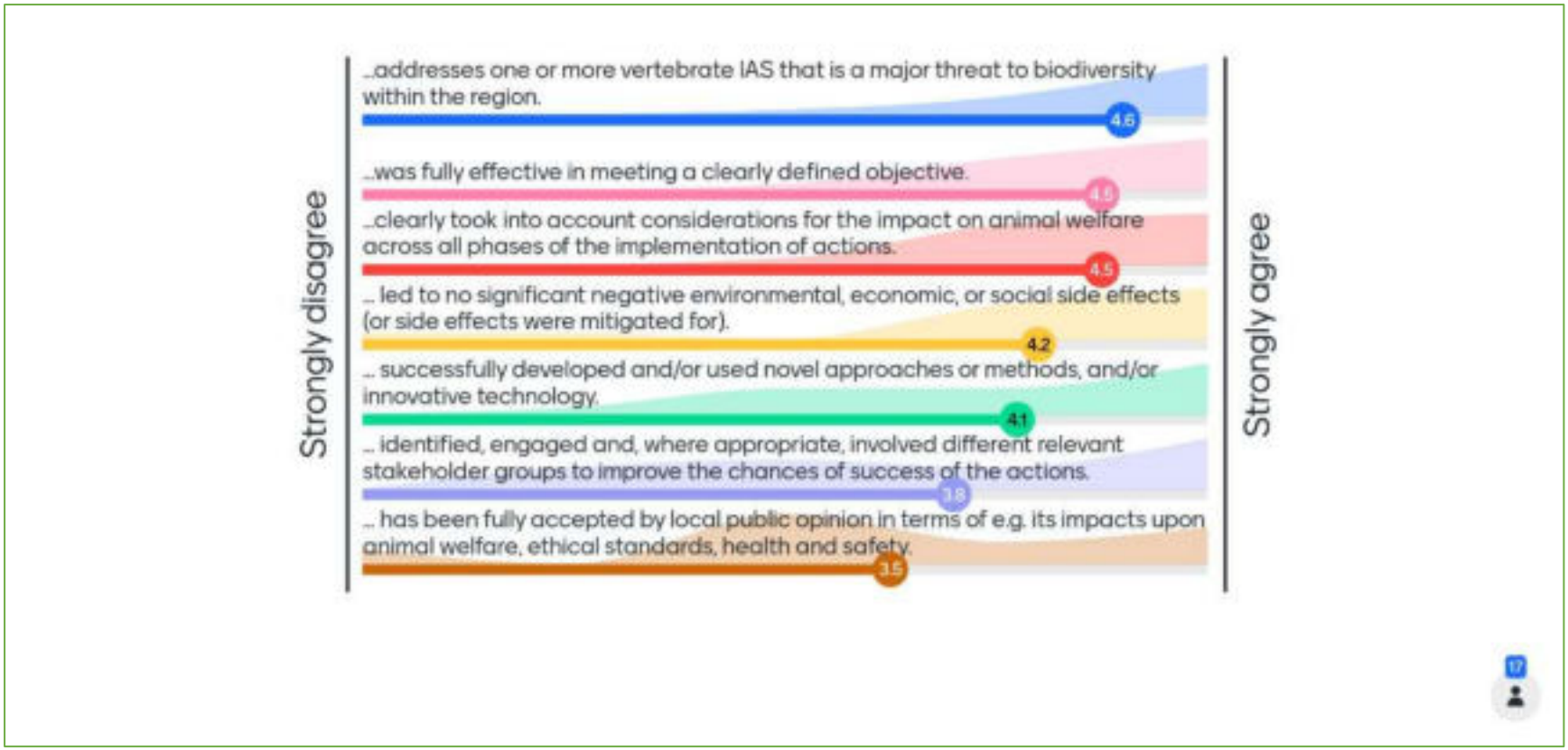
Case study 9 score. Hungary: *Lepomis gibbosus*

2.7.11. Case study 10. Hungary: *Trachemys scripta*

Group: Reptiles	
Country: Hungary	
Entity: MME BirdLife Hungary	
Category	**Response**
Species targeted	*Trachemys scripta* (Red-eared, yellow-bellied and Cumberland sliders)
Objective(s)	Eradication of widespread population: Eradication of non-native slider species of 2 lakes
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Hand removal • Trapping: Live decoy traps
Measures used to remove (dispatch/sterilise/captivity) species	• Keeping in captivity
Measure(s) no covered	Floating basking trap: The trap provides a basking place for turtles, which they can climb on and get trapped in the centre.
Description of the measure	Floating basking trap: Spanish colleagues (Trachemys-LIFE) shared this best practice suggestion, which is easy to prepare and maintain. The basking opportunity is usually favoured by larger, more adventurous non-native turtles, providing a sort of selective method. There was no need to worry about the fate of trapped animals; no chance of drowning. Traps were easy to install further from the shore, preventing human "intervention" by tourists. It was also easy to teach lake-owners about use of the traps, and traps were lent out several times when the lake-owners approached us. Varsa trap: commonly used traps against non-native fish such as brown bullhead (*Ameiurus nebulosus*). In order to avoid drowning of turtles, we applied PET-bottles to float the trap partially. Smaller turtles enter them, sometimes even without bait. It also catches fish, that might be problematic, so the usage has to be negotiated with local fishing right owners. One good point is that because of this, education of fishing rights owners is possible, in order to assist with avoidance of future drowning of turtles in such traps.
Time period	At Lake Naplás we used 3 floating basking traps over 3 year period (in active season - from March to October). At Lake Feneketlen we used 1 floating basking trap and 3 varsa traps in 2 years, over a 2 month period (in August and September).

Location and scale of application	Lake Naplás (0.16 km^2) and Lake Feneketlen (0.011 km^2) is located in Budapest, capital of Hungary. Cross both lakes we managed to remove 100-100 non-native turtle specimens, 90% of them were Red and Yellow eared sliders.
Effort	Traps were checked every 2 or 3 days (from March to October at Lake Naplás in August and September at Lake Feneketlen). Each check required approximately 1 hour effort, plus travel.
Costs	Overall costs: 2,300 € - Personnel costs: 1,500 € - Equipment and infrastructure: 300 € - Other, including capacity building and overheads: 500 €
Additional details on costs	Travel costs are estimates in overheads as turtles were transported regularly to Budapest Zoo. Personnel costs are estimates as no one was hired for the direct task, participants were already employed for conservation projects by MME and Rákosmenti Mezei Őrszolgálat.
Source(s) of funding	Lake manager of Lake Feneketlen (FŐKERT Rt) contracted MME for the removal. Local council ranger body (Rákosmenti Mezei Őrszolgálat) covered the production of traps from their own budget.
Effectiveness	Effective
Key evidence/results	In the follow-up years the annual capture of non-native turtles dropped significantly. Most of them seemingly arrived as new individuals because people still continue to release them. Some people learned our activities and directly took animals to Budapest Zoo or Rákosmenti Mezei Őrszolgálat; therefore their release was prevented by our activities.
Replicability	Observations were gathered through our citizen-science website (https://herpterkep.mme.hu/hullo.php?lang=hu&id=61) and it is planned to approach lake managers for all locations where we see established populations. Already these trapping methods are used in Szeged and Parks with similar success.
Humaneness/animal welfare	At the moment the number of captured turtles were not exceeding the capacity of zoos, therefore we were not forced to decide about the human killing of the trapped individuals. In case we would have to do so, the vets at Budapest Zoo can provide their expertise, including animal welfare issues.
Public acceptance	No public criticism reached us, as we can communicate the actions as transfer back to captivity (thanks to the involved zoos).
Side effects	Both traps capture native European pond turtles as well, but this way (by mark-recapture) we can develop a view on their actual population size. Varsa traps captured other species as well, including native and non-native fish and

	crayfish. This has to be taken into consideration, when starting this method and it is recommended to communicate this probability to fishing right owners.
Stakeholder engagement – implementation:	Many schools were visiting the Lake Naplás site were informed and checking of traps was part of their educational experience.
Dissemination	At both lakes we gave interviews to TV-channels, creating waves of online news. Information boards were placed at Lake Feneketlen, explaining the reasons for our activities.
References	Trachemys-LIFE manual: https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=TRACHEMYS_Manual_Control_Erradicion_GalapagosInvasores.pdf

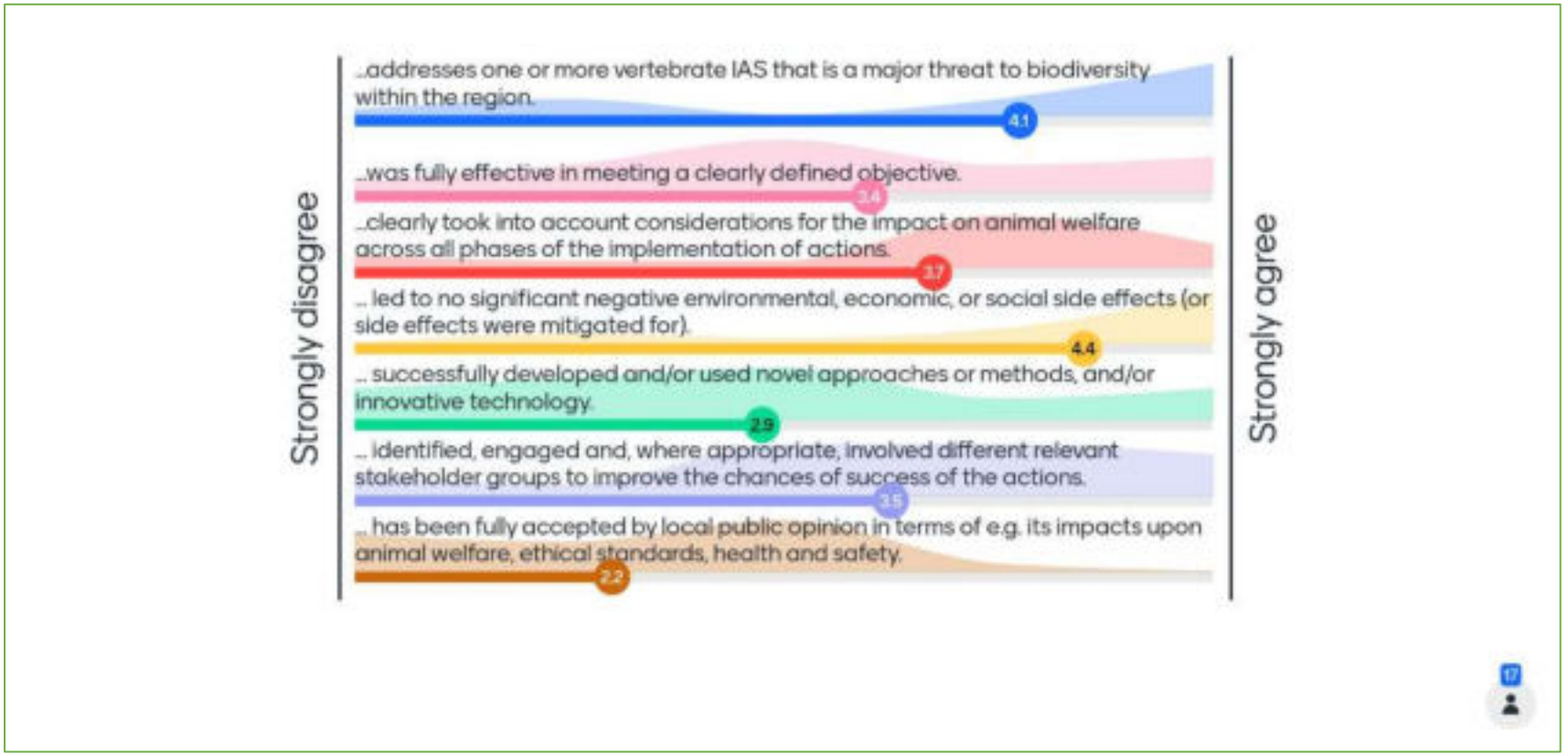


Case study 10 score. Hungary: *Trachemys scripta*

2.7.12. Case study 11. Hungary: *Alopochen aegyptiaca*

Group: Birds	
Country: Hungary	
Entity: Ministry of Agriculture, Department for Nature Conservation	
Category	**Response**
Species targeted	*Alopochen aegyptiaca* (Egyptian goose)
Objective(s)	Rapid eradication (early stage intervention): This was the first breeding pair in Hungary so it was necessary to eradicate them as soon as possible.
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Shooting
Description of the measure	The first breeding Egyptian goose pair was observed in 2016 in Vas county, on an artificial lake. This pair was breeding again in 2017, and they reared ten chicks. Because the chicks were developed enough that they could fly, the local nature conservation authorities and the local hunting authorities with the hunters decided that they should shoot the individuals from a boat. All in all, in July 2017 they shot one female and seven chicks, however the male and the two chicks flew away from the water body.
Location and scale of application	Western Hungary, Vas county, Zsennye village. Artificial lake: 30 hectares
Effectiveness	Moderately effective - One female and seven chicks were killed, however one male and two chicks escaped
Replicability	It is replicable, however it is very important to emphasize that shooting is applicable only on those water areas where there is not a lot of strictly protected bird species, especially ducks and herons. Usually these water areas are artificial lakes e.g. gravel pit lakes.
Humaneness/animal welfare	The killing (shooting) of individuals is rapid, painless, and it does not cause long-term suffering for the individuals
Public acceptance	The public were not informed of this action
Stakeholder engagement – implementation:	Hunters (only those who have hunting license) carry out the shooting
Lessons learned	It would have been important to shoot the chicks before they could fly

References	http://chernelmte.extra.hu/cinege2016_21_teljes.pdf (Hungarian article about the first breeding pair)

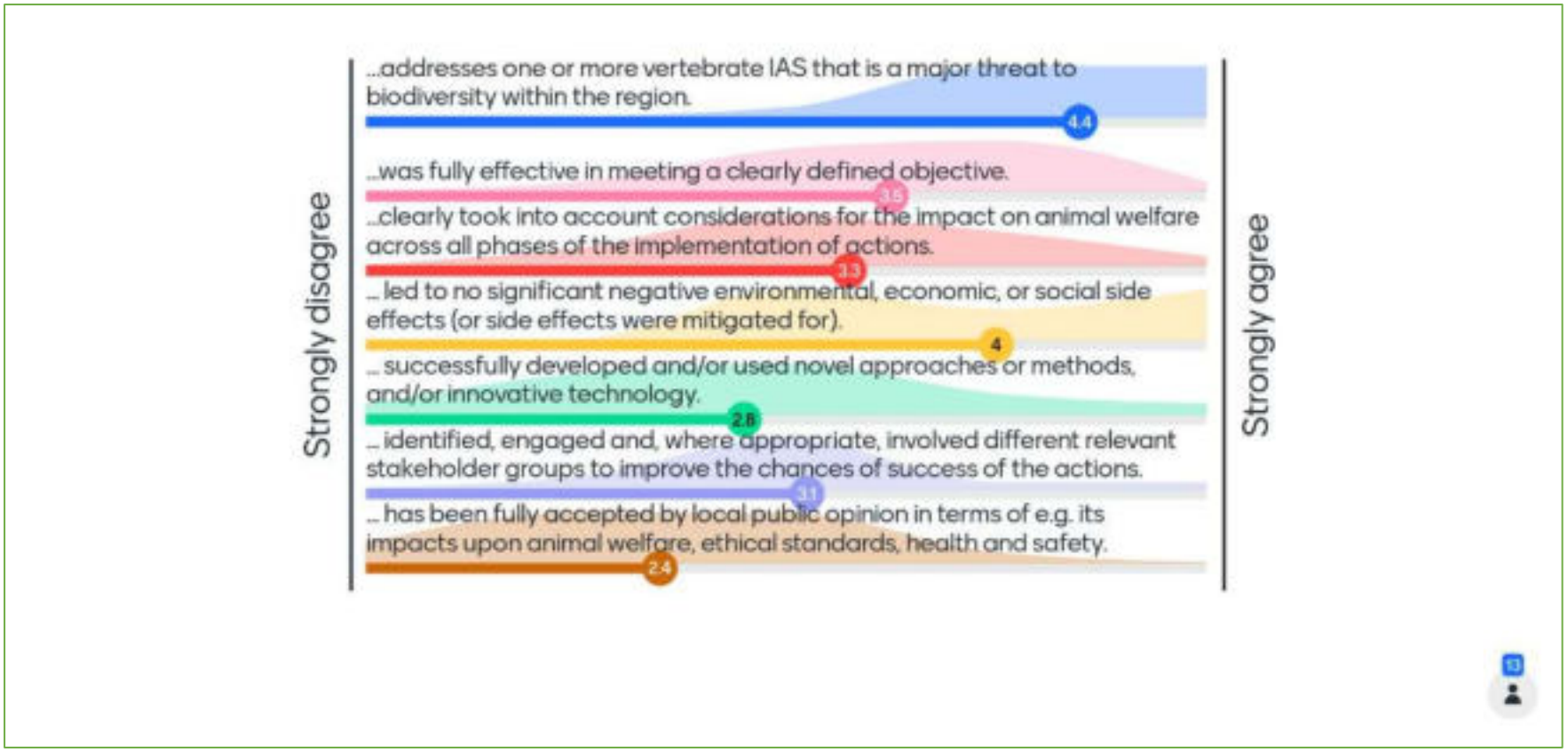


Case study 11 score. Hungary: *Alopochen aegyptiaca*

2.7.13. Case study 12. Hungary: *Myocastor coypus*

Group: Mammals	
Country: Hungary	
Entity: Balázs Pók (Hunter)	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu)
Objective(s)	Control: The aim of the measure is to control the population of coypu by hunting and trapping, the expected result is to prevent the overgrowth of the species.
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Cervical dislocation • Cranial depression • Shooting - dispatch restrained animals
Description of the measure	Two methods were used to reduce the species' population. One was hunting with a 0.22Lr caliber small rifle weapon and a 12/70 caliber lead-shot hunting weapon. The hunting method was ambush hunting or still-hunting at dusk and in the evening, along the waterfront. The other method was trapping, in which two cage traps measuring 1400x300x325mm with baits (mangel-wurzer and crushed corn) were used. Traps were placed along the waterfront, right at the water's edge.
Time period	From November to March is the most suitable period for trapping, as the vegetation on the waterfront is small and low and the animal can be easily detected. Also, during this period coypu do not find enough food, so it is easily attracted by the bait.
Location and scale of application	Ács settlement, between Concó and Széles river
Effectiveness	Unknown: During two months 49 individuals were killed; 31 by trapping and 18 by hunting
Replicability	The methods are easily repeatable and applicable for this species in all areas of its distribution
Humaneness/animal welfare	The individuals were killed in the fastest and most painless way as possible

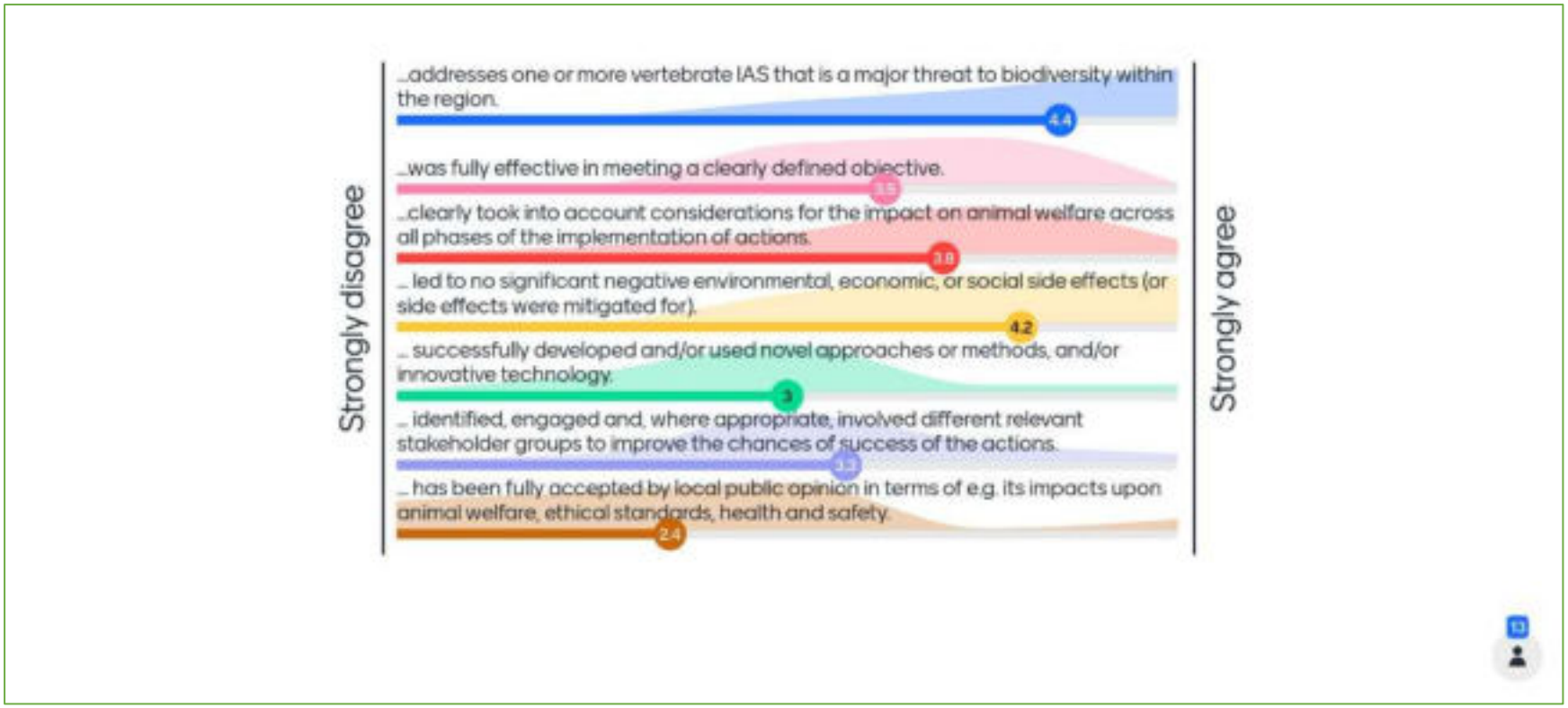
Public acceptance	This species is unknown in nature by the majority of the public
Side effects	Slowing down the destruction of waterfront softwood groves which is very valuable riparian habitat in Hungary
Stakeholder engagement – implementation:	Komárom-Esztergom County Government Office Nature Conservation Authority: Issuance of a permit for the killing/trapping of coypu; Komárom-Esztergom County Government Office Hunting Authority - Hunting obligation to hunting companies; Hunting Company along Concó – Field experiences and helping other way.
References	Pok A.B. (2020): A nutria (*Myocastor coypus* Molina, 1782) előfordulása és gazdasági jelentősége a Concó patak mentén. Szakdolgozat (SOE-EMK-Vadgazdálkodási és Gerinces Állattani Intézet)



Case study 12 score. Hungary: *Myocastor coypus*

2.7.14. Case study 13. Hungary: *Myocastor coypus*

Group: Mammals	
Country: Hungary	
Entity: Fertő-Hanság National Park Directorate	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu)
Objective(s)	Control: Based on field experience, the coypu population shows an increasing trend, therefore the purpose of the control (shooting) is to prevent further population growth.
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Shooting
Description of the measure	The hunters (only those who have hunting license) carry out the control (shooting) with lead-shot hunting weapon
Time period	During all year, there is no open season
Location and scale of application	Szigetköz
Effectiveness	Unknown: The shooting is still ongoing, but in 2020 20 individuals were killed (shot) by hunting
Replicability	The control (shooting) is ongoing. The method is repeatable.
Humaneness/animal welfare	The killing (shooting) of individuals is rapid, painless, and it does not cause long-term suffering for the individuals
Public acceptance	This species is unknown in nature by the majority of the public
Side effects	There are no side effects
Stakeholder engagement – implementation:	Hunters (only those who have hunting license) carry out the shooting
Lessons learned	The shooting is still ongoing and therefore conclusions cannot be drawn yet



Case study 13 score. Hungary: *Myocastor coypus*

2.7.15. Case study 14. Hungary: *Myocastor coypus*

Group: Mammals	
Country: Hungary	
Entity: Local Government of Komarom-Esztergom County	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu)
Objective(s)	Rapid eradication
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Trapping: cage traps
Measures used to remove (dispatch/sterilise/captivity) species	• Shooting - dispatch restrained animals
Description of the measure	To our knowledge, the specimens were shot with pellet or were eliminated with firearm after being captured in a cage trap.
Time period	Within two years
Location and scale of application	The estuary of creek Concó and the neighbouring habitats (a few km^2)
Effectiveness	Moderately effective: Based on validated entries of the killed specimens in the kill registry
Replicability	It is easily replicable for the species concerned, but it is not warranted for other species at the moment
Humaneness/animal welfare	Killing with a firearm ensures the least possible suffering for the individual, and the cage trap is also the most humane trapping method existing.
Stakeholder engagement – implementation:	National park, the hunting and nature conservation authorities were engaged in the obligation to hunt and providing feedback. Moreover, those entitled to hunt were also engaged in the enforcement.
Lessons learned	The measures of both the nature conservation management and the authorities were necessary and effective in the given circumstances

2.7.16. Case study 15. Hungary: *Procyon lotor*

Group: Mammals	
Country: Hungary	
Entity: Zsolt Raffai, Bács-Kiskun County Government Office	
Category	**Response**
Species targeted	*Procyon lotor* (Raccoon)
Objective(s)	Rapid eradication (early stage intervention)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Shooting
Description of the measure	When the hunters observed the raccoon (1 individual), they shot it immediately
Time period	Based on experience, observations were made 2-3 times a week, and when hunters observed the raccoon (1 individual), they shot it immediately.
Location and scale of application	Wooded grove area (1 individual was observed)
Effort	14 hours/week
Costs	Overall costs: 20 € - Personnel costs: 2 € - Equipment and infrastructure: 10 € - Other, including capacity building and overheads: 8 €
Source(s) of funding	Private sources
Effectiveness	Effective: Photo of the killed individual
Replicability	Hunting is widely applicable to other huntable non-native mammal and bird species
Public acceptance	The measure (shooting) has been partially accepted by the public
Side effects	No changes were observed, as the raccoon's population is small in the area

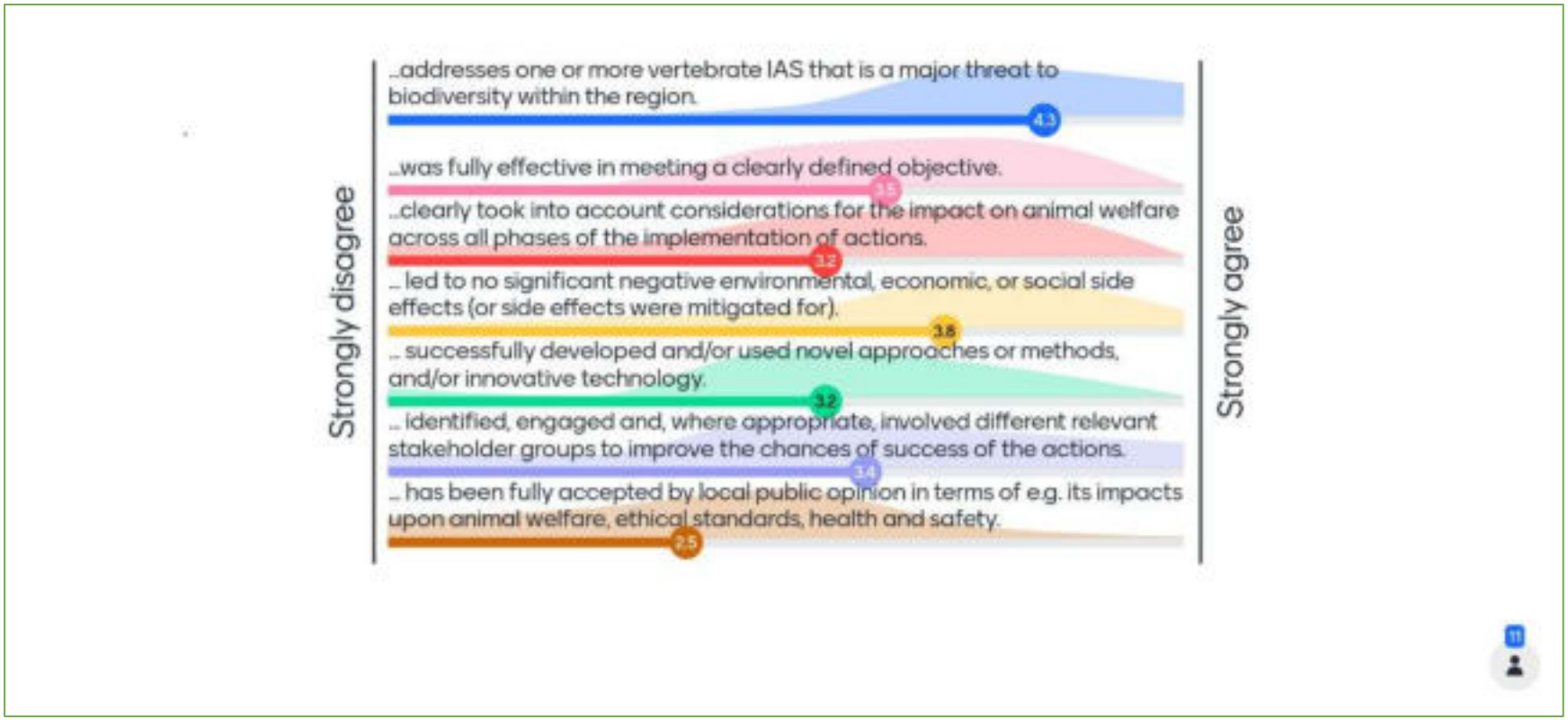
Stakeholder engagement – implementation:	All hunters were called upon to monitor the raccoon, and if raccoon was observed, it had to be shoot immediately as an efficient management method.
Dissemination	In the form of information to the hunters
Lessons learned	It is necessary to continue the elimination of the species from the area of the Park, the species has a great ability to rebuild the population in a short time.
References	Personal communication

Case study 15 score. Hungary: *Procyon lotor*

2.7.17. Case study 16. Hungary: *Nyctereutes procyonoides*

Group: Mammals	
Country: Hungary	
Entity: Bükk National Park Directorate	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog)
Objective(s)	Control
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Trapping: Spring operated traps
Description of the measure	Swan neck traps with bait were used. The traps were placed on the animals' trails. The operational principle of the swan neck trap is that when the animal digs the bait, it collides and kills the animal immediately. The trapping in this area is intended to protect the great bustard population; therefore the aim is not only to reduce the raccoon dog, but also other common small mammal predators, such as red fox.
Time period	Annual recurring activity. The traps are placed from February to June, then from September to November in each year.
Location and scale of application	Fields of grasslands, especially Pannonic salt steppes and salt marshes. Pannonic salt steppes of Dél-Heves: 2000 hectares. Borsodi-Mezőség: 10 km^2
Effort	Approximately 25-30 traps were placed out to the above-mentioned areas. These are checked by one person in each of the two areas. It means 2-3 hours of work per person per day during the trapping period (from February to June, from September to November). This is a total of approximately 40 days of work for one person, a total of 80 days of work in the two areas.
Costs	Overall costs: 7,000 €/year + 4,200 € for buying swan neck trap occasionally - Personnel costs: 6,000 €/year (1,000 €/month, 6 month/year) - Equipment and infrastructure: 4,200 € (one-time cost) - Other, including capacity building and overheads: 1,000 €/year

Source(s) of funding	Budget of “Cross-border protection of the Great Bustard in Central Europe (LIFE15/NAT/AT/000834)”; budget of Bükk National Park Directorate; sources from the Ministry.
Effectiveness	Effective - The trappers consider the method effective
Replicability	The method is repeatable easily and it can be used other mammal species too.
Humaneness/animal welfare	The killing with swan neck trap of individuals is rapid, painless, and it does not cause long-term suffering for the individuals
Stakeholder engagement – implementation:	Besides the Bükk National Park Directorate’s colleagues, local hunting companies were involved in the measure
Lessons learned	There is no estimated data for the raccoon dog population in the area. We believe that it is in the early invasion phase, so the species is spreading now. As a result, only a few individuals are trapped in each year. If we consider the time and financial effort, the program would not be effective only for controlling raccoon dogs. However, the trapping in this area is intended to protect the great bustard population with killing of red fox and other small mammal predators, so the measure is sustainable.
References	Personal communication



Case study 16 score. Hungary: *Nyctereutes procyonoides*

2.7.18. Case study 17. Hungary: *Platalea leucorodia*

Group: Birds	
Country: Hungary	
Entity: Kiskunság National Park Directorate	
Category	**Response**
Species targeted	*Platalea leucorodia* (Eurasian spoonbill)
Measure(s) not covered	Cannon-net: This is a process that uses small cannons that shoot projectiles, attached to a net, out over birds standing on the ground in front of the net.
Description of the measure	Canon netting on feeders were used to catch Eurasian Spoonbills for the purpose of research, **they were released as they are native and strictly protected birds.** Similar methods could be worth trying in the case of IAS listed Sacred Ibis (*Threskiornis aethiopicus*), but the captured individuals should not be released.
Effort	In the case of Eurasian spoonbills, we were able to catch 1 and 6 individuals with canon net. To catch those birds one day was needed with 4 people to put out canon net, after 2-4 days were needed for one person to feed the birds, and finally, one day was needed for 4 people to catch and handle Eurasian spoonbills for scientific research and put transmitters to their backs. Probably, the same method can work for Sacred Ibis and a hunter is needed to kill them.
Costs	- Personnel costs: ~ 100 €/day/person - Equipment and infrastructure: ~4,200 € - Other, including capacity building and overheads: ~ 100 €/day
Effectiveness	Moderately effective
Key evidence/results	In case of Eurasian spoonbills 1 and 6 individuals were captured after one shot with the canon net. It is estimated to be more effective method in case of Sacred Ibis.
Replicability	We used it in the case of Eurasian spoonbills, it can work on Sacred Ibis
Humaneness/animal welfare	It is a selective method, protected species can be released, invasive species can be killed
Side effects	If the protocol of the canon netting is done well, no side effect is expected
References	https://vwsg.org.au/waders/wader-monitoring/cannon-netting/

2.8. Black Sea, Steppic & Continental (East) Region: Bulgaria, Romania

2.8.1. Summary of case studies submitted for the Black Sea, Steppic & Continental (East) region

	Country	Entity submitting	Species	Measures used to restrain, capture and/or remove (kill/sterilise) the species	Measures used to remove (dispatch/sterilise/captivity) species	Average score at workshop
1	Bulgaria	Sofia Zoo	*Myocastor coypus, Nasua nasua, Procyon lotor*	Habitat manipulation: physical barriers	Keeping in captivity	N/A[1]
2	Bulgaria	Sofia Zoo	*Trachemys scripta*	Habitat manipulation: aquatic barriers	Keeping in captivity	3.4
3	Romania	University of Bucharest	*Nyctereutes procyonoides, Ondatra zibethicus*	Shooting Other approaches: Hunting dogs (tracking/baying)	Shooting - dispatch restrained animals	3
4	Romania	ONG S.E.O.P.M.M. Oceanic Club Constanța	*Neovison vison**	Trapping: cage traps	Cervical dislocation	3

* Vertebrate IAS not on the Union list

[1] Case study presented at the workshop but not scored, as the species was not caught in the wild, but yet managed as part of a zoo collection

2.8.2. Case study 1. Bulgaria: *Myocastor coypus, Nasua nasua* and *Procyon lotor*

Group: Mammals	
Country: Bulgaria	
Entity: Sofia Zoo	
Category	**Response**
Species targeted	*Myocastor coypus* (Coypu), *Nasua nasua* (Coati), *Procyon lotor* (Raccoon)
Objective(s)	Containment: Kept in captivity to be presented to the public

Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Habitat manipulation: Physical barriers
Measures used to remove (dispatch/sterilise/captivity) species	Keeping in captivity
Description of the measure	Controlled raising/keeping in a protected environment. All species are situated in enclosures secured with barriers suitable for the species, which do not allow them to escape outside. The enclosures form small habitats which provide the necessary living conditions to ensure the animal good health and welfare. Educational signs are placed on each enclosure.
Time period	Permanent
Location and scale of application	Sofia Zoo with a total area of 230 dka
Effort	Full time employee/s
Costs	Personnel costs, Equipment and infrastructure, and Other costs (incl. overheads)
Additional details on costs	BGN
Source(s) of funding	Annual budget (Municipality)
Effectiveness	Effective - No escape of animals
Replicability	Can be applied in other zoos
Humaneness/animal welfare	The measure is humane. Good living conditions are provided to the animals. No signs of stereotypical behaviour are observed.
Public acceptance	Approved by the people. Zoos are places where people can get the necessary information about animals, their way of life and behaviour, and their impact on the environment and other animals. This definitely contributes to increase of knowledge about animals, especially among young generation.
Stakeholder engagement – implementation:	Ministry of Environment and Water of Bulgaria, Regional Inspectorate for Environment and Water
References	http://zoosofia.eu/?lang=en

2.8.3. Case study 2. Bulgaria: *Trachemys scripta*

Group: Reptiles	
Country: Bulgaria	
Entity: Sofia Zoo	
Category	**Response**
Species targeted	*Trachemys scripta* (Red-eared, yellow-bellied and Cumberland sliders)
Objective(s)	Containment: Keeping in captivity
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Habitat manipulation: Aquatic barriers
Measures used to remove (dispatch/sterilise/captivity) species	Keeping in captivity
Description of the measure	In Sofia Zoo, *Trachemys scripta* have been kept in captivity in a controlled environment in two ways depending on their origin: 1. Specimens, which were confiscated by the authorities during attempts for illegal transport into the country by private persons, and handed over to the Zoo are kept indoors. 2. Specimens that are released by visitors into the large lake of the Zoo without the permission and knowledge of the Zoo managers are kept in the lake. The animals inhabit the lake and the area around it, without leaving it because they have enough food and good living conditions, and there is no other appropriate place they can go.
Time period	Permanent
Location and scale of application	Sofia Zoo, at an area of 6,000 m^2
Effort	Full time employee/s
Costs	Personnel costs, Equipment and infrastructure, and Other costs (incl. overheads)
Additional details on costs	BGN
Source(s) of funding	Annual budget (Municipality)

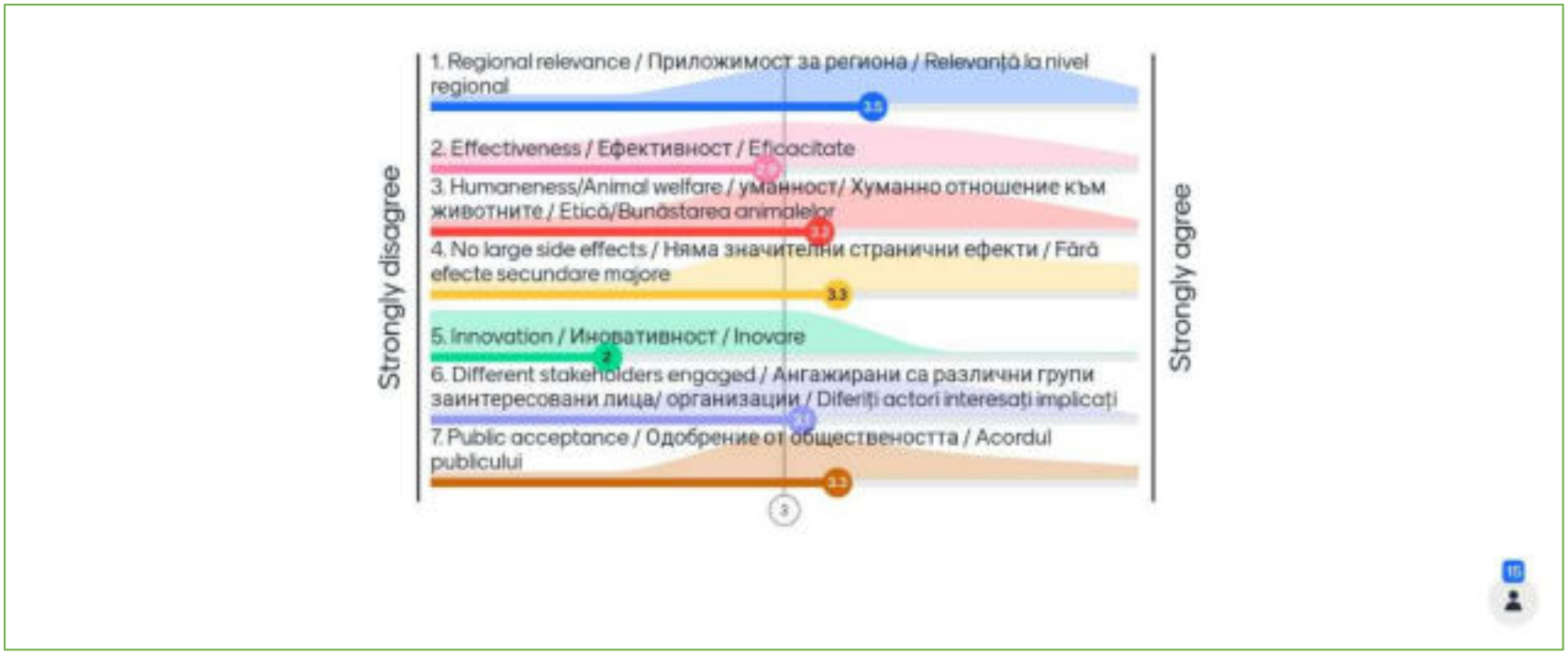
Effectiveness	Moderately effective: No escape of animals is observed; Usually the animals become well acclimatised in the lake, but rarely, in very cold winters, single specimens may die. However, the capacity of the Zoo is limited.
Replicability	Artificial reservoirs/ ponds can be constructed in places designated specially for this purpose on the territory of the country, where these turtles can be collected and kept. A campaign may be launched to encourage people to carry turtles to such places instead of releasing them into Zoos, parks, and into the wild.
Humaneness/animal welfare	The measure is humane. Good living conditions are provided to the animals. No signs of stereotypical behaviour are observed. However, the space is limited.
Public acceptance	Approved by the people
Stakeholder engagement – implementation:	Ministry of Environment and Water of Bulgaria, Regional Inspectorate for Environment and Water
References	http://zoosofia.eu/?lang=en

Case study 2 score. Bulgaria: *Trachemys scripta*

2.8.4. Case study 3. Romania: *Nyctereutes procyonoides* and *Ondatra zibethicus*

Group: Mammals	
Country: Romania	
Entity: University of Bucharest	
Category	**Response**
Species targeted	*Nyctereutes procyonoides* (Raccoon dog), *Ondatra zibethicus* (Muskrat)
Objective(s)	Control: Reduce the number of individuals by hunting (based on annual cull quota)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Other approaches: Hunting dogs (tracking/baying)
Measures used to remove (dispatch/sterilise/captivity) species	• Shooting - dispatch restrained animals
Description of the measure	The racoon dog is a game species, hunted with a rifle with cartridges (3.5 - 4 mm caliber). The main hunting methods are still hunting, with a dog, scouting, and stalking. The muskrat is a game species, hunted with a shotgun (with birdshots) or a rifle with cartridges (2.5 mm caliber). The main hunting methods are still hunting and scouting.
Time period	Racoon dog: 15 September – 31 March Muskrat: 1 September – 15 April
Location and scale of application	Romania (within hunting grounds, i.e., excluding inhabited areas, national parks, strictly protected areas) for the muskrat and only a hunting ground for the raccoon dog (Tulcea county, Posta village).
Costs	10 Euro per one muskrat, 30 Euro for raccoon dog
Additional details on costs	Hunting ground tariffs for the respective species
Source(s) of funding	Administrators of hunting management units (private)
Effectiveness	Ineffective - The number of shot individuals is very low (2 raccoon dogs and 3000 muskrats in a year)
Replicability	No

Humaneness/animal welfare	As normal as other hunted species (immediate killing)
Public acceptance	No reaction
Side effects	No data
Stakeholder engagement – implementation:	Hunters and hunter association (as hunters and administrators)
Lessons learned	The species must be hunted all year round, without a specified cull quota
References	National Hunting Regulation (Law 407/2006, http://legislatie.just.ro/Public/DetaliiDocument/77053)

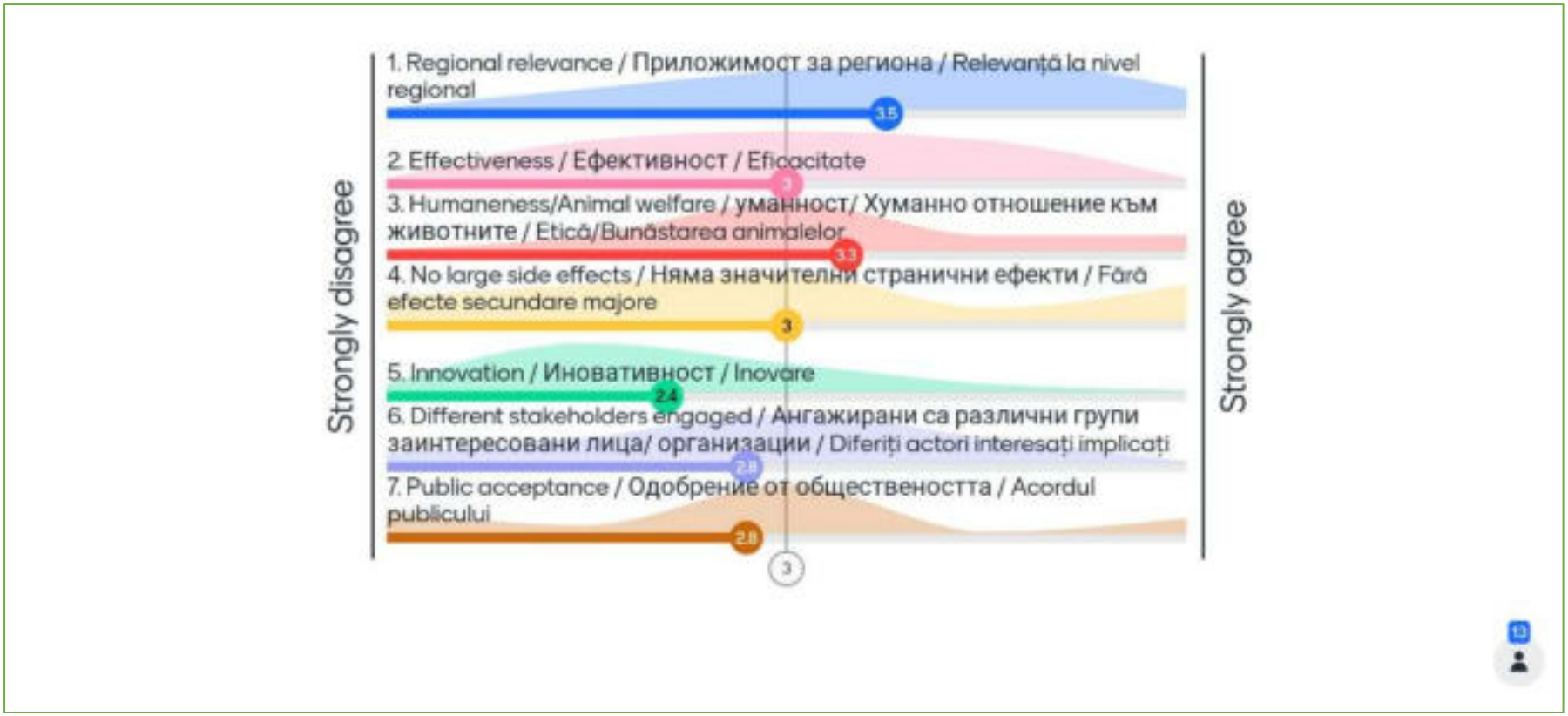


Case study 3 score. Romania: *Nyctereutes procyonoides* and *Ondatra zibethicus*

2.8.5. Case study 4. Romania: *Neovison vison*

Group: Mammals	
Country: Romania	
Entity: ONG S.E.O.P.M.M. Oceanic Club Constanța	
Category	**Response**
Species targeted	*Neovison vison* (American mink)
Objective(s)	Rapid eradication (early stage intervention)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Trapping: Cage traps
Measures used to remove (dispatch/sterilise/captivity) species	Cervical dislocation
Description of the measure	Immediately after observing that animals escaped from the farm, Tomahawk live traps were installed in the areas close to the farm. After capture, the animals were euthanised.
Time period	At least six months, trying to catch as soon as possible the animals escaped from the farm
Location and scale of application	Brașov, 10 km^2
Effort	2 people, 30 days/year
Costs	Overall costs: 5,000 € - Personnel costs: 3,000 € - Equipment and infrastructure: 1,000 € - Other, including capacity building and overheads: 1,000 €
Source(s) of funding	Private
Effectiveness	Ineffective: less than 25% of the intended number of animals
Replicability	In theory, the measure can be applied to similar species

Humaneness/animal welfare	Frequent visits to the traps; traps generally sheltered from unfavourable weather conditions
Public acceptance	It was not presented to the public
Side effects	No side effects were observed
Stakeholder engagement – implementation:	Only the mink farm owners were involved
Dissemination	No details were released
Innovation	No innovative practices were used
Lessons learned	A tenfold effort must be made in order to achieve the expected results. The dispersal potential of the animals immediately after escape is higher than anticipated.



Case study 4 score. Romania: *Neovison vison*

3. Overall summary of case studies for all the regions

A total of 70 case studies were received from 22 EU Member States (with 3 of those covering more than one MS), referring to 18 of the vertebrate species of Union concern (see Table 4 below, Figures 1 and 2). France and Hungary were each included in 10 case studies, the highest of all EU Member States, followed by Poland with six case studies (Figure 1). Only Malta, Ireland, Estonia, Czech Republic and Cyprus were not included in any case study.

Of the 22 vertebrate species of Union concern, it was the mammal species that were the target more than any other: *Myocastor coypus*, (17 case studies), *Nyctereutes procyonoides* (15)*, Procyon lotor* (13) and *Ondatra zibethicus* (12). Only four species were not included in any case study: *Threskiornis aethiopicus, Sciurus niger, Plotosus lineatus*, and *Oxyura jamaicensis*.

Figure 1. Number of case studies received by EU Member State.

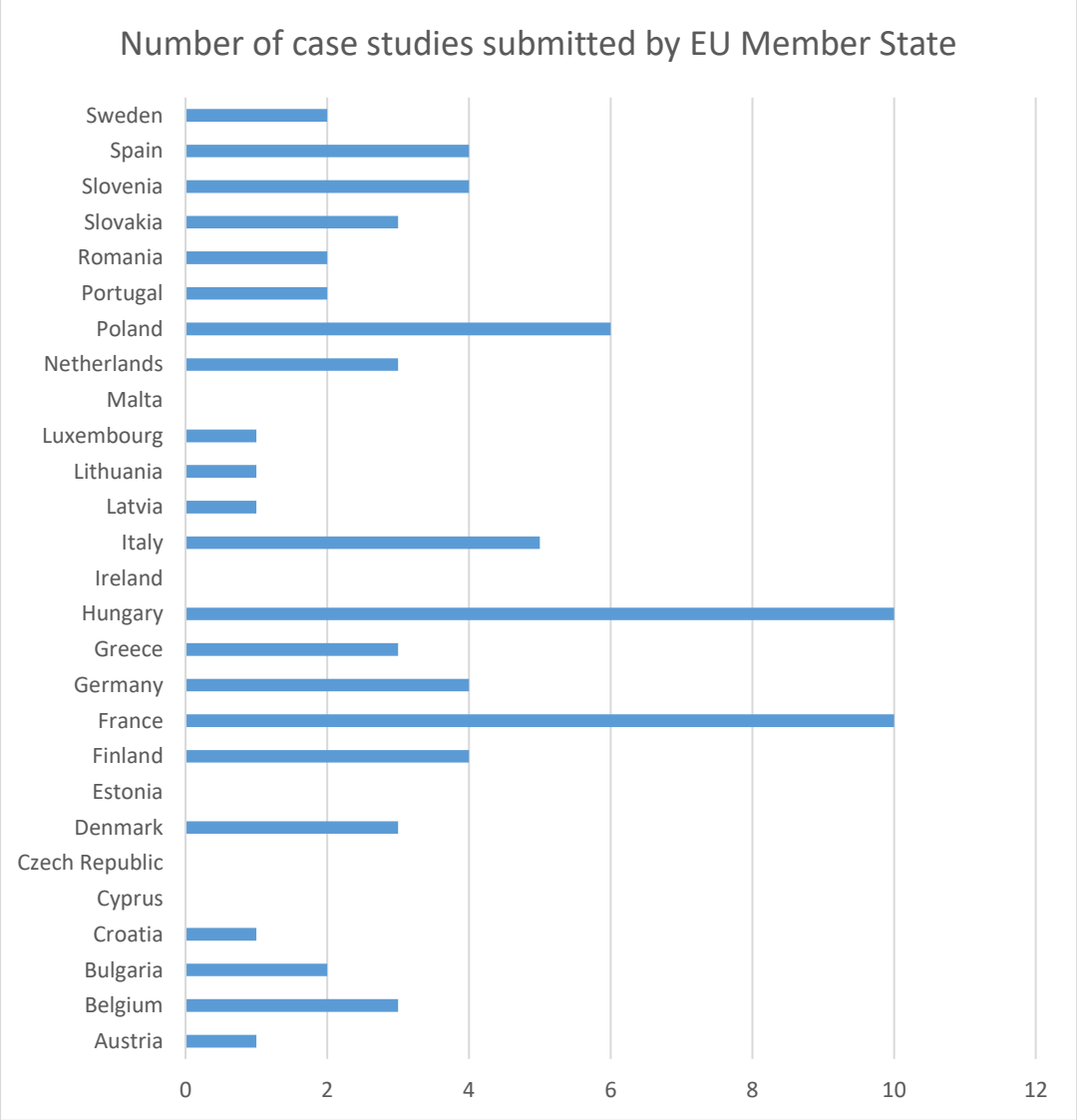
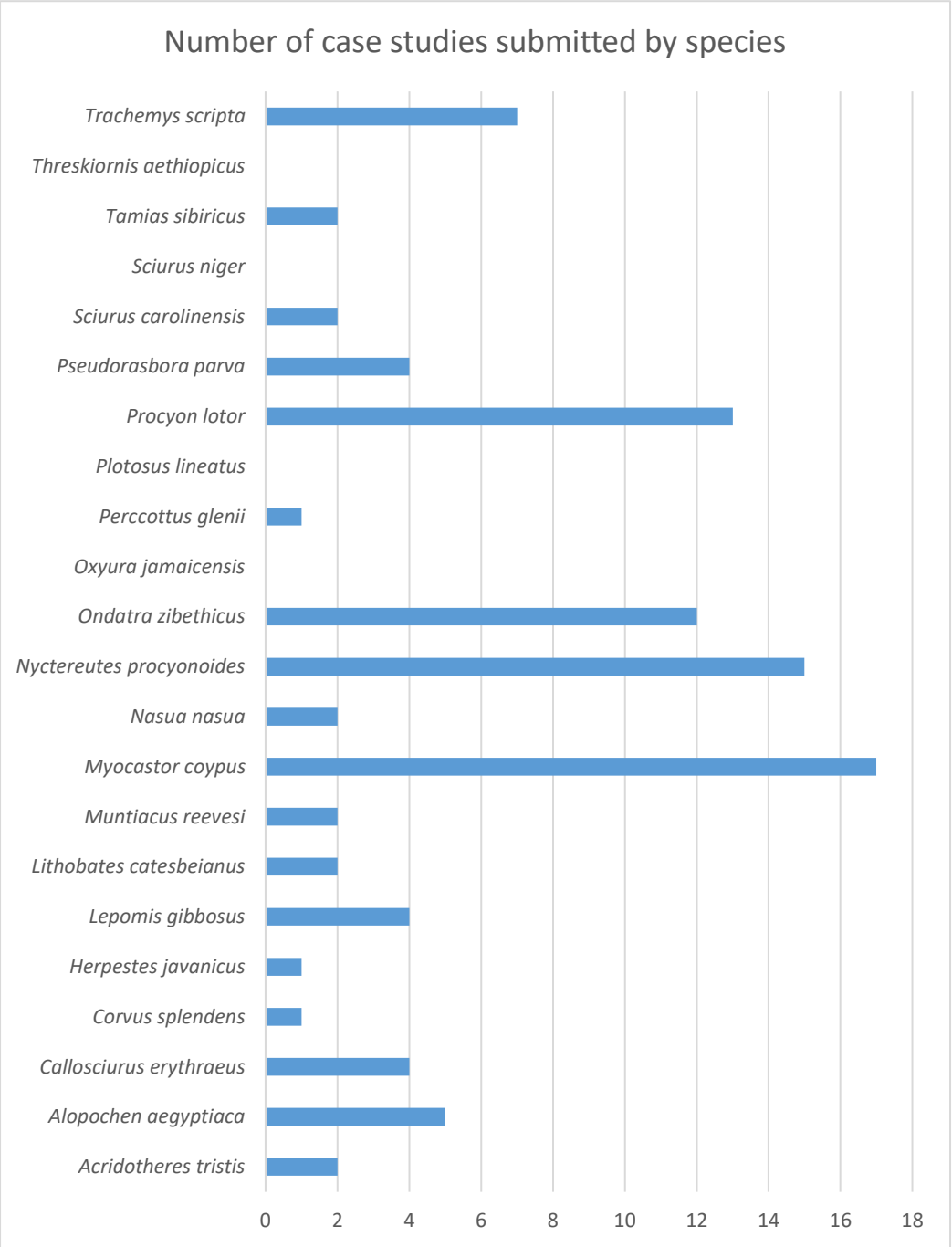


Figure 2. Number of case studies received by vertebrate species of Union concern.



4. Case studies submitted for regions outside of the EU

This section showcases case studies on the management of vertebrate IAS of Union concern (and additional species) that were undertaken either in regions outside of the EU, or in combination with regions outside of the EU (as is the case for the Outermost Region Réunion in combination with Madagascar and Yemen). Case studies from the EU Overseas Territories (specifically French Polynesia), were also included in this section. Again, and similarly to what was done in Sections 2.2-2.8, on occasions where a field was not completed in the questionnaire, the category has been removed in its entirety from the corresponding table.

4.1. Summary of case studies submitted from outside the EU

	Country	Entity submitting	Species	Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	Measures used to remove (dispatch/sterilise/captivity) species
1	United Kingdom, Seychelles	WildWings Bird Management	*Acridotheres tristis*	Poisons and toxins in bait Shooting Trapping: cage traps Trapping: live decoy traps	Cervical compression: Captured mynas euthanised by compression of the neck, just behind the skull, with round-nosed long-nosed pliers. This technique was developed and found to be effective and considered the most immediate and humane method in island eradications in Seychelles
2	Réunion (French Outermost Region), Madagascar, Yemen	InGrip-Consulting	*Corvus splendens*	Shooting Trapping: cage traps (tried but always failed)	Cervical dislocation (planned if specimen are trapped, not used) Decapitation (to be followed after cervical dislocation to secure death) Shooting - dispatch restrained animals (planned if specimen are trapped, not used)
3	French Polynesia	Société d'Ornithologie de Polynésie	*Acridotheres tristis, Pycnonotus cafer*	Poisons and toxins in bait Shooting Live decoy traps	Cervical dislocation Stunning the bird

4.2. Case study 1. United Kingdom/Seychelles: *Acridotheres tristis*

Group: Birds	
Country: United Kingdom, Seychelles	
Entity: WildWings Bird Management	
Category	**Response**
Species targeted	*Acridotheres tristis* (Common myna)
Objective(s)	Rapid eradication (early stage intervention) Eradication (of widespread population)
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Poisons and toxins in bait • Shooting • Trapping: cage traps • Trapping: live decoy traps
Measure(s) not covered)	• Cervical compression: Captured mynas euthanised by compression of the neck, just behind the skull, with round-nosed long-nosed pliers. This technique developed and found to be effective and considered the most immediate and humane method in island eradications in Seychelles (see text appended to this questionnaire at end of document).
Description of the measure	The euthanasia technique described here is for mynas (and can be used for other small birds) that have been live caught in cage or live decoy traps (for details of the trapping see Feare *et al*. 2016 *Pest Management Science* DOI 10.1002/ps.4263, and in press *Management of Biological Invasions*).
Location and scale of application	The method has been developed during projects in Seychelles, but is relevant wherever small IAS birds are needed to be controlled/eradicated
Effort	Our studies on small (C. 100 ha) islands with populations of c. 1000 mynas suggest that eradications, using 20+ traps operated by 2 people + shooting by marksmen in the later stages can be achieved within about 2 years. Trappers are usually volunteer postgraduate students who are trained by me and/or my team to use the new euthanasia method
Costs	Equipment and infrastructure: Round-nosed long-nosed pliers cost c. 10 € each. Two are recommended for each eradication team

Effectiveness	Effective
Key evidence/results	Three *A. tristis* eradications of populations of 700-1100 birds have now been achieved on Seychelles islands. We have a publication in preparation that highlights the positive responses endangered endemic birds to the removal of mynas from targeted islands.
Replicability	The technique has also been used successfully on Red-whiskered Bulbul *Pycnonotus jocosus* and Madagascar Fody *Foudia madagascariensis*.
Humaneness/animal welfare	In our eradication attempts other euthanasia techniques we used are: placing birds in cloth bags and hitting the bags strongly on hard surfaces, holding birds by the body and hitting the head on hard surfaces, and cervical dislocation. I found none of these to kill 100% of birds on the first attempt and was increasingly concerned about humaneness. Exposing birds or traps containing mynas to carbon dioxide from cylinders or carbon monoxide from car exhausts is used in Australia but cessation of movement can take up to 4 minutes –I have doubts about the humaneness of this. Or technique of crushing the neck just behind the skull I believe caused quick and instantaneous death of the myna.
Public acceptance	Most island staff appear to accept that our actions are necessary. If tourists (the three islands from which mynas have been eradicated cater for high-end tourism) ask we will discuss with them, but we do not solicit opinions and do not euthanise in their presence.
Side effects	None
Stakeholder engagement – implementation:	In Seychelles our work was requested by island management and the NGO Green Islands Foundation
Dissemination	Feare, C.J., van der Woude, J., Greenwell, P., Edwards, H.A., Taylor, J.A., Chadwick, W., Pandey, S., Raines, K., Garcia, F., Komdeur J. & de Groene, A. 2016. Eradication of common mynas *Acridotheres tristis* from Denis Island, Seychelles. *Pest Management Science* DOI 10.1002/ps.4263 Feare, C.J., Waters, J., Fenn, S.R., Larose, C.S., Retief, T., Havemann, C.J., Ahlen, P-A., Waters, C., Little, M.K., Atkinson, S., Searle, B., Mokhobo, E., de Groene, A. & Accouche, W. Eradication of invasive common mynas *Acridotheres tristis* from North Island, Seychelles, with recommendations for planning eradication attempts elsewhere. In press. *Management of Biological Invasions*.
Innovation	Our development of euthanasia by cervical compression is innovative
Lessons learned	We are satisfied that cervical compression is more reliable and quicker that other options. Please see report appended at the end of your questionnaire below

References	Feare, C.J., van der Woude, J., Greenwell, P., Edwards, H.A., Taylor, J.A., Chadwick, W., Pandey, S., Raines, K., Garcia, F., Komdeur J. & de Groene, A. 2016. Eradication of common mynas *Acridotheres tristis* from Denis Island, Seychelles. *Pest Management Science* DOI 10.1002/ps.4263 Feare, C.J., Waters, J., Fenn, S.R., Larose, C.S., Retief, T., Havemann, C.J., Ahlen, P-A., Waters, C., Little, M.K., Atkinson, S., Searle, B., Mokhobo, E., de Groene, A. & Accouche, W. Eradication of invasive common mynas *Acridotheres tristis* from North Island, Seychelles, with recommendations for planning eradication attempts elsewhere. In press. *Management of Biological Invasions*. Griffin, A.S. & Boyce, H.M. 2009. Indian mynahs, *Acridotheres tristis*, learn about dangerous places by observing the fate of others. *Animal Behaviour* 78: 79-94. Tidemann, CR & King, DH. 2009. Euthanasia of mynas, starlings and sparrows with CO_2 and CO from petrol engine exhaust. *Wildlife Research* 36, 522–527. Total length of the pliers is 15 cm.
Addendum	I have been involved in the management of one of the target species, Common Myna *Acridotheres tristis*, in two UK overseas territories (Ascension and St Helena islands) and in eradication of this species from islands in Seychelles, but not within the EU. Nevertheless, I think that some of my experience is relevant to considerations of Common Myna eradications within the EU and would like to make a recommendation for the euthanisation of mynas (and possibly other birds) that have been trapped. On St Helena, two methods of killing trapped mynas were used. A method that had apparently been recommended by the Durrell Institute involved placing the living myna in a cloth bag and then swinging the bag against a hard surface, e.g. a brick wall or concrete floor. This achieved an instantaneous kill in many cases but exceptions were not infrequent, with the wounded bird surviving and having to be processed again. To me the process looked barbaric (and I learned later that people on Ascension who had seen the process were similarly concerned). The second method, which I had formerly used with larger species, involved holding the bird low down its body and striking the head against a hard surface. With mynas this did not always kill at the first attempt. (During invasive bird management I have not attempted to kill by cervical dislocation; as a youngster I found that I could not reliably achieve a kill at the first attempt. This was for oiled seabirds). In Australia, the recommended method is to place trapped mynas, or even the entire trap containing living birds, in a bag that is connected to a vehicle exhaust or carbon dioxide cylinder. I have no experience of this technique but carbon monoxide/dioxide asphyxiation can take several minutes to kill (Tidemann & King, 2009). These authors regarded CO_2 as less humane as death was preceded by more signs of stress than with CO, but with the latter cessation of movement could take up to 4 minutes.

As part of island rehabilitation programmes in Seychelles we eradicated populations of c. 1000 mynas from each of two small (c. 100 ha) islands, using mainly decoy traps. These wire-mesh traps had a central compartment that housed a live decoy myna, surrounded by four catching compartments. Each of these had a door that was triggered by an entering bird, so that a maximum of four birds could be caught in a trap at any time. To ensure continuity of trapping, the traps were visited at regular intervals during the day to remove any trapped birds and re-set the doors. Initially during the first eradication attempt, each caught bird was placed in a cloth bag and taken back to our "office" for killing and taking a variety of measurements/observations of each bird. During the course of the work we realised that this transport placed unnecessary stress on the birds and we decided to kill each bird on removing it from a trap, and this was done throughout the second eradication.

For killing large numbers, based largely on decoy trapping (Feare *et al*., 2016, in press), we trialled a method of euthanasia using long-nosed round-nosed pliers (see illustration et end of this letter) to crush the necks, just behind the skull of trapped mynas. I think death is instantaneous but have not had the resources to monitor physiological responses to confirm this. It is certainly very quick and can be done at the site where a bird is removed from a trap. We turn away from the trap to do this so that any birds remaining in the trap (including the live decoy) cannot see the process. It is also possible to shield the operation from any people in the vicinity, but we try to avoid emptying traps when other people are around. Occasionally, mynas give distress calls when handled but this stops as soon as the neck is crushed. Some mynas twitch and flap wings for some seconds after killing but by putting corpses in cloth bags as soon as the neck has been crushed this is hidden from any birds and people in the vicinity.

Importantly, in relation to eradicating our two island populations of mynas, we did not detect any signs of aversion by mynas to our trapping activities for much of the trapping programmes. Trap visits, to check for the presence of trapped birds and to remove and euthanise any that had been caught, were undertaken through the day in order to reset the trap mechanisms and ensure that trapping compartment doors were open for most of the time and thus able to trap further birds. Griffin & Boyce (2009) concluded that multi-catch traps used to control urban populations of mynas in SE Australia should not be emptied of mynas during daylight because the birds learned that the traps were associated with danger; we found no evidence of this. Eventually, trapping success did diminish, at which stage we introduced shooting, by marksmen with specialised weaponry and a good understanding of bird behaviour, to remove the remainder of the birds. On another Seychelles island we used the same killing technique on two other invasive species, Red -whiskered Bulbul *Pycnonotus jocosus* and Madagascar Fody *Foudia madagascariensis*, both smaller that mynas. On Bird Island, which has a large Sooty Tern colony, some terns are found injured (broken or dislocated wing) on the beach having been attacked over the sea by frigatebirds.

	We have found that our killing method is efficient for dispatching the injured birds (body mass c. 180g) quickly. We suspect that this is about the upper size limit for which our pliers are suitable. My conclusion is that round-nosed long-nosed pliers offer a quick and humane technique for euthanising smaller invasive birds. In my opinion, this technique minimises risks of prolonging suffering that can occur with other techniques. The term "cervical constriction" might best fit this technique and differentiate it from "cervical dislocation".

4.3. Case study 2. Réunion (French outermost region), Madagascar and Yemen: *Corvus splendens*

Group: Birds	
Country: Réunion (French outermost region), Madagascar and Yemen	
Entity: InGrip-Consulting	
Category	**Response**
Species targeted	*Corvus splendens* (House crow)
Objective(s)	Rapid eradication (early stage intervention): Eradication took place not in the EU but other countries, however, the situation is to compare with the EU situation. One eradication of a good dozen of birds on the island of Socotra (Yemen) comprised the breeding population of those birds that survived egg collection processes that aimed for long term control as final tool of eradication by population reduction to zero. However, always single nests slipped through this system so the eradication was necessary. It was performed by shooting with life ammunition. The second eradication happened in 2019/2020 in a port city of Madagascar. The population removed was around 50 birds with one left before the Pandemic forced the experts to leave the country. But a system was established to remove the last bird and deal with any new arriving which shows effect now as meanwhile two new House crows have entered via ship. All activities were done by shooting with high power air rifle. The arrival was in ports by ship, shooting happen under strong security and public concerns, so a situation comparable for any EU situation. It shows to be the most effective way of eradicating new arriving or small established populations, except where poisoning can be used what would be ruled out for EU situations. One House crow that arrived recently in Reunion, France, was shot at site too.

Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Shooting • Trapping: cage traps (tried but always failed)
Measures used to remove (dispatch/sterilise/captivity) species	• Cervical dislocation (planned if specimen are trapped, not used) • Decapitation (to be followed after cervical dislocation to secure death) • Shooting - dispatch restrained animals (planned if specimen are trapped, not used)
Description of the measure	Cage trapping was attempted in both projects by us or afore by partners by use of ladder traps, similar to modified Australian crow traps. In Madagascar we also used larsen traps to attempting catching single birds or a breeding pair. None worked although non target species were caught (and released). The method used was shooting for all individuals. In Yemen under use of shotgun 12 gauge, as well as rifle .22 lfr and .17 calibre life ammunition. In Madagascar only by shooting with air gun .22 calibre, high power. Always under use of sight/scope and silencer. On Reunion the single bird in 2018 was shot by shotgun. Shooting never took place above 50 –70 m distance and mostly by using afore established hides (out of side of people but in the area and spots used by House crows for resting, feeding, nesting).
Time period	In Yemen we eradicated the species from Socotra in 20 days, in Toamasina we spent 12 weeks. Traps were only applied for a fraction of that time. Shooting 5 individuals per week seems to be an average number. On Reunion the bird was shot after one week of observations.
Location and scale of application	In Yemen around 5 km². In Madagascar only 50 ha in the city center.
Effort	2 persons shoot 5 birds per week within 5 km² if afore investigations of the sites used by the birds are done. Trapping can be attempted for around two weeks to be effective, to try further does not mean it will ever work but can be done unlimited.
Costs	Yemen: 6.000 € Madagascar: 30.000 € - Personnel costs: is the majority of the costs for experts, plus travel; in Europe different since staff from government authorities might be used and is located on site already - Equipment and infrastructure: 4.000 € if guns needed to get bought
Source(s) of funding	Yemen: Government, Madagascar: CEPF-grant
Effectiveness	Effective (shooting) Ineffective (trapping)
Key evidence/results	All birds are shot each time, (Madagascar: 1 left that died later). Trapping costed a lot of attention, material costs and criticism (animal welfare) but was not catching anything under these circumstances (but is effective

	elsewhere). Shooting allows to count the numbers down if known (precondition that you know how many birds you deal with) and under ideal scenarios 50 % of the population can be shot in a few minutes if the right time and staff is involved. Still days without success are in between and staff needs some break also as work is trying (guns, liability, risks, permanent attention to species and individuals to not been seen but also people not to interfere etc.).
Replicability	Always possible, up of ca. 50 birds only advisable if location is well known, can be freely used, enough time and funds for staff are existing
Humaneness/animal welfare	Shooting if done by experienced staff and right material is absolutely animal welfare conform and recommended by all organisations or institutions and authorities. The risk is the public and damage to people and materials. Thus trapping is saver for public but brings more stress to animals. The catch and holding was designed to be limited to an uttermost necessary duration (2 days) and water, shade, food and no stress by other animals or people were preconditions for trapping and selecting the trap site. Catching the birds was designed to be at night to less stress them and avoid this been seen by other animals around (not caught target species individuals) or people delaying the needed quick handling of the birds by interfering. Than the measures as marked under Q 06 were to get applied as all control was designed to be lethal. However, it was not needed. We draw the recommendation for it from all international recommended euthanasia documents like from Australian Government, US University and laboratory standards and mainly the American Veterinary Associations Euthanasia Panel guidelines (key reference). It showed that nothing binding or standardised exists in the EU as all once established documents showed to be out of date. We established our own protocols for trapping, killing of trapped birds and shooting.
Public acceptance	The aim of the project was explained and that the House crows will be killed immediately. Due to the countries involved and the different level of animal welfare relevance in daily life this was not an issue at all. However, we passed all international protocol standards and got agreement of donors like CEPF, hence the international acceptance was secured as well.
Side effects	Shooting allows for active process of the project while trapping needs to wait until the birds decide to enter the trap. It looks martially to some people perhaps, but is sooner over than egg collections etc. If the shooter does not shoot unsafe or onto non-target species that are intermixed with the target species in one feeding flock or so there is no risk existing. Acceptance will be higher if you are from local authorities and in uniform etc. In other countries foreigners with gun in the city are seen as suspective always.
Stakeholder engagement – implementation:	International NGO (MFG) with local branch; government entities like ministries and police for permissions
Dissemination	Not by us. By NGO.

Innovation	None. Standards applied.
Lessons learned	If funding is secured, all permissions existing, enough time of staff allowed and the situation inspected beforehand (details!) it can be a concerted manner that shows quickly results and hence is convincing and example giving for everyone associated or witnessing it. Selecting carefully for the right shooter(s) is important as no cowboy mentality is needed but species knowledge and eradication orientation (i.e. willingness to cut its own contract short for the earliest success possible).
References	As mentioned in the management factsheet provided to EC/IUCN in 2019 (technical note) or on request. CEPF reports are internally still.

4.4. Case study 3. French Polynesia: *Acridotheres tristis* and *Pycnonotus cafer*

Group: Birds	
Country: France (French Polynesia)	
Entity: Société d'Ornithologie de Polynésie	
Category	**Response**
Species targeted	*Acridotheres tristis* (Common myna), *Pycnonotus cafer* (Red-vented bulbul)
Objective(s)	Control We are controlling them at Tahiti monarch valley entrance in order to prevent agressions/predation/nest destruction from those introduced birds toward the critically endangered Tahiti monarch
Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field	• Poisons and toxins in bait • Shooting • Live decoy traps
Measures used to remove (dispatch/sterilise/captivity) species	Cervical dislocation Stunning the bird - Stunning consist of putting the bird in a sock and hitting the head of the bird on a hard corner

Description of the measure	We have a handbook for our trapper network in order to take care of the Judas bird, living in cage and in order to learn them how to kill the bird rapidly and without suffering.
Location and scale of application	Punaauia and Paea districts - 180 ha?
Effort	We have 50 families of trappers and we are calling them each month - since 2012. We complete the trapping with shooting and poisoning the birds in the valleys (in monarch's territories)
Source(s) of funding	20% DIREN; 20% France at two occasions; the rest hundreds of different sources of funding
Effectiveness	Effective
Key evidence/results	See References
Replicability	Anywhere if useful
Humaneness/animal welfare	We followed anglosaxon good practice, we obtained the agreement of the local association of animal welfare before the project was initiated (in 2021 - Fenua animala); we prefered stunning and cervical dislocation because the stess is minimal whereas death induced by inhalation is longer (5 minutes minimum).
Public acceptance	This is a well accepted action in general, but it was coupled (at its initiation in 2012) with massive communication
Side effects	No non-target affected by trapping, for poisoning on valley we use bread - we used camera traps and only introduced species of birds were observed eating the poison
Stakeholder engagement – implementation:	Inhabitant of Paea and Punaauia, Mayor house with a pact signed in 2016
Dissemination	Twice a year we have a letter of information on the species
Innovation	Trapping with a network
Lessons learned	People appreciated to be involved & now we have two other networks: gardeners and in the fight against the little fire ant
References	Blanvillain, C., Ghestemme, T., Saavedra, S., Yan, L., Michoud-Schmidt, J., Beaune, D. & O'Brien, M. (2020). Rat and invasive birds control to save the Tahiti monarch (*Pomarea nigra*), a critically endangered island bird. *Journal for Nature Conservation*, 55, 125820. https://doi.org/10.1016/j.jnc.2020.125820

Blanvillain, C., Saavedra S., Withers, T., Votýpka J., Laroucau K., Lowenski, S. & Modrý, D. (2021) Screening of diseases in wild exotic birds on Tahiti Island; implications for French Polynesian conservation. Pacific Conservation Biology, https://doi.org/10.1071/PC20049

Blanvillain, C., Salducci, J.M., Tutururai, G. & Maeura, M. (2003). Impact of introduced birds on the recovery of the Tahiti Flycatcher (*Pomarea nigra*), a critically endangered forest bird of Tahiti. *Biological Conservation*, 109: 197-205, https://doi.org/10.1016/S0006-3207(02)00147-7

5. Concluding Table

Table 4. Total number of submitted case studies per country and species. *Note that the sum of the species or country case studies will not add up to the total value, as some case studies covered more than one species, or more than one country, e.g. for *N. procyonoides*, one case study was for both Sweden and Finland. Additionally, the total for 'Other Species' does not mean 26 species in total, as some species, for example *N. vison*, were managed in more than one study within a country or in different countries.

	Acridotheres tristis	*Alopochen aegyptiaca*	*Callosciurus erythraeus*	*Corvus splendens*	*Herpestes javanicus*	*Lepomis gibbosus*	*Lithobates catesbeianus*	*Muntiacus reevesi*	*Myocastor coypus*	*Nasua nasua*	*Nyctereutes procyonoides*	*Ondatra zibethicus*	*Oxyura jamaicensis*	*Perccottus glenii*	*Plotosus lineatus*	*Procyon lotor*	*Pseudorasbora parva*	*Sciurus carolinensis*	*Sciurus niger*	*Tamias sibiricus*	*Threskiornis aethiopicus*	*Trachemys scripta*	*Other species*	***Total Case Studies***
Austria																	1							**1**
Belgium		1							1			1				1								**3**
Bulgaria									1	1						1						1		**2**
Croatia						1											1							**1**
Cyprus																								**0**
Czech Republic																								**0**
Denmark								1	1	1	2	1				1						1		**3**
Estonia																								**0**
Finland											4												1	**4**
France		1	2		1			1	7		1	7				2				2			2	**10**
Germany							1		2			1				1								**4**
Greece									1														3	**3**
Hungary		1				2			3		1					1						1	2	**10**
Ireland																								**0**
Italy			1													1		2						**5**
Latvia																						1	2	**1**
Lithuania						1								1			1							**1**
Luxembourg																1								**1**
Malta																								**0**
Netherlands			1						1			1				1								**3**
Poland											4					3							4	**6**
Portugal																							1	**2**

	Acridotheres tristis	*Alopochen aegyptiaca*	*Callosciurus erythraeus*	*Corvus splendens*	*Herpestes javanicus*	*Lepomis gibbosus*	*Lithobates catesbeianus*	*Muntiacus reevesi*	*Myocastor coypus*	*Nasua nasua*	*Nyctereutes procyonoides*	*Ondatra zibethicus*	*Oxyura jamaicensis*	*Perccottus glenii*	*Plotosus lineatus*	*Procyon lotor*	*Pseudorasbora parva*	*Sciurus carolinensis*	*Sciurus niger*	*Tamias sibiricus*	*Threskiornis aethiopicus*	*Trachemys scripta*	*Other species*	***Total Case Studies***
Romania											1	1											1	**2**
Slovakia		1									1											1		**3**
Slovenia							1															2	1	**4**
Spain																	1						8	**4**
Sweden		1									1													**2**
Non-EU	2			1																			1	**3**
Total	**2**	**5**	**4**	**1**	**1**	**4**	**2**	**2**	**17**	**2**	**15**	**12**	**0**	**1**	**0**	**13**	**4**	**2**	**0**	**2**	**0**	**7**	**26**	**78**

Appendix 1. Online questionnaire to collect case studies on the humane management of vertebrate IAS

Good Practices on Humane Management of Vertebrate IAS

Welcome!

This questionnaire forms part of the project "Identification, Assessment, Sharing and Dissemination of Best Practices for Humane Management of Invasive Alien Species" (please see details about the project here).

We are asking for your help in identifying **good practices in the humane management of vertebrate invasive alien species** (IAS) that have been used across Europe.

Your contribution will inform a set of eight regional workshops across the EU, where measures available to eradicate, control and contain populations of the 22 vertebrate IAS of Union concern will be discussed. Participants of each workshop will select the 5 best good practice case studies per region, which will be combined to produce a list of 40 good practices from across all regions. From this list, ideally 22 case studies will be selected, each one representing one of the invasive alien vertebrate species of Union concern. These final 22 good practice case studies will then be presented at the final conference of the project in 2022 and may also be included within dissemination and communication materials for the individual regions, providing an opportunity for high exposure of the selected good practices.

For your good practice case study to be considered, please submit it according to the following schedule:

- 7 March 2021 for case studies covering Bulgaria, Romania, Estonia, Finland, Latvia, Lithuania, Sweden
- 21 March 2021 for case studies covering UK, Ireland, Netherlands, Belgium, France

- 11 April 2021 for case studies covering Italy, Malta, Portugal, Spain, Croatia, Czechia, Hungary, Poland, Germany, Denmark, Luxembourg
- 16 May 2021 for case studies covering Cyprus, Greece, Austria, Slovenia, Slovakia

Late submissions will be accepted, but might not be fully considered in the process.

The questionnaire asks you to provide comprehensive information about your case study, including geographic information, and an evaluation of its impact on animal welfare, effectiveness and innovativeness. You do not have to answer all questions, but please provide as much information as possible. There are 26 questions in this survey and we estimate that it will take you around 30 minutes to fill it in.

Please submit this questionnaire online: https://onsubject.limequery.net/392715

If you have any questions about this questionnaire or the full project, please contact Ana Nunes at Ana.Nunes@iucn.org.

Contact information

Please let us know how we can contact you for further information.

[Q00001] Contact information

Full name	
Position	
Organisation	
Email	

Good practice - Introduction

In this first step, we are asking you to provide information on the species targeted, the countries covered and the overall objective of the measure.

[Q00002] Species group targeted

Highlight your choice below (e.g. in a different colour).

- Mammals
- Birds
- Amphibians
- Reptiles
- Fishes

We are focusing on mobilising good practices for IAS of Union concern. However, there may be instances where a practice has only been applied to other IAS but could (potentially) be applied to an IAS of Union concern, for example a closely related species. If this good practice relates to

another IAS, please name the species in the 'Other' box and tick the IAS of Union concern it could (potentially) be applied to.

Add the vertebrate invasive alien species (IAS) targeted by the good practice management actions.

[Q00002a] Species targeted (Birds)

Highlight your choice below (e.g. in a different colour).

- *Acridotheres tristis*, Common myna
- *Alopochen aegyptiacus*, Egyptian goose
- *Corvus splendens*, Indian house crow
- *Oxyura jamaicensis*, Ruddy duck
- *Threskiornis aethiopicus*, Sacred ibis
- Other:

[Q00002b] Species targeted (Mammals)

Highlight your choice below (e.g. in a different colour).

- *Callosciurus erythraeus*, Pallas' squirrel
- *Herpestes javanicus (=H. auropunctatus)*, Small Indian mongoose
- *Muntiacus reevesi*, Muntjac deer
- *Myocastor coypus*, Coypu
- *Nasua nasua*, Coati
- *Nyctereutes procyonoides*, Raccoon dog
- *Ondatra zibethicus*, Muskrat
- *Procyon lotor*, Raccoon
- *Sciurus carolinensis*, Grey squirrel
- *Sciurus niger*, Fox squirrel
- *Tamias sibiricus*, Siberian chipmunk
- Other:

[Q00002c] Species targeted (Reptiles)

Highlight your choice below (e.g. in a different colour).

- *Trachemys scripta*, Red-eared, yellow-bellied and Cumberland sliders
- Other:

[Q00002d] Species targeted (Amphibians)

Highlight your choice below (e.g. in a different colour).

- *Lithobates catesbeianus*, North-American bullfrog
- Other:

[Q00002e] Species targeted (Fishes)

Highlight your choice below (e.g. in a different colour).

- *Lepomis gibbosus*, Pumpkinseed
- *Percottus glenii*, Amur sleeper
- *Plotosus lineatus*, Striped eel catfish
- *Pseudorasbora parva*, Stone moroko
- Other:

[Q00003] Objective

Provide some details on the objective of the measure, its specific aim or intended outcome. Tick the correct option(s) and provide the text in the relevant management objective section.

Please highlight all that apply and provide a comment:

Rapid eradication (early stage intervention)	
Eradication (of widespread population)	
Control	
Containment	

[Q00004] Country(ies)

List the country(ies) where the measure was applied. Highlight your choice below (e.g. in a different colour).

- Austria
- Belgium
- Bulgaria
- Croatia
- Cyprus
- Czechia
- Denmark
- Estonia
- Finland
- France
- French Outermost Regions: French Guiana
- French Outermost Regions: Guadeloupe
- French Outermost Regions: Martinique
- French Outermost Regions: Mayotte
- French Outermost Regions: Réunion
- French Outermost Regions: Saint-Martin
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- Malta
- Netherlands
- Poland
- Portugal
- Portuguese Outermost Regions: Azores
- Portuguese Outermost Regions: Madeira
- Romania
- Slovakia
- Slovenia
- Spain
- Spanish Outermost Regions: Canary Islands
- Sweden
- Other:

Good practice - Measures used

Please categorise which specific measures were applied to manage the invasive alien species. Scroll down the page to get an overview of all the measures identified as possible to use and select those that were applied for this good practice. If applicable, please select both the measures that were used to restrain, capture and/or remove (kill/sterilise) the species in the field, as well as measures that were used to remove (dispatch/sterilise/captivity) species once captured. In case a new measure not listed here was used, please indicate its name and description under the category 'Measure(s) not covered' at the end of the page.

[Q00005] Measures used to restrain, capture and/or remove (kill/sterilise) the species in the field

Pick the specific measure(s) applied below. Highlight your choice below (e.g. in a different colour).

[Q00005a] Biological control

- Native predators

[Q00005b] Habitat manipulation

- Aquatic barriers
- Aquatic habitat management - Pond drying/draining
- Physical barriers

[Q00005c] Hand removal

- Hand removal
- Physical fishing methods - including aquatic nets

[Q00005d] Poisoning or toxicants

- Stupefying bait
- Chemical treatment of habitats
- Poisons and toxins in bait

[Q00005e] Shooting

- Shooting - hunting

[Q00005f] Trapping

- Drowning traps
- Goodnature self-resetting traps
- Spring operated traps
- Cage traps
- Neck-hold traps, and snares
- Live decoy traps

[Q00005g] Other

- Egg oiling
- Electrofishing
- Chemical fertility control
- Hunting dogs (tracking/baying)
- Judas animals

[Q00006] Measures used to remove (dispatch/sterilise/captivity) species

[Q00006a] Dispatch/removal once captured

Highlight your choice below (e.g. in a different colour).

- Cervical dislocation
- Cranial depression
- Decapitation
- Electrocution
- Freezing
- Injection euthanasia
- Keeping in captivity
- Modified atmospheres
- Shooting - dispatch restrained animals
- Slaughter with a knife
- Surgical sterilisation

[Q00007] Additional measures

[Q00007a] Measure(s) not covered

If the measure used is not listed above, please add your measure name and description here.

	Measure	Description
Measure 1		
Measure 2		
Measure 3		
Measure 4		
Measure 5		

Good practice - Description

This section asks for more detailed descriptions of the practice used for the humane management of the species.

[Q00008] Description of the measure

Describe the methodology of the application of the measure(s). Include the specific methods used for each measure, e.g. specific type of cage trap, or specific type of aquatic barrier used.

[Q00009] Time period

For relevant measures (i.e. those with clearly defined start and end period, e.g. months trapping) detail the length of time over which the measure was applied (e.g. the number of months the trapping took place).

[Q00010] Location and scale of application

Note the geographic area/location where the measure was applied – state scale (km^2) and/or size of the population to which the measure was applied to, if possible.

[Q00011] Effort

Provide a quantitative estimate of effort, indicating units of effort and duration, if possible (e.g. person days/year, #traps/km^2/year).

[Q00012] Costs

Please provide overall costs (financial or other), summarising what aspects of the measure's application this covers.

If possible, provide a breakdown of the Overall costs according to Personnel, Equipment and infrastructure, and Other costs (incl. overheads). If possible, please use Euro as the currency, or indicate the currency used in the box below.

Overall costs	
Personnel costs	
Equipment and infrastructure	
Other, including capacity building and overheads	
Currency used above (default: EUR)	

[Q00013] Additional details on costs

Please add any additional details explaining the costs provided above, as necessary.

[Q00014] Source(s) of funding

Good practice - Evaluation

Please assess the practice according to a number of different criteria.

[Q00015] Effectiveness

How effective was the measure at meeting its objective? Highlight your choice below (e.g. in a different colour).

- Effective
- Moderately effective
- Ineffective
- Unknown

[Q00016] Effectiveness

Please provide key evidence/results.

[Q00017] Replicability

Note any potential for transferability and replicability of the measure (e.g. to other species or areas).

[Q00018] Humaneness/animal welfare

Detail how considerations about how the management actions might impact animal welfare were incorporated into the selection and implementation of the management measure (e.g. were any good practices followed to reduce suffering or distress of animals?). Were other available measures not used due to potential welfare impacts (if so, which ones)? Please shortly summarise the observed impact of the measure on the animal welfare.

[Q00019] Public acceptance

Please provide details on how the measure's impact on animal welfare has been presented to the public (if relevant) and describe how the public opinion reacted to the application of the measure.

[Q00020] Side effects

Detail any known or potential side effects (both positive and negative) from the application of the measure, including on non-target species, the environment, public health and wellbeing, and economic.

Note that this does not include the intended outcome of the measure (e.g. native species recovery due to eradication/control of the IAS).

Good practice - Outreach and innovation

Use this section to provide information on outreach and innovation related to the management actions applied. Please also provide relevant references and a small selection of photographs, if available.

[Q00021] Stakeholder engagement - implementation

Detail which stakeholder groups were engaged (and in which capacity) in the implementation of the management actions.

[Q00022] Dissemination

Detail any dissemination and communication activities with the public and/or other groups that were undertaken for the implementation of the management actions.

[Q00023] Innovation

Detail any innovative practices developed and implemented.

[Q00024] Lessons learned

Please summarise here any lessons learned from the application of the measure.

[Q00025] Photos

Please upload 1-3 photos related to the management actions, if possible. After uploading a photo, please provide meta data (photographer, year, copyright) as part of the comment field that appears in the pop up box. By uploading photos, you provide permission for these pictures to be used as part of the case study evaluation process (including at the workshops). We will contact you again if we would like to use the photos publicly (e.g. as part of reports or other materials).

Kindly attach the aforementioned documents along with the survey

[Q00026] References

List references cited and other key documents for further reading

Please submit this questionnaire online: https://onsubject.limequery.net/392715

Data policy

The content of your case study will be shared with the project team, our partners at the European Commission and the participants of the respective regional workshop. This content will be analysed and used for reporting to the European Commission and for dissemination purposes, and may be published on-line.

This survey also collects limited personal data (name, email). This data will be used to contact you a) in case we need additional information to better understand your case study and b) if your case study is selected for inclusion in the EU competition. Your personal data is collected by the online survey platform Limesurvey and later stored securely on IUCN servers. It will not be shared with third parties and all data will be handled in accordance with IUCN data policy. For questions or concerns related to data privacy, please contact ana.nunes@iucn.org.

Participants have the right to access, view, and edit their own information in a timely manner, the right to be forgotten, which means being deleted from the survey results and also the right to be able to opt-out from future messages during the lifetime of the project. All personal data will be deleted within six months of completion of the project (i.e. March 2023).

Legal notice

This questionnaire has been drafted within the framework of the contract No. 07.027746/2019/812504/SER/ENV.D.2. “Identification, Assessment, Sharing and Dissemination of Best Practices for Humane Management of Invasive Alien Species”. The information and views set

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