MICA
Management of Invasive Coypu and muskrAt in Europe

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Layman’s report

Innovative methods developed by the LIFE MICA project and their application for monitoring and management of invasive alien species beyond the project

LIFE18 NAT/NL/001047 – MICA
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Index

Scope of the LIFE MICA project

Innovative methods for monitoring and management of coypu and muskrat

The LIFE MICA project (Management of Invasive Coypu and MuskrAt in Europe) is an EU LIFE project that aimed to develop management strategies for invasive coypus (*Myocastor coypus*) and muskrats (*Ondatra zibethicus*) in Europe. From 2019 to 2023, innovative methods for population control of these species have been developed and tested in cooperation between German, Dutch and Flemish institutions.

Invasive alien species

In the course of globalization, species are spreading around the globe and often establish outside their native range. When these species threaten biodiversity, human and animal health or cause economic damage in their new habitats, they are referred to as invasive alien species (IAS).

EU Regulation on invasive alien species

The EU Regulation No. 1143/2014 aims to mitigate negative impacts of invasive alien species on biodiversity. The regulation defines measures to prevent the introduction of invasive alien species and to manage established populations. A Union list names invasive alien species of Union concern: among others are coypus and muskrats.

Figure 1: Swimming coypu.

Coypus and muskrats in Europe

Originally, coypus are native to South America and muskrats come from North America. They established in Europe after releases from fur farms in the early 20th century. Both species are semi-aquatic rodents, which mainly feed on riparian vegetation and burrow tunnels in dykes and riverbanks. As such, the main impacts of coypus and muskrats are threats to biodiversity in their new habitats, undermining of waterway infrastructure (dikes and dams) and damage to agricultural land.

Management methods developed by LIFE MICA

In the LIFE MICA project, innovative methods for monitoring and management of coypus and muskrats were developed and tested in 11 project areas in Flanders, the Netherlands and Germany. The aim of LIFE MICA was to provide tools for coypu and muskrat management that can be employed in further regions with coypu and muskrat occurrence. Generally, those methods can be also applied for the management of other invasive alien species or even protected species.

- Smart camera traps
- Environmental DNA (eDNA) analysis
- DNA-Mapping
- Smart life traps
- Dashboard

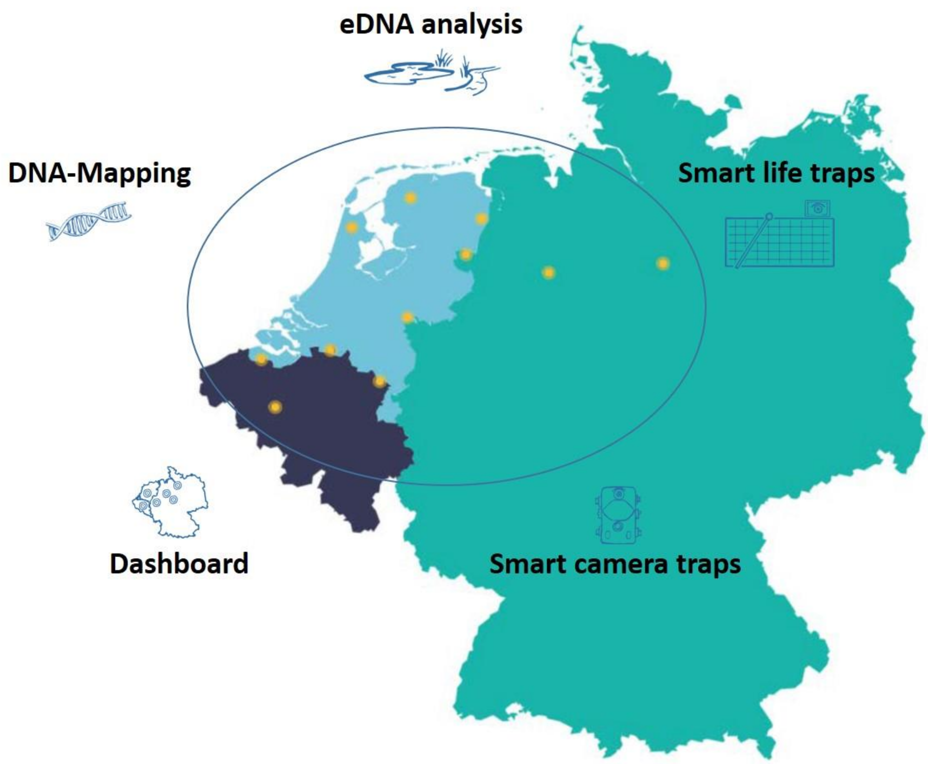
Biodiversity monitoring

In the course of the project, birds, damsel- and dragonflies and riparian vegetation were monitored in the project areas to draw conclusions on the impact of coypu and muskrat populations on biodiversity.

Communication and dissemination actions

The LIFE MICA project was presented at numerous dissemination events (ranging from fairs and workshops to congresses) and was featured in various contributions in scientific journals, general press or TV programs. In this way, the project partners maintained a dialogue with different stakeholder groups.

Management methods developed by LIFE MICA



The following pages contain information on the management methods developed during the LIFE MICA project and offer an outlook on how those methods can be replicated and transferred beyond the project.

Smart camera traps

Large-scale screening of occurrence of coypus and muskrats

In the management of invasive alien species, an efficient early recognition of the first occurrence of the respective species and a thorough monitoring of existing populations are essential. As a consequence, prompt measurements for rapid eradication or prevention of further spreading of those species can be taken. For this purpose, the LIFE MICA project developed an innovative camera trap monitoring that reduces the workload of image analysis with the help of artificial intelligence and thus enables a large-scale monitoring of the occurrence of coypus and muskrats on waterways.

Method

In the course of LIFE MICA, numerous camera traps have been installed at key locations on waterways in project areas in Flanders, the Netherlands and Germany.

Figure 2: Installation of camera traps at a waterway. The cameras are directed towards the surface of the water.

The camera traps take pictures of all animals passing on the waterways.

Figure 3: Camera trap image of a coypu (left) and a muskrat (right) on a waterway.

The camera trap images are uploaded and organized on the platform Agouti (www.agouti.eu). In the beginning of the project, all uploaded images were classified manually according to observed species and number of animals.

Figure 4: Screenshot of the Agouti interface for classification of the camera trap images.

With the help of the classified images, an algorithm was trained for automated image recognition. The algorithm is operating and able to differentiate coypus and muskrats from other species. However, some camera trap images are still classified manually in order to further refine the algorithm.

Figure 5: Classification of camera trap images by the algorithm for image recognition in Agouti. A muskrat is correctly classified as muskrat (Ondatra zibethicus).

Agouti has a user-friendly interface and works with the Camera Trap Data Package Standard, the exchange format for camera trap images.

Application of the method

The organization of camera trap data on Agouti and the screening of the images for the occurrence of coypus and muskrats with the help of the Agouti algorithm, significantly reduces the workload of camera trap monitoring. The Agouti algorithm can also be used for recognition of other animal species. Thus, the Agouti platform might be employed for monitoring of other invasive alien or even protected species.

Figure 6: Camera trap image of an otter at a desiccated waterway.

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Environmental DNA (eDNA) analysis

Detection of muskrats in low density areas

In regions where coypus and muskrats occur just in low population densities, tracking based on visual cues, such as damage to waterways and vegetation becomes extremely time consuming and thus expensive. In these cases, analysis of water samples for the presence of environmental DNA (eDNA) can be a useful tool. As part of the LIFE MICA project, a method was developed by the University of Amsterdam (UvA) to detect muskrat eDNA in water samples.

Method

Semi-aquatic species, such as muskrats constantly shed DNA into the water by losing skin cells, urine or feces. With the help of qPCR, even those small amounts of eDNA can be detected in water samples.

Figure 7: Swimming muskrat.

To reduce the number of samples that must be taken, water from a waterway is pooled over a distance of 5 km to a final volume of 500 ml. To facilitate the sampling, an automated water sampling device was developed; the eDNA autosampler.

Figure 8: eDNA autosampler for automated water sampling.

The current version of the eDNA autosampler can be used from a boat, a remote-controlled boat or for sampling on foot. The eDNA autosampler accurately logs the coordinates of the route taken and can also be adjusted for taking 500 ml of water over tracks of 1 km.

Figure 9: Water sampling via eDNA autosampler from a boat. The water samples run through a plastic tube and are collected in a plastic bottle.

The collected water samples are brought to a laboratory the same day, where they are filtered and further processed for analysis.

Figure 10: Processing of the water samples. The water from the plastic bottle is filtered and the filter paper containing the eDNA is further processed.

During the LIFE MICA project, the strategy for water sampling was improved constantly and adapted to field conditions by frequent exchange with the trappers testing the method in the field.

If a 5 km track is positive for muskrat eDNA, the track can be divided in 1 km tracks to further narrow down the home range of the muskrats. If no visual signs of burrows are present along positive 1 km tracks, point water samples every 100 m along this track can be taken to precisely localise burrows. Point water samples are taken using a manual device.

Application of the method

Results from the LIFE MICA project indicate that full coverage sampling of waterways in an area is not required for obtaining a good estimation of the muskrat population in an area. Therefore, management areas are subdivided into sampling areas. Semi-random sampling of a subset of the waterways with 40 5 km samples can give a good approximation of the population in a sampling area. To statistically confirm that an area is empty of muskrats, an additional 40 samples from different waterways are taken.

In principle, the protocols developed by LIFE MICA for sampling and sample processing for muskrat detection can be transferred and adapted for monitoring of eDNA of other invasive species, such as crayfish, or protected species such as beavers.

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DNA-Mapping

Identification of migration routes of muskrats

Once an invasive alien species is detected in a certain region, it is crucial for an effective management to identify migration routes of the animals. That way, management actions can be directed to avoid a continuous influx of those animals. The LIFE MICA project developed a method that allows identification of relationships between different muskrat populations by genetic analyses (DNA-Mapping) and helps to identify their migration routes.

Method

The protocols for DNA-Mapping were developed and tested exemplary for the province of Friesland in the Netherlands.

For this purpose, tails of trapped muskrats were collected in the course of the Dutch muskrat management in the province of Friesland and neighboring provinces. Samples of the tails were used to elaborate DNA profiles of the animals and compare them with each other.

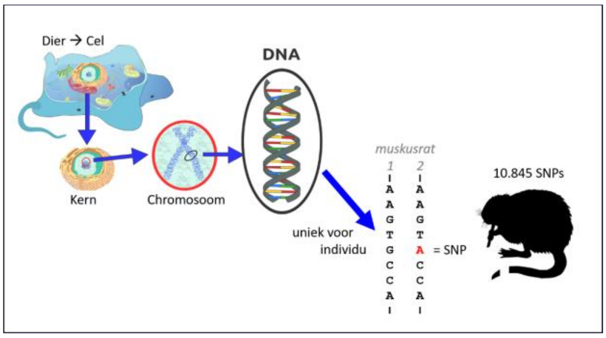

Figure 11: Illustration of DNA-Mapping of muskrats for differentiation of individuals.

The results of the genetic analyses are depicted in Figures 13 and 14 below. Each color represents a trapping organization from different Dutch provinces. In Figure 13, the single red dots on the right side represent the original population of the province of Friesland. On the other hand, the red dots among the cluster of yellow dots, for example, symbolize animals that were trapped in Friesland, but were genetically similar to the population of the province of Zuiderzeeland.

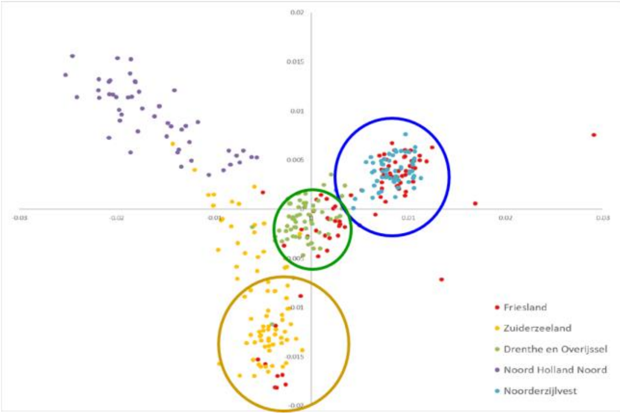

Figure 12: Results of DNA-Mapping of muskrats from Friesland and neighboring provinces. The colors symbolize the different trapping organizations.

On the basis of the identified relationships of muskrat populations from Friesland to populations from neighboring provinces, regions could be identified along which muskrats supposedly migrate to Friesland.

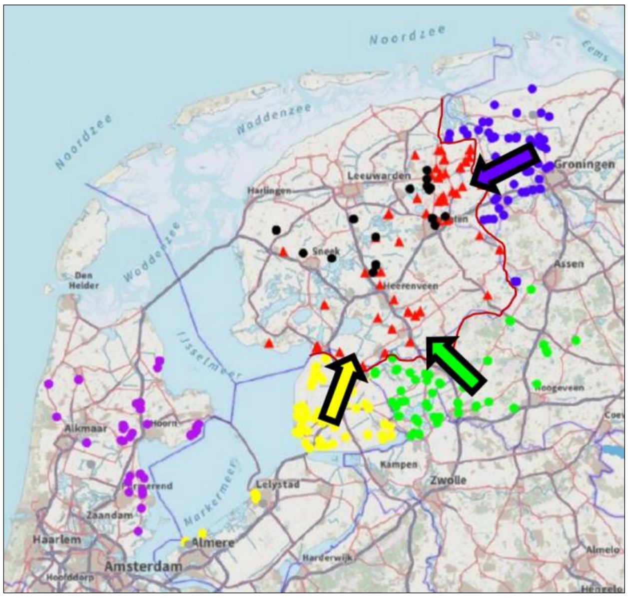

Figure 13: Illustration of the muskrats trapped by different trapping organizations in Friesland and neighboring provinces. The colors symbolize the different trapping organizations. The arrows identify the regions where high migration to Friesland was detected based on the genetic analyses.

The detection of those migration routes of muskrats allows more efficient management measurements, for example, by increasing trapping efforts along water ways where migration occurs.

Application of the method

DNA-Mapping for the analysis of relationships between different populations and identification of migration routes is generally replicable for other invasive alien species.

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Smart life traps

Avoiding unwanted by-catch during trapping

Trapping is an essential tool for population control of coypus and muskrats. However, both species share their habitat with protected mammals like otters and beavers. In order to avoid unwanted by-catch of those protected species, the LIFE MICA project developed selective life traps that work with an image recognition software and only close for the target species coypu and muskrat.

Method

The smart life traps are equipped with an image recognition system in the rear part of the traps and a reverse electromagnet which secures the door of the traps and keeps it open.

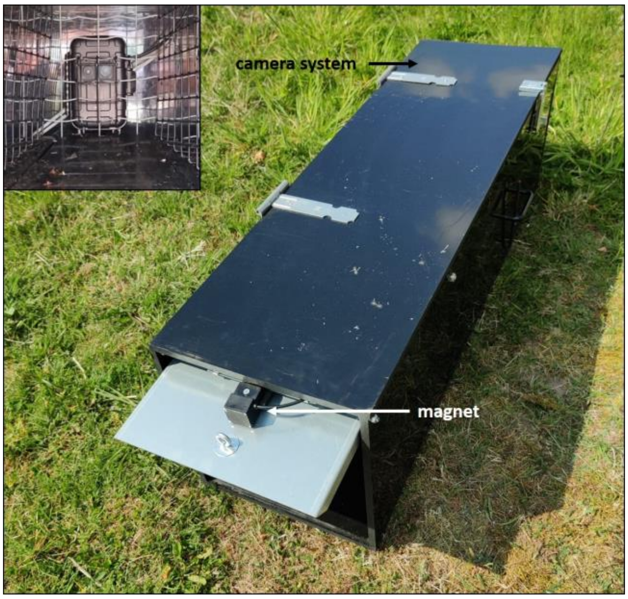

Figure 14: Composition of the prototype of the selective life traps with electromagnet at the door and image recognition system in the rear part of the trap. Inserted picture: image recognition system in the trap.

The image recognition system consists of a motion detector, a camera and a mini computer. If an animal enters the trap, the motion sensor detects a movement and induces the camera to take pictures. The pictures of the animal in the trap are classified by the mini computer with the help of an algorithm.

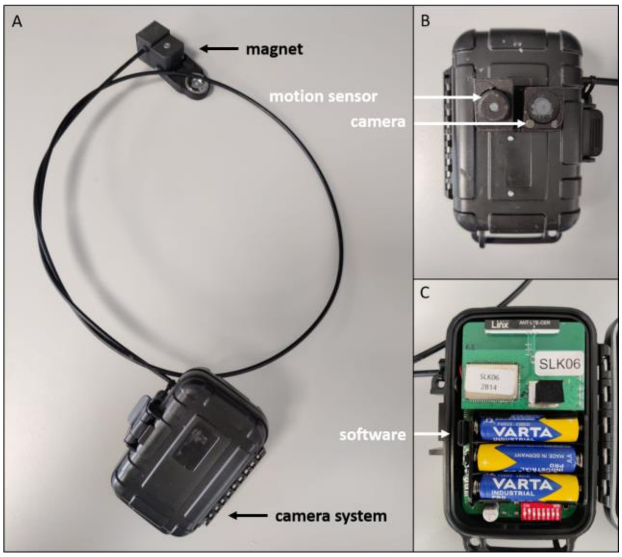

Figure 15: Components of the image recognition system. (A) The camera is connected with the electromagnet, which can be connected to the door of the trap. (B) Frontal view of the camera. (C) Camera system and mini computer from inside.

When the image recognition system detects a target species, coypu or muskrat, a short power pulse (12 V) is applied to the reverse electromagnet and results in its demagnetization. The door of the trap is released, catching the target animal.

Figure 16: A coypu enters the smart life trap. The inserted picture shows an image taken of the animal by the camera inside of the trap. The image is directly analyzed and classified by the algorithm.

Furthermore, the image recognition system issues a message with the location of the trap and an image of the animal from inside of the trap via messaging application (e.g. Telegram) to the smartphone of the trapper.

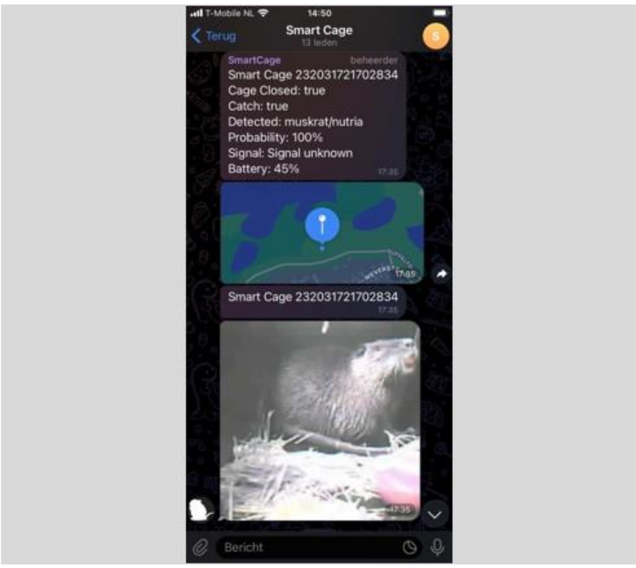

Figure 17: Screenshot of a notification of a coypu catch via messenger service to the smartphone of the trapper.

Application of the method

Prospectively, the developed image recognition and closing mechanism will be adjusted for trapping of other target species (e.g. other invasive alien species or native predators) and adapted for complying with different types of life traps.

Figure 18: Raccoon and otter at a smart life trap. The inserted images show photos taken from the animals inside the trap.

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Dashboard

Collection of data on monitoring and trapping of coypu and muskrat

Management concepts for invasive alien species should be based on available data from species monitoring and an evaluation of applied management actions. Since invasive alien species usually occur transnationally, data on monitoring and management should ideally be exchanged between neighboring countries. The LIFE MICA project developed a dashboard which visualizes data on monitoring and trapping of coypus and muskrats in Flanders, the Netherlands and Germany.

Method

The LIFE MICA project collects data on monitoring and trapping of coypus and muskrats in 11 project areas in Flanders, the Netherlands and Germany. Furthermore, management authorities and trapping organizations in Flanders and the Netherlands register data on trapping of both species nationwide. Data transfer scripts were written for the different data sets and enable publishing the data on GBIF, the global databank for biodiversity data.

Figure 19: Illustration of the data flow from data collection via smartphone application and publication on GBIF to visualization on the dashboard.

After the publication of the data on GBIF, they are visualized on the dashboard of the LIFE MICA project (http://mica.inbo.be/). The datasets can be selected separetedly for visualization and the data can be filtered for species and time period. Data is also displayed in a graph illustrating the development of monitoring or trapping data.

The code for the data transformation scripts and for the dashboard is freely available on GitHub.

https://github.com/inbo/mica-dashboard
https://github.com/inbo/mica-occurrences

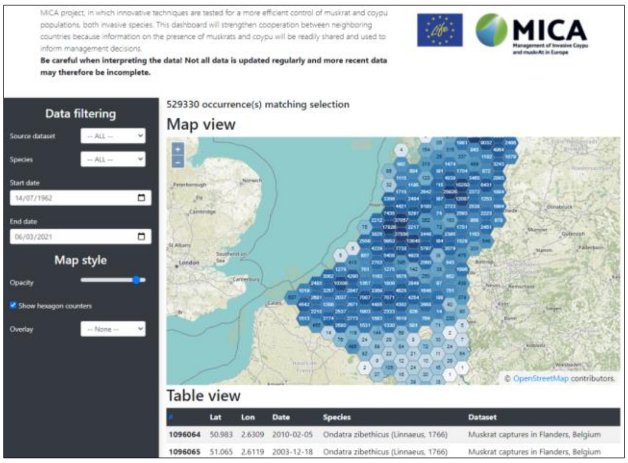

Figure 20: Screenshot of the dashboard of the LIFE MICA project for monitoring and trapping data of coypus and muskrats.

Application of the method

An exchange of data on management and monitoring of invasive coypus and muskrats between neighboring countries is essential for an efficient and coordinated transnational management. The dashboard developed by the LIFE MICA project should therefore ideally integrate data sets from further countries and might also serve as a model for data management regarding other invasive alien species.

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Replication and Transfer

Sharing experiences and results of EU LIFE projects

A **fundamental part of the EU LIFE program is to disseminate the results of the funded projects. The gathered experiences and the methods that were developed and tested throughout a LIFE project should be shared with relevant stakeholders beyond the beneficiaries and the project areas. The goal is to enable Transfer and Replication of the developed methods and approaches.**

In the context of the LIFE MICA project, Replication and Transfer have the following meaning:

Replication:

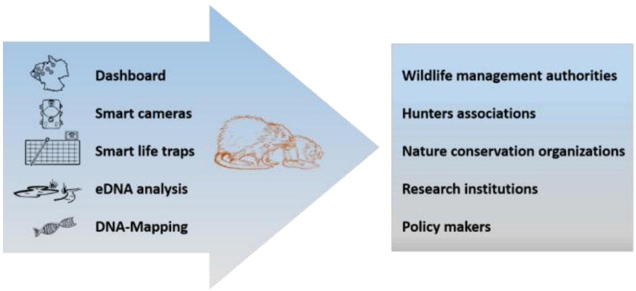
Replication refers to the implementation of the developed coypu and muskrat management tools for management of coypu and muskrat in geographical regions beyond the LIFE MICA project areas.

Transfer:

Transfer refers to the adaptation of the developed coypu and muskrat management tools for the management of other species (e.g. other IAS or even protected species).

In the face of biodiversity loss and the One Health approach (recognizing that the health of people, animals and ecosystems are interconnected), wildlife management currently gains importance. Therefore, the general potential for Replication and Transfer of the LIFE MICA management methods is high.

Potentially interested stakeholders in wildlife management tools are among others: wildlife management authorities, hunters associations, nature conservation organizations, research institutions and policy makers.



The LIFE MICA project aims to ensure the replication and transfer of results and experiences beyond the project, including in other sectors, entities, regions or countries.

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Biodiversity – impact of coypus and muskrats

In the course of the LIFE MICA project, birds, damsel- and dragonflies and riparian vegetation were monitored in the project areas to draw conclusions on the impact of coypu and muskrat populations on biodiversity.

Biodiversity monitoring

Evaluation of the impact of coypus and muskrats on biodiversity

Coypus and muskrats are semi-aquatic rodents which burrow tunnels in riverbanks and dikes and feed mainly on riparian vegetation. By this, both species can influence riparian ecosystems and potentially have a severe impact on bird, fish, amphibian, and insect species that rely on these habitats for survival. The LIFE MICA project evaluated the impact of coypus and muskrats on biodiversity in the project areas.

Reed vegetation monitoring

With the help of Satellite images (Sentinel-1), the areas where reed grows can be mapped. By using this mapping technique systematically over the project areas, the change in reed extent was monitored. The changes in reed extent turned out to vary only a little over the (relatively short) project duration and there was no clear relationship between the reed area and muskrat or coypu abundance.

Figure 21: Reed vegetation in a project area of LIFE MICA.

Part of this lack of a relationship can be due to the very fine resolution that is required to map the relevant changes. In addition, there may be other causes for disappearance (and return) of reed vegetation. Most are due to management by humans but also grazing by waterfowl plays a role.

Monitoring of birds, damsel- and dragonflies and riparian vegetation

Figure 22: Photos of species monitored during the biodiversity studies of LIFE MICA.

From 2019 to 2023, the occurrence of birds, damsel- and dragonflies and plants were surveyed in six of our project areas (Lake Dümmer, Aschau Teiche, Vechtegebiet, Sint-Laureins, Sint-Maartensheide - De Luysen, and Border Gelderse Poort / Kreis Kleve). The same protocols were used for collecting the observations in the field.

We did only see small differences in species richness (number of unique species within a given area) across years. However, there were notable differences between project areas: the highest richness of damselflies & dragonflies (15 species) and plants (35 species) were observed in Sint-Laureins and Sint-Maartensheide - De Luysen and highest bird species richness in Lake Dümmer (18 species). Especially Lake Dümmer and Sint-Maartensheide – De Luysen did harbour a lot of redlist species (14).

Across the project areas there was a positive relation between the reed vegetation extent and the species richness, while there was a weakly negative relation with the muskrat and coypu density. We expect the same relations also within project areas but this could not be confirmed because the project duration was too short for that.

Communication – towards a transnational management of IAS

The LIFE MICA project was presented at numerous dissemination events (ranging from fairs and workshops to congresses) and was featured in various contributions in scientific journals, general press or TV programs. In this way, the project partners maintained a dialogue with different stakeholder groups.

Communication and dissemination actions

Maintaining a dialogue with different stakeholder groups

The overall objective of the LIFE MICA project was to initiate the first steps towards a transnational management approach for coypus and muskrats, including innovative management methods. The project partners engaged in dialogue with a wide range of stakeholder groups for this purpose.

Fairs, congresses, workshops, seminars

From 2019 to 2023, the LIFE MICA project was presented at numerous dissemination events to an audience ranging from IAS management authorities, hunters' community, water authorities, nature conservation agencies, nature conservation organizations, research institutions and animal welfare organizations to the general public. The innovative management methods for coypus and muskrats developed by the project were explained and possibilities to replicate and transfer those methods in wildlife management beyond the LIFE MICA project were discussed with participants of the events.

Figure 23: Presentation of the LIFE MICA project.

Publications

The project partners also published several articles in national, regional or scientific journals to raise awareness of the impact of invasive alien species in general and coypus and muskrats in particular.

Outlook

The LIFE MICA project connected institutions from the EU member states Belgium, Germany and the Netherlands and was a valuable teamwork experience. We sincerely hope that this exceptional network of project partners and stakeholders will develop further, combining the exchange of experiences and methods and transnational collaboration. The goal of the LIFE MICA partners is not only to disseminate and transfer the developed methods, but also to go further steps to improve and upscale them. The chance of joint research and practical experience among EU member states within the LIFE funding will therefore hopefully lead to joint management intentions for invasive alien species across the EU.

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