



LIFE Project Number

LIFE14 NAT/AT/000057
Final Report

Covering the project activities from
01/09/2015 to 30/06/2022

Reporting Date

30/11/2022

LIFE PROJECT NAME or Acronym

Restoration of sterlet populations in the Austrian Danube

Data Project

Project location	Niederösterreich, Wien / Bratislavský kraj, Západné Slovensko
Project start date:	01/09/2015
Project end date:	30/06/2022
Total budget	907.096.- € (real expenditures 1.012.754,-)
EC contribution:	544.096.- €
(%) of eligible costs total budget	59,98%

Data Beneficiary

Name Beneficiary	University of Natural Resources and Life Sciences, Vienna Institute for Hydrobiology and Aquatic Ecosystem Management
Contact person	Mr Thomas Friedrich
Postal address	Gregor Mendel Straße 33, 1180 Vienna, Austria
Fax:	-
E-mail	lb4s@boku.ac.at
Project Website	http://life-sterlet.boku.ac.at

With the contribution of the LIFE-Programme of the European Union



Coordinating Beneficiary



University of Natural Resources and Life Sciences, Vienna
 Institute for Hydrobiology and Aquatic Ecosystem Management
 Gregor-Mendel Straße 33, 1180 Vienna, Austria

Associated Beneficiaries



Stadt Wien, Wiener Gewässer
 Am Brigittenauer Sporn 7, 1200 Vienna, Austria



Plant Science and Biodiversity Center SAS
 Institute of Botany
 Dúbravská cesta 9, 845 23 Bratislava 4, Slovak Republic

Co-Financiers



 Bundesministerium
 Land- und Forstwirtschaft,
 Regionen und Wasserwirtschaft

viadonau



1 Table of contents

1	Table of contents.....	3
2	Lists of key-words and abbreviations.....	5
3	Executive Summary	6
4	Introduction.....	7
5	Administrative Part.....	8
5.1	Description of project management.....	8
5.2	Organigram of the project team and the project management structure	10
5.3	Information of changes or additional tasks without the needs of an Amendment.....	10
6	Technical part	10
6.1	Technical progress, per Action.....	10
A1	Datenbank Genetik.....	11
A2	Sterletcontainer	12
A3	Bewilligung & Dokumentation Sterletcontainer	12
C1	Sterletaufzucht und Auswilderung	13
D1	Monitoring Austria & D2 Monitoring Slovakia.....	16
D3	socio-economic impact.....	18
DX & DY	Additional monitoring methods	18
E1	Pressemitteilungen	19
E2	website.....	19
E3	Networking with other projects	20
E4	Noticeboards & Folder	21
E5	Infotafel Container	23
E6	Aquarium.....	24
E7	Events.....	24
E8	Give away stakeholder	25
E9:	Films.....	27

E10: Spezialinfo Stakeholder	28
E11: International Symposium on Sturgeons 8.....	28
E12: Layman’s report.....	28
EX: Guided tours and excursions, external events and interdisciplinary dissemination actions	29
F1: Project management by IHG	29
F2: Projektbuchhaltung	30
F3: EU Reporting und visits	30
F4: Indicators	30
F5: external auditor.....	30
F6: After LIFE Plan	30
6.2 Main deviations, problems and corrective actions implemented	31
6.3 Evaluation of the project implementation	32
6.4 Analysis of benefits.....	37

2 Lists of key-words and abbreviations

APA	Austrian Press Agency (www.apa.at)
AB	Associated beneficiary
CB	Coordinating beneficiary
Danube Island Vienna	A more than 20 km long island in the centre of Vienna located at the Danube River.
IGB- Berlin	Institut für Gewässerökologie und Binnenfischerei, Berlin
IHG	Institute of Hydrobiology and Aquatic Ecosystem Management at the University of Natural Resources and Life Sciences in Vienna; the coordinating beneficiary.
Ind.	Short for Individual/ Individuals
Inselinfo	Building of the MA45 where information is spread to visitors of the Danube Island in Vienna
ISS8	International Symposium on Sturgeons 8 (2017 in Vienna)
MA45	Magistratsabteilung 45 Wiener Gewässer; the main associated beneficiary
ORF	Austrian Broadcasting Company

3 Executive Summary

Sturgeons are the most threatened animal family globally and an example of the drastic effects of human impacts on our river ecosystems. Four out of five sturgeons are extinct in the Austrian Danube. The main reasons are overfishing in the past and the interruption of migration routes. Only the potamodromous sterlet, the smallest of the native sturgeon species, can still be found in small numbers in the Upper Danube. However, the remnant population is severely threatened due to its small size. The species is on the Red List Austria as "Critically endangered" and is protected by the Convention on International Trade in Endangered Species (CITES).

The aim of the EU- project LIFE-Sterlet was to strengthen the wild population of the sterlet and to establish healthy, self-sustaining populations in the last free-flowing stretches of the Upper Danube.

The project was led by a team of the Institute of Hydrobiology and Aquatic Ecosystem Management of the University of Natural Resources and Applied Life Sciences Vienna, project partners were the City of Vienna - Wiener Gewässer (MA 45) and the Slovak Academy of Sciences. The project was also supported by the Federal Ministry of Agriculture, Regions and Tourism, viadonau, the Lower Austrian Provincial Fisheries Association and a number of other organizations from the fields of fisheries, administration and nature conservation.

The Wachau and the Donau-Auen National Park as well as the River Morava as tributary to the National Park section were selected as project areas. These are the last free-flowing stretches of the Danube in Austria and offer a variety of different habitats due to ongoing river restoration works, which favors the reestablishment of healthy sterlet populations.

Young sterlets were reared by a team of BOKU experts in a hatchery container on Vienna's Danube Island on the premises of the Inselinfo of the City of Vienna - Wiener Gewässer from 2016 to 2021. The rearing tanks were supplied with Danube water and the feeds were selected according to the natural diet. This ensured that the young fish imprinted to the water body and show homing behavior to spawn in the natal river. At the same time, the young fish were prepared in the best possible way for life in the wild by the natural food and fluctuations in temperature, water turbidity, current and chemistry.

A small remnant population of old sterlets was detected by chance downstream of Vienna. Starting in 2018, parental fish from this population were caught annually, propagated and the juvenile fish reared in the hatchery container, with the adults being tagged and released after reproduction. The young fish obtained in this way maintain the genetic heritage and diversity of this remnant population.

Thousands of sterlets have been successfully reared in the hatchery station every year with varying sizes released into suitable sections of the project area during the summer and fall months. The sizes varied from feeding fry of a few centimetres in length to fish of 30 to 40 centimetres in length. While the smaller fish can adapt to a new environment more quickly but are more prone to predation,

larger fish take longer to adapt but are less likely to be eaten. Since the start of the project in 2016, more than 238,000 juvenile fish have been released into the Danube and March rivers. This almost doubles the number of 150,000 envisaged at the beginning of the project.

The hatchery station was open to the public during the summer months and offered a large number of visitors the opportunity to learn more about the project, the sturgeons and the Danube as an ecosystem. Around 50 delegations from Austria, the European Commission, other EU countries and even China visited the rearing container on Danube Island. More than 40 school classes took part in guided tours of the hatchery station, with all school children releasing their personal sterlet into the Danube. With over 180 press reports, TV and radio features, there was wide media interest in the project.

The project was accompanied by intensive monitoring from the beginning, surveying small populations of wild sterlets in the Danube by netfishing. Some of the wild fish caught were later used for breeding purposes. In parallel, genetic samples were taken and the size of the populations downstream of Vienna and in the Jochenstein area on the German-Austrian border was calculated using the degree of relationship. The results showed that the populations in both areas are very small, ranging from 60 to 120 individuals. A particular success in 2021 was the recapture of the first three mature fish that had been released as juveniles in 2017.

A telemetry study was conducted as part of the monitoring. For this purpose, 75 sterlets were equipped with hydroacoustic transmitters. At the same time, receivers were installed along the Danube from the Freudenu power plant to the next power plant in Slovakia, recording the fish swimming past. From the data obtained in this way, valuable conclusions can be drawn about the migratory behavior and habitats of the sterlet.

Even though the LIFE-Sterlet project has already achieved great success, a continuation of the efforts is essential to ensure the survival of this endangered fish species in the Upper Danube. LIFE-Boat 4 Sturgeons, being implemented from 2022-2029, will continue the effort and widen the scope to the whole Danube River Basin and all four remaining sturgeon species.

4 Introduction

The sterlet (*Acipenser ruthenus*) is the smallest species of the Danube sturgeons and lives during its whole life cycle only in freshwater without the need to migrate to the Black Sea. Sterlets are still present in very small quantities in the Upper Danube whereas the large anadromous sturgeon species became extinct in the last century due to overfishing and migration barriers. Sturgeons are a symbol for diverse human impacts on aquatic ecosystems and their negative effects on the biota. The Austrian population of the sterlet is threatened with extinction with only very few specimens remaining. With their extremely low densities they could reach a critical limit for self-reproduction. Hence, the threats targeted in the project were the risk of Allee effects, genetic bottlenecks, as well

as inter- and intraspecific hybridisation with non- native sterlet genotypes and non-native sturgeon species having escaped or being deliberately released into the Danube. We also addressed the lack of awareness for the species in the public and in stakeholders.

From a population dynamic point of view at least 500 to 1.000 adult mature fish in a Danube stretch of about 30- 50 km length are needed to build a minimal viable population. The main objective of the project was to reproduce genetically autochthonous and diverse sterlets and rear their offspring with methods targeting homing behaviour and fitness in the wild. The aim was to release 150.000 juveniles total into the three project areas to establish/support wild populations with 2.000 adult reproductive fish in each project area to increase natural reproduction.

Target areas for the releases were the two free- flowing sections of the Austrian Danube in the regions called „Wachau“ and „Donau-Auen Nationalpark“, the latter including the Morava river at the Austro- Slovakian border. These areas offer suitable habitat diversity and have a high importance to the long-term success of the measures. Different LIFE Projects in these areas have already taken place. They already have and will further increase habitat quality by great scale river revitalization work. In addition, smaller numbers of fish have also been released in other sections during events or for research purposes.

Monitoring actions were mainly focused on habitat use of fish equipped with telemetry transmitters. During the frame of the project, this was extended to population monitoring of two remnant populations using mark-recapture and genetic methods.

Due to the longevity and late maturation, the final success of the project can only be assessed several years after the projects end. However, the longevity also means, that positive effects (released animals) of the project have a long-term impact, hopefully contributing to reproduction and improving conservation status over at least two decades. The project equipment was directly transferred into the LIFE-Boat 4 Sturgeon successor project and the methodology will be replicated and extended in scope for the other Danube Sturgeon species for conservation and dissemination actions alike. Likewise, the approach and hatchery container were replicated for a national reintroduction project of the grayling (*Thymallus thymallus*) in Lower Austria. The container also served as evolutionary step for the third version to be built for the reintroduction of the Atlantic sturgeon (*A. oxyrinchus*) on the Odra River by the German colleagues.

5 Administrative Part

5.1 Description of project management

The main responsible persons at the University of Natural Resources and Life Sciences, Vienna:

- The Scientific Supervisor was Prof. DI Dr. Stefan Schmutz.

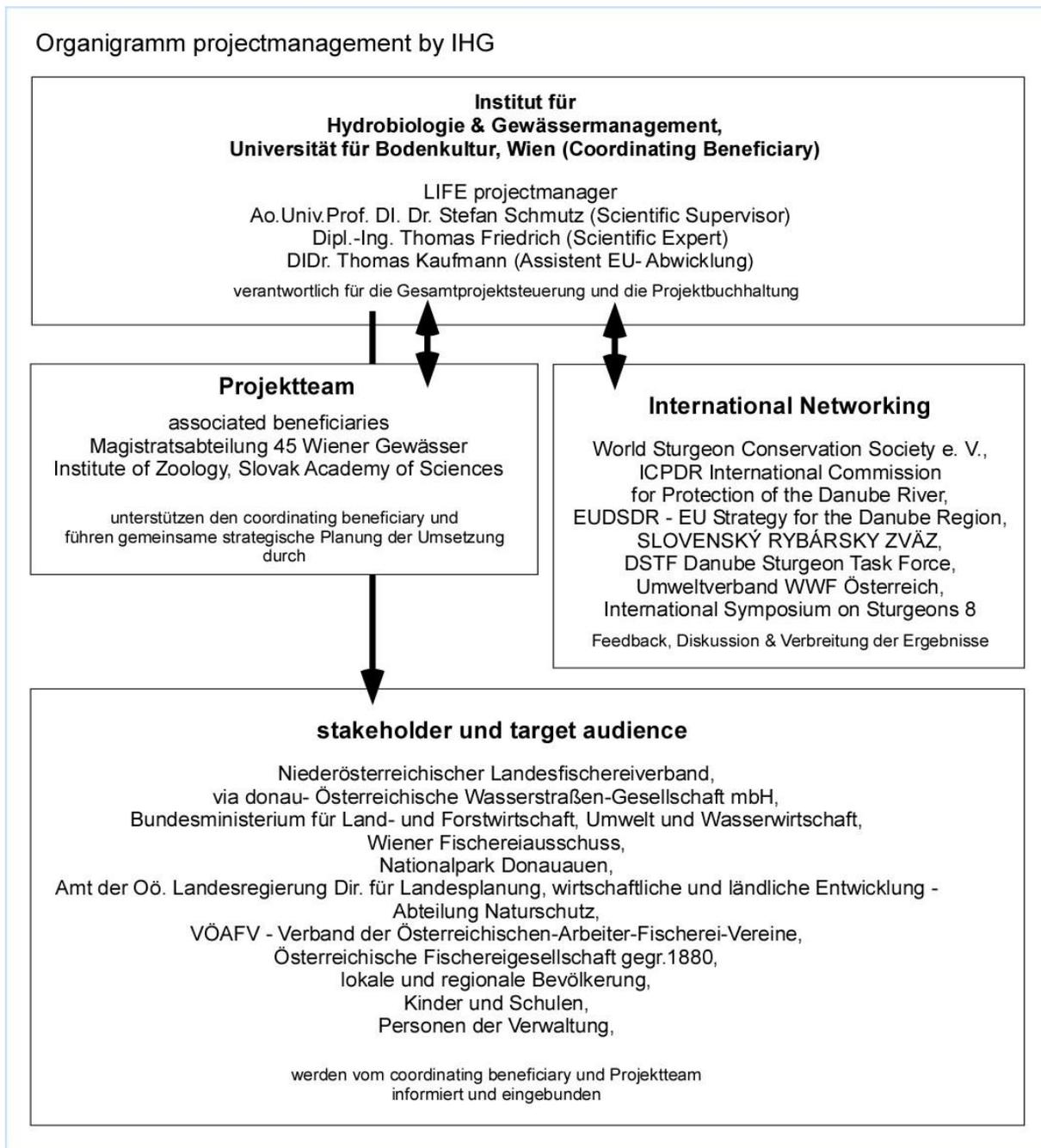
- The Scientific Expert DI Dr. Thomas Friedrich was the responsible project manager for the implementation of the project. This included administrative and operative implementation of all actions, personnel management, hatchery management & strategic linking and embedding of the project.

- The Project Assistant DI Dr. Thomas Kaufmann was responsible for reporting and visits towards the European Commission and direct communication with the Monitoring Team.

At the Associated Beneficiary, Stadt Wien- Wiener Gewässer, three persons were mainly responsible for the project. Dr. Thomas Ofenböck was the project manager, Ing. Woditsch, was responsible for the construction of all structural measures and Dr. Mathilde Urban was responsible for the public relations.

At the Associated Beneficiary, PSBC-SAS, Dr. Ladislav Pekarik was the project manager responsible administrative and operative tasks.

5.2 Organigram of the project team and the project management structure



5.3 Information of changes or additional tasks without the needs of an Amendment

Not applicable.

6 Technical part

6.1 Technical progress, per Action

A. Preparatory actions, elaboration of management and/or action plans

A1 Datenbank Genetik

In order to find suitable animals for breeding, wild sterlet stocks as well as brood stocks in aquaculture facilities were examined for their genetic origin in order to exclude non-native genotypes. In parallel, population genetics of the only known reproductive sterlet population in the Upper Danube, at the German-Austrian border, as well as a small remaining stock downstream of Vienna, which was only discovered during the project, were used to determine the population size. It was planned to analyse 200 samples in the project, which was far exceeded with samples of 286 fish. The preliminary results can be found in the report by 2018 (ANNEX A1), and the final results were submitted to the peer reviewed Journal “Diversity” in summer 2022 for a special issue on “Conservation genetics of sturgeons” (Submitted Version included in DELIVERABLES A).



Article

Genetic Assessment of Remnant Sub-Populations of Sterlet (*Acipenser ruthenus* Linnaeus, 1758) in the Upper Danube

Thomas Friedrich ^{1,*}, Dietmar Lieckfeldt ² and Arne Ludwig ^{2,3}

¹ Institute for Hydrobiology and Aquatic Ecosystem Management, University of Natural Resources and Life Sciences, Vienna, Gregor-Mendelstraße 33, 1180 Vienna, Austria
² Leibniz Institute for Zoo and Wildlife Research, Alfred-Kowalke-Straße 17, 10315 Berlin, Germany
³ Albrecht Daniel Thaer-Institute, Faculty of Life Sciences, Humboldt-University Berlin, 10099 Berlin, Germany
* Correspondence: thomas.friedrich@boku.ac.at

Abstract: While the potamodromous sterlet was common in the past throughout the Upper Danube in Germany and Austria, it nearly vanished in the second half of the 20th century. Until recently, only one small and isolated reproductive sub-population is known from the German–Austrian border. However, isolated remnants in another section downstream of Vienna, near the Austrian–Slovakian border, were discovered in 2014. An assessment of the population size is one of the most important prerequisites for conservation management. This study aims to assess the population sizes at both sites, using genetic pedigrees and comparison to mark–recapture data. A total of 193 samples collected from these populations between 2011 and 2021 have been investigated. In addition, 59 samples from captive stocks, 38 wild fish from downstream, and 247 genetic profiles from previous studies were used for comparison. Results show close relationships and intermittent reproduction on one site. Estimated populations based upon genetic pedigree are very small, and are consistent with mark–recapture results. Small population sizes of remnant populations have only limited, sporadic reproduction, as well as continual losses to outmigration support conservation actions for sturgeons in the Upper Danube, including the restoration of functional migration corridors.

Keywords: Danube; population size; relationship; sturgeon; conservation



Citation: Friedrich, T.; Lieckfeldt, D.; Ludwig, A. Genetic Assessment of Remnant Sub-Populations of Sterlet (*Acipenser ruthenus* Linnaeus, 1758) in the Upper Danube. *Diversity* **2022**, *14*, 893. <https://doi.org/10.3390/d14100893>

Academic Editor: Mark C. Bell

Received: 8 September 2022
Accepted: 19 October 2022
Published: 21 October 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Sturgeons are the world's most threatened group of species, as most populations have collapsed in the last few centuries due to anthropogenic impacts, such as overfishing, the construction of migration barriers, and habitat degradation [1]. Six sturgeon species once thrived in the Danube, which can be separated into three parts along its course: the Lower Danube (LD), from its mouth into the Black Sea to the Iron Gate Gorge between Serbia and Romania, the subsequent Middle Danube (MD), until the Austrian–Slovakian border, and the Upper Danube (UD), between the border and its source in Germany [2]. In the past, the sturgeons' range extended until Ulm, in the UD. Presently, more than 30 barriers in the historic range deny the unrestricted use of the Danube by sturgeons [3]. Hydropower plants (HPP) constructed at the Iron Gate in 1969 and 1984 made the Upper and Middle Danube inaccessible for anadromous species [4].

At present, the potamodromous sterlet (*Acipenser ruthenus* Linnaeus, 1758) is the only species still occurring in small numbers in the UD [5]. The species has patterns of a panmictic population in the Danube [6], but the fractured range with the barriers being mostly impassable for the species may lead to genetic separation of sub-populations, as gene flow is restricted to downstream drift and outmigration of juveniles and adults. The remnant sub-population in the UD within Austria is estimated to be less than 1000 reproductive adults [7]. While the sterlet is classified as “endangered,” with a decreasing trend on the IUCN Red List [8], it is classified as “critically endangered” by the Austrian Red List [7]. Currently, only one small reproductive sub-population below the HPP Jochenstein at the

Fig 1: First page of the submitted manuscripts on genetics.

A2 Sterletcontainer

Construction of the hatchery container started in Germany in late fall 2015. The project manager travelled to the producer for a final approval and finalization of the construction. The hatchery container was delivered on August 1st 2016. After installation of water pipes and power supply trials were run in fall 2016 and full operation commenced with the first sterlet eggs in spring 2017. A photo documentation can be found in DELIVERABLE A. After the LIFE-Sterlet project, the container will be revitalized and used within the LIFE-Boat 4 Sturgeons project.



Fig 2: Inner workings of the hatchery container.

A3 Bewilligung & Dokumentation Sterletcontainer

A water use permit and a building permit were obtained for the construction and operation of the container. In addition, the facility was approved and registered as an aquaculture facility. In accordance with the requirements of the Lower Austrian and Viennese Fisheries laws, permission was obtained from the fishing rights holders to release sterlets in their fishing grounds. All permits can be found in ANNEX A3.

B. Purchase/lease of land and/or compensation payments for use rights

Not applicable.

C. Concrete conservation actions

C1 Sterletaufzucht und Auswilderung

A prerequisite for the successful reintroduction of highly endangered fish species or fish species that have become extinct in the wild is the use of locally adapted, genetically autochthonous strains, which should also exhibit a high level of genetic diversity.

Based on Action A1, it was planned to obtain genetically suitable eggs from commercial fish farms as well as from wild fish from the Slovakian and Hungarian Danube. In 2016, juveniles were sourced for initial trials from three fish farms in Germany, Hungary and the Czech Republic. In 2017, egg incubation started in the completed rearing container. In 2017-2019, a share of the eggs was sourced from a fish farm in Germany, and additionally from 2018 to 2021 eggs were sourced from a Hungarian institute which was able to propagate wild fish from the Hungarian Danube in cooperation with the DTP-MEASURES project. Originally, own propagation was not planned in the project, but during surveys in the monitoring work package a residual population of old sterlets below Vienna could be detected. After genetic analysis, wild fish from this population could be independently propagated and eggs hatched and juveniles released from 2018 to 2022. In total, twelve families were established and a part of each family was kept as future brood stock for the follow-up project to preserve their genetic lineages. After reproduction, the parental fish were returned to their Danube section.

Due to the cooperation with the DTP-MEASURES project as well as the IGB-Berlin, in 2020 eggs and juveniles of Danubian Russian sturgeon (*Acipenser gueldenstaedtii*) and beluga sturgeon (*Huso huso*) were obtained and could be hatched and reared in the container to gain experience. The juveniles will be kept as future mother fish for the follow-up project LIFE-Boat 4 Sturgeons.



Fig 3: Artificial reproduction of wild brood stock, egg incubation in Danube water and hatched larvae.

The incubation of the eggs and rearing of the young fish took place in the rearing container with Danube water. The water was not treated biologically, chemically or thermally in order to simulate conditions in the wild as closely as possible. The young animals were fed with live nauplii of brine shrimps (*Artemia* sp.), later chopped up or whole midge larvae (Chironomidae), shrimps (*Mysis* sp.) and midge larvae (Culicoidea). Hatching and rearing in Danube water differed from commercial rearing under controlled conditions due to temperature fluctuations, turbidity caused by floods, etc., but mortality in the different life stages was within the range of empirical values of commercial farms. In particular, the duration of incubation and conversion from yolk sac to exogenous feeding differed significantly from the literature depending on prevailing water temperatures in the spring. A publication in a scientific journal is currently being finalized. A detailed description of the rearing methodology can be found in Annex Theses in the master thesis of Ms. Lina Florian. The incubation and rearing protocols proved so successful that less than the planned 300.000 eggs were necessary to obtain even more than the originally planned juveniles for release.

It was planned to release 150,000 juveniles in the project areas. In total, over 238,000 juveniles were reared in the rearing container and released in the project areas between 2017 and 2022, exceeding planned numbers by far. The release of juveniles into the project areas Wachau, Donau-Auen National Park and Morava-Thaya system took place at irregular intervals from the feeding postlarval stage in mid-May until September, when the juveniles have already reached total lengths (TL) of 25 to 35 cm. The stocking of especially younger stages was done by boat far from the shore in order not to expose the animals directly to the feeding pressure of invasive Gobiidae in rip-rap areas or wave impact by shipping. Many stocking measures were linked to events, e.g. the willow festival in Drösing, Danube Day, 50th anniversary of the floodplain reserve Marchegg, but also to opening and closing events of several other LIFE projects in the Wachau and along the Morava river. In the context of PR measures or scientific questions, small numbers of fish were also introduced into other sections, for example in the revitalized lower reaches of the river Traisen in the LIFE+ Traisen project.

Some of the juveniles were marked with PIT tags in order to be able to allocate recaptures without any doubt. The project application foresaw a tagging of 1250 juveniles in autumn (0+) or the following spring (1+). In total, more than 3000 released juveniles were marked with PIT tags as well as floy tags (Tab.2). Furthermore, several hundred juveniles, which were kept as future broodstock, were tagged in order to keep the families separate.

The expected survival rates should account to a higher number of adult mature fish strengthening the wild population once all animals are mature around 2026 to 2027 than the originally envisioned 2.000 per project area.

Table 1: Number of released animals in the different size classes

2017-2022	larvae	3 -5 cm	5 -10 cm	10 -15 cm	15 -20 cm	20 -30 cm	>30 cm	TOTAL
Danube/Wachau	17500	28700	4650	1869	910	1369	821	55819
Danube/Greifenstein-Freudenau	23500	8800	1220	880	382	1218	234	36234
Danube/Donau-Auen Nationalpark	34000	51700	10827	1918	1908	2948	1048	104349
River March CZ	8500	5500	7610	4593	670	1962	569	29404
River March AT	8000	2800	1050		50	124	131	12155
Danube/Marchfeldkanal						200		200
Danube/Asten						200		200
River Traisen						253	50	303
TOTAL	91500	97500	25357	9260	3920	8274	2853	238664

Table 2: Tagged fish (PIT= Passive Integrated Transponder, FLOY= Anchor tags, VIE= Visible Implanted Elastomer)

2017-2022	PIT	FLOY	VIE
Danube/ Wachau	106	278	
Danube/Greifenstein- Freudenau	70	100	
Danube/Donau-Auen Nationalpark	675	665	162
River March CZ	298	797	
River March AT			
Danube/Marchfeldkanal			
Danube/Asten			
River Traisen	124		
TOTAL	1273	1840	162

D. Monitoring of the impact of the project actions

D1 Monitoring Austria & D2 Monitoring Slovakia

To gather information on migration behaviour and habitat use of sterlet, different telemetry studies in the Austrian and Slovakian Danube were conducted.

In 2019, the suitability of different telemetry systems was evaluated during a pre-study. The study area was situated in the 35 km long Danube stretch between the hydropower plants (HPP) Melk and Altenwörth, including the Wachau, one of the last free flowing sections of the Austrian Danube. During the study both, the Juvenile Salmonid Acoustic Telemetry System (JSATS) and Lotek's Mobile Acoustic Processor System (MAP) were tested. While the JSATS is especially designed for the use with smaller sized fish, the MAP system is limited to be used with larger fish due to available tag sizes. In the study four different hydrophones, three operating on the JSAT system, one operating on the MAP system and three different tag types were used. All different tag and hydrophone combinations were tested for detection range and detection efficiency in different habitats (free flowing section, impoundment and head of impoundment). The hydrophone operating with the MAP system showed larger detection ranges and is therefore more suitable for a large river like the Danube.

From March 2020 to October 2021 a study on large-scale migration was conducted in the free flowing section along the Donau-Auen National Park. A total of 38 sterlets (5 wild, 33 stocked) were observed using the preliminary tested MAP system. The wild sterlets were caught via net fishing in the study area. The stocked sterlets were reared under semi-natural conditions in the course of the LIFE Sterlet project and kept in ponds until their release. For the application of the acoustic tags a surgery following the standard protocol obtained from literature was necessary.



Fig. 4: anesthetization and surgery

The study area was located between the two HPPs Freudenu (AT) and Gabčíkovo (SK). Along the 48 km of the Austrian stretch, 12 stationary hydrophones were distributed and two hydrophones were deployed in the Slovakian section. In addition to the continuously collected data from the stationary hydrophones, mobile tracking was carried out every month using a mobile tracking device.

Of the 38 released fish, three were never detected and two had very low detection rates or were detected over a very short period. Within the free-flowing section less encounters were made, which can be related to high flow velocities and subsequent background noises. In general, wild sterlets showed longer observation periods and smaller migration ranges than stocked individuals and mainly stayed at their release site. Conversely, stocked sterlets showed a variety of migration patterns, which could be linked to their individual ability to adapt to the new environment. The most observed pattern was an immediate downstream movement after the release. Post-stocking downstream migrations are believed to be a reaction to the flow velocity since all stocked sterlets were held in ponds until their release. The observed migrations could not be related to changes in temperature and discharge.

From March to May 2021 a study on small-scale habitat use and behaviour of sterlets was conducted. An array of five hydrophones was installed in the project area in the Danube downstream of Vienna. The setup allowed retrieving the sterlets' exact positions and residence depth when heard by at least three hydrophones. Four sterlets, which were already part of the large-scale migration study, were observed over six weeks. The average used depth of three individuals was between 10 and 12 m. One individual preferred shallower areas with an average residence depth of 7.5 m. Moreover, it could be observed that the used habitats of all sterlets partly overlapped. However, events with a spatial and temporal overlap between the sterlets were rarely observed. The activity of all four individuals increased with water temperatures exceeding 10 °C.

In the Slovakian Danube a total of 72 Sterlets were caught between June and September 2021 via netfishing. A total of 31 were tagged with acoustic transmitters. The observed river stretch had a length of 13 km. One stationary hydrophone was installed in the upper part of the observed stretch and the rest of the stretch was searched with a mobile tracking device. During the study, 29 individuals were detected. Additionally, three sterlets which were tagged and released during the telemetry study in the Austrian Danube were encountered in the Slovakian section. Between September and October, a total of 32 individuals were detected regularly in the upper part of the study area whereas 25 individuals were detected in the river stretch below. However, only 20 Sterlets in the upper part and six Sterlets in the downstream stretch could be detected in November. This suggests an outmigration of the study area and the use of wintering habitats further downstream. The resolution of the gained data did not allow to develop targeted habitat restoration and conservation recommendations on a small spatial scale with regard to spawning and foraging sites. Nevertheless, the data acquired in several different set ups, presented by all students during the

2022 North American Sturgeon and Paddlefish Conference, is very important for future conservation actions and further refining approaches to detect bottleneck habitats as well as for designing fish passage solutions on barriers suitable for sterlets. Also, the data provided a background for more general recommendations in the “Pan European Action Plan for Sturgeons”.

The project intended to collect information on catches from sportfishing and, therefore, to directly involve anglers in the monitoring schemes (E8 & E10). In total, sport anglers reported nine catches of sterlet and one Siberian sturgeon from the Morava/Thaya system and the Danube through sport fishermen. Based on the total lengths of the animals (420 mm - 650 mm) and the previous lack of records from the area, it can be assumed that they originate from the stocking program within the LIFE-Sterlet project.

D3 socio-economic impact

Sociological effects of the LIFE-Sterlet project result mainly from the awareness of the human population for the endangerment of the aquatic fauna and the sturgeons, whereby special attention was paid to the value of the Danube as an ecosystem and its diverse ecosystem services. As part of the master thesis of Ms. Pamela Gumpinger, a questionnaire was developed in 2016 and surveys of the Viennese population were conducted, which focused on the topics of awareness of sturgeons, effectiveness of public relations, perception of the European Union in nature conservation and interest in conservation work. The survey was repeated in 2021 as bachelor thesis of Ms. Margarete Stockert.

Both surveys show that biodiversity and conservation of native species have a high priority among the respondents. The preservation of aquatic habitats, conservation of flora and fauna and protection of endangered species are considered very important ecological functions of the Danube Island. In both surveys, almost all respondents were able to assign the correct image to a sturgeon. In 2021, “native species” and “endangered species” were mostly associated with sturgeons in contrast to 2016, where “caviar” and “endangered species” were mentioned the most. Very low sturgeon-specific knowledge was noted in both years. A comprehensive summary can be found in DELIVERABLES D and both master and bachelor theses in ANNEX Theses.

DX & DY Additional monitoring methods

During a field trip in the frame of an excursion several old sterlet individuals could be caught incidentally in the project area downstream of Vienna. While originally not budgeted, these net catches were the impetus for artificial reproduction and propagation of this population as well as monitoring using the capture-mark-recapture (CMR) method and genetic population size (A1). Results of the data generated between 2018 and 2021 were submitted as a scientific article to the Journal of Applied Ichthyology (ANNEX PUBLICATIONS). CMR is a commonly used tool to estimate population sizes and collect various biological information. The objective of CMR monitoring was to

assess the structure and size of the remnant population of wild sterlets east of Vienna. The data collected will serve as the basis for evaluating the success of support stocking in the future.

Using a set of four to five trammel nets 10-20 times per year we were able to catch 47 fish from 2018-2022. All fish were tagged with PIT tags, had their biotic data and genetic samples taken and were released immediately or after artificial reproduction. Depending on the model used for calculation, the population size estimates range from 48-53 (95 % CI=(42)43-(63)80) individuals. Detailed results can both be found in DELIVERABLES D as well as ANNEX PUBLICATIONS. The capture of three mature male fish in 2021 which originate in the 2017 released cohort together with the old animals has to be highlighted as very positive signal towards the survival, maturation and expected contribution to a population recovery.

Since eight of the nine catches from recreational fishing originate from the Morava/Thaya system, a two-day electrofishing survey was conducted in the Thaya in spring 2022 as an additional monitoring measure over a length of 22 km between the weir in Břeclav and the estuary into the Morava River. In the course of the sampling, 31 fish species were detected, but no sterlet could be caught. The collected data on the other species will be used for habitat restoration and species conservation by the Water Research Institute Prague.

E. Public awareness and dissemination of results

E1 Pressemitteilungen

To inform the general public about the progress of the project and to increase the knowledge about sturgeons, 20 print articles and 3 TV contributions were planned in the project application. This goal was far exceeded with over 120 press articles in print and online media as well as journals, 10 radio contributions and 20 television contributions. In addition to press releases and articles designed by the project team, the high level of interest of media and constant requests and reporting on the project are particularly noteworthy. A summary of the articles can be found DELIVERABLES E and ANNEX_E1.

E2 website

The website for the LIFE Sterlet project has been online since November 2015, providing insights and up-to-date information about the project. Updates have been made monthly and quarterly at the latest, and the news page includes over 210 entries since the project began. Links to press releases could thus also be archived on the website and provide a good overview of the entire project duration. The website will be operated under its own domain at least until five years after the end of the project: <https://life-sterlet.boku.ac.at/index.php/home.html>. In addition to relevant information about the project, there is also a download area where products of the LIFE project, press releases, audiovisual material and scientific articles and background documents about the project are available. Over the

years 2018 - 2021, according to Google Statistics, there were 50,469 hits on the homepage and 20,487 visitors. A more detailed list is given in the DELIVERABLES E.

To host the films and videos produced in the project a YouTube channel for the project was created, allowing embedding of films.

While not originally envisioned and budgeted, we created an Instagram channel with the name "Sturgeon_conservation" which provides quick insight and low-threshold access for younger interested people. The account has 925 followers and is linked to many partner organizations.

E3 Networking with other projects

LIFE-Sterlet participated annually in the LIFE Platform of the Federal Ministry starting in 2016, where an overview of the project's progress was presented to all participants.

Unfortunately, hosting the LIFE Platform by the LIFE-Sterlet could not take place due to the pandemic situation in 2020 and 2021. The budgeted funds were used for multiple other events as listed in DELIVERABLES E.

A DSTF Meeting was hosted in 2019. The agenda is to be found in ANNEX_E3 and the file DELIVERABLES E.

As member of the IUCN Sturgeon Specialist Group, the project manager travelled to Shanghai, China in September 2019 to conduct a re-evaluation of the Eurasian sturgeon status for the IUCN Red List with other experts. The reclassification evaluation process was completed in 2022 and the results were subsequently published at the Red list website. Contributions by the project manager are to be found in ANNEX_E3.

At the international conference "Conservation of Danube Sturgeons - a Challenge or a Burden" in Galati, Romania in October 2019, the project was presented and contributed to the Galati Declaration for the Protection of Sturgeons in the Danube and Black Sea Region. The declaration and the presentation are to be found in ANNEX_E3.

As part of the International Commission for the Protection of the Danube River (ICPDR) WePass project, the LIFE-Sterlet project manager was present in the stakeholder process and provided technical input. The project progress of the LIFE-Sterlet project was regularly presented at the Ordinary Meetings of the ICPDR.

Together with the INTERREG-MEASURES project, we visited several fish farms with a species conservation focus as well as commercial sturgeon farms in Italy (Aquatic Species Conservation Center South Tyrol, Caviar Farm Naviglio, Caviar Farm Pisani Dossi, Storioni Ticino), Germany (Rhoenforelle, Institute of Fisheries of the State Research Institute for Agriculture and Fisheries

Mecklenburg-Vorpommern, Institute of Freshwater Ecology and Inland Fisheries, Berlin), Hungary (Rideg & Rideg, NAIK-HAKI).

During the project there was a permanent exchange of experience and coordination with the reintroduction efforts of the Baltic sturgeon (*A. oxyrinchus*) in the Odra river and the European sturgeon in (*A. sturio*) in the Elbe and Rhine rivers by the Institute of Freshwater Ecology and Inland Fisheries Berlin (IGB-BERLIN).

Dr. Friedrich and Mrs. Florian visited the German project on May 1- 5th 2016 using LIFE funds. Dr Friedrich visited the German projects several more time, for example Oct. 26-30th 2017, March 11-16th 2018 or Aug. 27-30th 2019 using funds from various other sources. German colleagues (Dr. Jörn Gessner) visited the LIFE-Sterlet facility on Sep. 10-16th 2017, July 9-10th 2018 and June 12th 2019 and several more times focussing on the development of the PAN-EU AP. All incurred costs could be covered from other sources than the LIFE budget.

Due to the activities of the project manager in the boards of the World Sturgeon Conservation Society (WSCS) and Danube Sturgeon Task Force (DSTF), the project was integrated in relevant international networks and the gained experiences also played an essential role in the preparation of the "Pan European Sturgeon Action Plan".

E4 Noticeboards & Folder

Noticeboards were placed in the entrance area of the Municipal Department 45, in the Haus des Meeres, in the Zoo Schönbrunn, in the visitor centre of the Donau-Auen National Park and in the information booth of MA45 on the Danube Island. The project information is thus on the one hand accessible to a broad public. The boards were placed in display cases and are intended to provide information about the project in general and its progress, and to offer contact opportunities. The first info sheet was completed in June 2016.



Fig.8: The infoboard in the Zoo Schönbrunn.

The hand out folder contains info about the sterlet and the project. During the course of the project, the folder was updated once to illustrate initial results of the project. The folder was available at the island info desk of MA45 and distributed at events. The first info folder was printed in 2016 in three different languages (5000 pcs. German, 2500 pcs. Czech, 1250 pcs. Slovak). In 2019 the folder was updated and 2500. pcs printed in German. Distribution happened via the locations at the Inselinfo and the visitor centre in the Nationalpark Donauauen as well as during multiple events.



Fig.9: The infolders.

E5 Infotafel Container

The information board was attached directly to the hatchery container on the Danube Island. On the 2,2 x 1,5-meter large board the contents of the project as well as general information about the sterlet and the project are presented. The board shows the EU- LIFE logo, the Natura 2000 logo and a text with reference to the EU funding. The information board was installed in time for the start of the project in 2016. In addition, a bilingual information board was installed at the bike path at the mouth of the Thaya as were two banners along the fence of the Inselinfo. Additional pictures can be found in DELIVERABLES E.



Fig.10: The information board on the container.

E6 Aquarium

A publicly accessible aquarium with juvenile sterlets was installed in the building of the Inselinfo of MA45. While the breeding container can only be visited during excursions, the aquarium is open to the public every day during the opening hours of the Inselinfo and serves as an information and exhibition piece of the project. In addition to sterlets, the aquarium also contained non-native sturgeon species to highlight the dangers of inadvertently releases of non-native species. The aquarium was set up and operated in accordance with the requirements of sturgeon species and the specifications of the Animal Welfare Department of the Veterinary Office of the City of Vienna (MA 60).

E7 Events

Originally planned were two large events to kick-off the project and celebrate the first release into the Danube. Instead, we organized three large events and several smaller events to increase the outreach of the project.

In 2015, the kick-off meeting for the project partners, donors and interested parties took place at Danube Island in an open discussion stakeholder forum. In 2016, the official opening event took place on the Danube Island to inaugurate the hatchery container with lively media interest and high-ranking personalities from politics, nature conservation, business and science.



Fig.11: Release of sterlets in the Danube/ Wachau with stakeholders and decision makers.

Over the years we organized three events along the Austrian and Czech Morava with school classes to release sterlets. Additional release events were organized several times with the “LIFE+ Auenwildnis Wachau”, “LIFE+ Untere Marchauen” and several federal ministers for environment and climate.

In September 2021 a large final event took place in September to which project partners, government representatives and stakeholders were invited to celebrate the success of the project.

A detailed list on all events can be found in DELIVERABLES E.

E8 Give away stakeholder

Sturgeon identification cards

The identification cards include all sturgeon species of the Danube, as well as non-native sturgeon species, identification characteristics and life requirements and was printed in an edition of 5000 pieces. In addition, the cards contain a contact address and telephone number and instructions on how to handle the caught animal as gently as possible so that in the event of catches by anglers, reporting is eased. The cards were distributed to visitors at the container and local fishing clubs and at events. The primary target audience are recreational fishermen, who can use the cards to identify the sturgeon upon catch. The intention of the cards is to raise awareness among recreational fishermen about sturgeon and the problems of introduced invasive species, as well as to promote the reporting of caught sturgeon in the Danube. The cards were completed in 2017 and have been distributed since then to stakeholders and fishing associations for further distribution to their members.



Fig.12: Sturgeon Identification cards

Better than caviar - mint candies

In May 2016, the first giveaway was ready. The "Better than Caviar" candies in caviar tin optics draw attention to the LIFE project, but also to the problem of illegal poached caviar. The tins were presented at Danube Day in June 2016 at the "Museumsquartier" in Vienna. The tins were subsequently used as give away during events as well as for school class visits.



Fig.13: "Better than caviar" mint candies in caviar shape.

Plush sturgeon

For special occasions small plush sturgeon toys were created in smaller numbers as giveaway.

E9: Films

Several short films were created over the course of the project. These are on average no longer than 3 minutes. In 2017, the first four short films were produced. The short films act as ongoing reporting of the project. The films were all uploaded to the internet platform YouTube and can be found on the project's own LIFE Sterlet channel, which has since been renamed LIFE-Boat4Sturgeon.

<https://www.youtube.com/channel/UCbDrS99SF716Ysbvq-ZLPTQ>

The originally planned four short films and one longer project documentary was surpassed by thirteen short films and a long project documentary, which was presented for the first time in 2021 at the final event of the project.

Project Documentation Film List:

2021: LIFE Sterlet – Project documentary, 11:08 min

2021: Documentary Trailer, 00:36 min

2020: Project Portrait by danubediversity.org, 04:36

2018: LIFE- Sterlet Identification of Exotic Sturgeon Species, 07:10

2018: LIFE-Sterlet Identification of Danube Sturgeon Species, 09:26

2018: LIFE-Sterlet Sanctuary for non-native sturgeons, 03:49

2018: LIFE-Sterlet – Photoactive behavior of early fry of *Acipenser ruthenus*, 00:59

2018: LIFE-Sterlet – Education of future sturgeon conservationists, 00:22

2018: LIFE-Sterlet – The next generation, 00:33

2017: LIFE Sterlet 2016 – Overview on actions within the LIFE-Sterlet project in 2016, 04:36

2017: LIFE Sterlet, Imagefilm of the project, 01:33

2017: Release captured & tagged sterlet, 00:15

2017: Release juvenile Sterlet 2017, 00:28

E10: Spezialinfo Stakeholder

Each year, apart from the pandemic years 2020 and 2021, an event was organized to invite recreational fishermen and fishing associations on a one-day workshop to inform them on the project and increase compliance towards reporting of catches as well as a hands- on training on identification of native and non-native sturgeon species. The events took place each year in July (22.07.2017; 22.07. 2018; 4.7.2019) with 23, 17 and 14 participants at the Danube Island hatchery station.

E11: International Symposium on Sturgeons 8

In 2017, the eighth International Symposium on Sturgeons (ISS8) was held at the University of Natural Resources and Applied Life Sciences, Vienna. Held every four years, the World Sturgeon Conservation Society (WSCS) conference is a global focal point for representatives from academia, aquaculture, the fish trade, species conservation and government bodies. The conference lasted six days and included parallel lecture sessions, workshops, field trips and social events. As part of the conference, one day was dedicated to the LIFE Sterlet project. During a one-day workshop, the project was presented and discussed to 250 international participants. This was followed by a field trip to the sterlet container. The conference proceedings will be forwarded as a print version.

E12: Layman's report

In 2021, the so-called Layman's Report was prepared. It was written in paper and electronic form and in both German and English as well as in a barrier-free version. The Layman's Report serves to

present the project objectives and the results in a generally understandable form. A total of 300 copies were printed in English and 1000 copies in German. While it was intended to print 5000 copies, we reduced the numbers as leftover printed material cannot be considered sustainable, especially in conservation project. As folders (E4) were still available in numbers it was decided to use the funds intended for more copies of the layman's report for additional events and higher numbers of reared juveniles for releases instead.

EX: Guided tours and excursions, external events and interdisciplinary dissemination actions

This action was not included in the application but became an elementary part of the project. Various groups from elementary school classes to delegations from abroad undertook excursions to the LIFE-Sterlet rearing container to gain insights into the life of the sterlets through a guided tour.

Since 2016, more than 100 field trips and excursions took place. Additionally, on weekends when the Inselinfo was open to the public, on average 10-20 walk-ins per day were given a tour.

The team has also been traveling nationally and internationally to disseminate the project on 72 external organized events to both interested public as well as stakeholders and scientific groups. These events include for example Danube Days, World Fish Migration days, ICPDR Meetings, EU Protects, 50 years Auenreservat Marchegg, March Renature Festival etc.

Another dissemination channel developed during the project through personnel of the project also teaching at an arts university, the linking of art and science to raise awareness of sturgeons. This took place in the form of a wide variety of national and international events on more than 22 occasions.

It is noteworthy that both external and on-site visits have mostly taken place upon request or invitation, as the interest in the project has multiplied over time.

A detailed list on all excursions and groups as well as external events is to be found in DELIVERABLES E.

F. Project management and monitoring of project progress

F1: Project management by IHG

The Institute of Hydrobiology and Aquatic Ecosystem Management (IHG) at the BOKU - University of Natural Resources and Life Sciences in Vienna conducted the whole project as coordinating beneficiary. The project manager Mr Thomas Friedrich was efficient, well established in scientific and practical communities and implemented the project as intended. Difficulties were overcome and his main idea to practically hatch endangered sterlets of genetically determined Danube status with natural Danube water and natural feed was successful. These by the project hatched and released individuals are best fit for environment. The administration of the project was done as team work and

was also successful because knowledge from other LIFE projects could be used and the University was an administrative, practical and scientific helpful institution.

F2: Projektbuchhaltung

The project's accounting was made by the accounting department of BOKU. The LIFE sterlet project had the unique account Number. Costs were charged to this account if the project manager gave his ok to assigned expenditures to the account and his supervisor, the institute representant signed it. The SPA, Service department of BOKU made the financial exposee of the personal costs and within the IHG Institute two persons checked the expenditures and archived the documents of the expenditures and set up the Info for LIFE reporting.

F3: EU Reporting und visits

Reports: 1st progress report 31/12/2016, mid-term report 31/08/2018, 2nd progress report 30/09/2019, 3rd progress report 30/11/2020.

There was an amendment made in 09/2021 to expand the projects duration for a half year (one breeding season in addition) until 30/06/2022

F4: Indicators

An indicator table was set up within the revision phase of the project proposal in 2015. After a trial to fill information into an excel sheet of the EU commission for outcome indicators in 2017, the database was closed. In 2018 the new KPI- database was filled.

F5: external auditor

Within the projects duration there was a change of LIFE regulations and the LIFE Sterlet Project no longer needs a financial audit because of its EU funding budget is below the threshold for a need of audit.

F6: After LIFE Plan

The After-LIFE plan, consisting of monitoring of project impacts, maintaining the data, resume releases of juveniles, networking and dissemination actions und prolonged use of the equipment such as the hatchery container, hydrophones for telemetry and minor items for conservation as foreseen in the proposal is carried out and increased in scope to more species and the overall Danube catchment in the successor project LIFE-Boat 4 Sturgeon. All partners of LIFE-Sterlet are beneficiaries in LIFE-Boat 4 Sturgeon and their legal binding commitment is to be found in the new Grant Agreement (see Annexes "Due Deliverables/ Deliverables F" and Annex others "Annex F6").

6.2 Main deviations, problems and corrective actions implemented

Although the last two years of project implementation happened in what can only be called challenging times because of COVID-19 pandemic, only minor problems were encountered during the project's timeframe.

Due to a strictly followed working regime, the covid-19 situation did not affect works within the hatchery container such as reproduction, incubation or juvenile rearing. Public relations activities and excursions had to be partially cancelled and postponed and unfortunately it was not possible to host the Austrian LIFE-Platform event due to the high number of LIFE-projects in Austria and hence limited slots available. However, this was mitigated by participation and information at all LIFE-Platforms throughout the projects timeframe and by organizing several more other events than originally planned in the proposal. Also, the possibility for telemetry tracking was seriously hampered by travel restrictions, leading to less data on habitat use of the released sterlets. Therefore, we included an additional survey with 2D telemetry to observe wild fish and their behaviour during the spawning season to get better insight in possible spawning sights and migration on meso-habitat scale (Annex_Theses Ms. Popp).

Transmitter performance did not fully meet the expectations as tag size was limited by the size of the juvenile sterlets and hydrological conditions of the Danube reduce the effective range. Coupled with travel restrictions, the resolution of the gained data did not allow to develop targeted habitat restoration and conservation recommendations on a small spatial scale with regard to spawning and foraging sites. Nevertheless, the data acquired in several different set ups, presented in Annex_Theses as well as by all students during the upcoming 2022 North American Sturgeon and Paddlefish Conference, is very important for future conservation actions and further refining approaches to detect bottleneck habitats as well as for designing fish passage solutions on barriers suitable for sterlets. Also, the data provided a background for more general recommendations in the "Pan European Action Plan for Sturgeons".

During the daily work with juvenile fish, minor issues both based upon technical problems, human errors or biological factors can occur sporadically. All problems encountered led to additional failsafe mechanisms to be implemented and overall no major problem that could not be overcome impacted the problem. Of interest were two summers with water temperatures $>24^{\circ}\text{C}$ over extended times, leading to infections with *Flavobacterium columnare* in ~5% of the juveniles. Reducing the densities in the basins and adding cold tap water to decrease temperature was the key to overcome this problem.

6.3 Evaluation of the project implementation

The reproduction, incubation and rearing methods were adapted throughout the project and proved to be more successful than anticipated as mortalities remained way lower than foreseen and many more juveniles than planned could be released. The final success of the project can only be evaluated once all released animals mature in the coming years. This was already stated in the proposal and the successor project enables consecutive analysis of the population development and impact of the project.

The overall public and stakeholder interest and hence effectiveness of the multiple dissemination actions exceeded expectations by far and led to many additional public relations activities not foreseen in the proposal.

The project led to or directly impacted several successful project applications, such as DTP MEASURES, LIFE-Boat 4 Sturgeon, IUCN-Sturgex and a feasibility study for *ex situ* conservation and accompanies other projects such as WePass and WePass2. Together with the International Symposium on Sturgeons 2017 in Vienna, the “Vienna Declaration for Sturgeon Conservation” was developed and published in 2018. The project manager was also one of the authors of the “Pan European Action Plan for Sturgeons” also published in 2018 and contributed to the “Galati Declaration on Sturgeon Conservation in the Danube Basin and the Black Sea” in 2019.

Based upon the visibility and success of the project, the project manager was also consulted by WWF-Caucasus on the development of sturgeon identification guidelines for the Eastern Black Sea and Georgia, as well as from 2021 to 2023 for the development of a sturgeon population monitoring programme, matching approaches and methods used in the Danube River Basin for an overall catchment exchange. In 2019, staff of the project contributed the updated IUCN Red List Status Assessment of Eurasian sturgeon species and co-authored two species (*A. ruthenus* and *A. stellatus*), published in 2022.

The project also attracted additional cooperation with Povodi Moravy and the town of Drösing, which led to additional events and releases with local school classes and stakeholders from the Czech Republic.

Table 3: Objectives and results

Action	Objectives in revised proposal	Expected Results	Achieved	Evaluation
A1	Analysis of 200 genetic samples	Identification of suitable donor populations in captivity	193 samples of wild fish in AT, 59 fish in captive stocks in EU and 38 fish from the Middle and Lower Danube have been analysed and further 247 samples from previous studies have been included in the analysis. Suitable donor populations have been identified and the sterlet populations of the Danube have been found to be panmictic. Furthermore, we did a genetic population size assessment for two remnant populations as well as an analysis of pedigrees within the population.	With 290 analysed samples and additional analysis relevant for conservation but not envisioned within the proposal, objectives have been exceeded.
		Evaluation of differences of wild populations along the Danube		
A2 & A3	Timely construction and permits for the hatchery container	Operational hatchery container	The container started test operation in fall 2016 and full operation in spring 2017.	All tasks have been achieved timely to start operation as foreseen in the proposal.
		All permits for operation are available		
C1	Incubation of 300.000 sterlet eggs/year	Strengthening of the wild population with 6.000 adult mature fish	Eggs numbers differed in the years, however, incubation and rearing methodology in Danube water proved so successful that lower numbers of eggs proved to be sufficient for planned release numbers. More than 238.000 juvenile fish have been released during the project. More than 3.000 tagged juveniles have been released.	The overall numbers of released animals exceeded the planned objectives by far and the novel methodology proved to be highly successful in rearing juveniles fit to survive in the wild. The expected survival rates should account to a higher number of adult mature fish strengthening the wild population once all animals are mature around 2026 to 2027.
	Release of 150.000 juveniles during the project			
	Release of 1250 tagged juveniles during the project			

D1 & D2	Migration studies on 75 released animals with telemetry tags	Increased knowledge in migration and habitat use of sterlets	104 sterlets were tagged with hydroacoustic telemetry tags. The gained data led to a huge increase of knowledge on the autecology of the species relevant for future conservation efforts. Statistics on catches included both sport angling captures as well as catches by the monitoring team. An additional mark-recapture survey was implemented to assess the size of a previously unknown remnant sterlet population of large old individuals downstream of Vienna.	The overall numbers of tagged individuals exceeded the plans. While the findings are of major importance, the resolution of the data on habitat use is not fine enough to recommend a targeted set of measures to restore certain key habitats and further investigations are required. The assessment by the mark-recapture survey not only gave insight into population size but also to relevant autecology such as spawning periodicity, sex differences, spawning time in the Danube as well as recapture of three mature male fish of the 2017 stocked cohort in 2021.
	Statistics on catches	Catalog of measures for future habitat restoration		
D3	Implementation of a survey in the frame of a master thesis	Study on the knowledge of the public on sturgeons, threats and status of freshwater ecosystems and the role of EU-LIFE in conservation.	The study was implemented in 2017. In order to see changes in public perception, it was decided to repeat the study in 2021 in an additional bachelor thesis.	The studies showed that perception of the broad public especially on freshwater ecosystems and their critical status remains low and contributions to conservation by the LIFE-programme need to be more prominent.
E1	20 press articles and 3 TV features	Increase public awareness on the covered topics and public visibility of the project and EU's contribution to biodiversity conservation.	More than 120 press articles plus numerous publications by the project team, as well as 20 tv and 10 radio features happened during the project.	The actions have been implemented as planned and numbers surpassed expectations by far.
E2	Website with 4 news per year		The website was implemented two months after the project start, with more than 210 news items since.	
E3	Yearly participation LIFE-Plattform	Professional and scientific exchange to improve the project and advance sturgeon conservation efforts throughout Europe.	The project participated in the LIFE platforms but could not host one due to the pandemic. All other objectives were met. The project participated in numerous other networks such as DSTF, WSCS, IUCN and coordinated with other projects such as DTP-MEASURES, which led to the development of multiple policies and declarations.	The project was strongly embedded in networks focused on sturgeon conservation and the active contribution to the "Pan European Action Plan for Sturgeons" as well as the IUCN Red List assessment have to be highlighted. The project led to several other sturgeon conservation projects, amongst them DTP-MEASURES, IUCN-STURGEX, LIFE-Boat 4 Sturgeons and others. Minor deviations from the proposal due to the pandemic are therefore easily mitigated.
	Hosting one LIFE-Plattform and one DSTF Meeting			
	Exchange with sturgeon projects			

E4	Print of 2 times 4000 folders in German	Increase public awareness on the covered topics and public visibility of the project and EU's contribution to biodiversity conservation.	The folders have been printed in the envisioned numbers, with additional print runs in Czech and Slovak languages.	All actions have been implemented as planned, with several additional steps taken to increase visibility not only locally but also in other member states.	
	Notice boards in four locations		The notice boards have been installed at all four locations.		
E5	Infoboard on the container		The infoboards have been installed on the container. Additionally, two banners along the fence as well as a bilingual infoboard at the confluence of Thaya and Morava have been installed.		
E6	Public aquarium at the Inselinfo		The aquarium has been in operation during the opening season since the project beginning.		
E7	Kick-Off event		Outreach to stakeholders and decision makers, media coverage		Instead of two large events we organized three large and more than ten smaller events, while participating in multiple others.
	Release event				
E8	5000 sturgeon identification cards disseminated	Increased awareness of anglers towards alien sturgeon species and reporting of sterlet bycatches	The cards have been produced and distributed in the planned numbers. Additional give-away items have been developed, produced and distributed.	The action has been implemented as planned, and with additional funds outside the project further popular items have been produced.	
E9	One imagefilm at project start	Increase public awareness on the covered topics and public visibility of the project and EU's contribution to biodiversity conservation.	The imagefilm and the long project documentary were produced according to the proposal. The envisioned number of short films was surpassed with 12 of them uploaded on YT.		
	Four short films				
	One documentation at the end of the project				
E10	Yearly meetings of stakeholders	Increased awareness of anglers towards alien sturgeon species and reporting of sterlet bycatches, inclusion of suggestions and criticism into project implementation.	A stakeholder meeting was organized yearly apart from the pandemic years 2020 and 2021.	The action has been implemented as planned apart from the two final years. Participation of the project lead in multiple meetings of stakeholders such as ICPDR, NÖLFV and many more should easily mitigate the loss of two events.	

E11	Presentation of the project at ISS8	Professional and scientific exchange to improve the project and advance sturgeon conservation efforts.	The project was presented through multiple scientific presentations and was received very positively. The hatchery container was a highlight and multiple participants visited a second time after the conference.	The action has been implemented as planned and led to the Vienna Declaration on Sturgeon Conservation.
	Excursion of participants to the container hatchery			
E12	2.500 Layman's reports in English	Increase public awareness on the covered topics and public visibility of the project and EU's contribution to biodiversity conservation.	The layman's report was designed and published in time. It was decided to lower print runs in order to use available funds more sustainable for other actions.	The layman's report was finished as an attractive product and disseminated to stakeholders, students and during excursions. The use of funds for additional excursions and event participation to disseminate the report was considered to have more impact than higher print numbers.
	2.500 Layman's reports in German			

6.4 Analysis of benefits

Quantitative & qualitative environmental benefits & policy implications

The increased population size of the species can positively impact the evaluation of the biological quality criteria “fish” in the frame of monitoring for the EU Water Framework Directive. Stabilized and recovering populations will also improve the status of the species for Article 17 reporting based upon continuous monitoring. The development of both successful rearing/release techniques as well as standardized methods for population monitoring will help sturgeon recovery throughout the Danube River Basin and stimulate and support other European sturgeon species in other areas. The “Pan European Action Plan for Sturgeons” was a milestone in European sturgeon conservation and provides a perfect framework for future efforts after it was endorsed by the Bern Convention.

The surviving released animals will considerably boost the size of remnant populations in the project area over the long-term due to their long life span. First positive signs can be seen in mark-recapture surveys and the development will be followed over the next seven years. Threats 1,2 and 5 (Allee effect, genetic bottlenecks, lacking fitness) have been directly addressed by the project and most likely eliminated, although final assessments for 1 can only be made once the released animals mature. Threat 3 and 4 (Releases of allochthonous sterlet genotypes and alien sturgeon species) have been partially contained as of stopping unregulated stocking activities with sterlets of unknown origin in the Austrian Danube and parts of the German stretch and Middle Danube. While illegal releases of other sturgeon species by ornamental fish owners or escaped fish from farms and artificial lakes cannot be ruled out in the future, we were able to raise awareness for this issue with anglers, fish sellers and pond owners. Also, the follow-up project targets the replacement of non-native genotypes with native sturgeons in farms and trade in the long-term. Threat 6 (Lack of public awareness on sturgeons and conservation status) was mostly eliminated by the extensive public relations activities. Threat 7 (Loss of pools as habitat) could not be addressed properly due to the lack of high-resolution habitat use data and will be addressed in further habitat studies. All activities will be continued and extended and the equipment reused in the LIFE- Boat 4 Sturgeon project.

Economic and social benefits

Apart from live feeds and tags, all costs and purchases incurred within the European Union. The project created about 7,5 FTEs of qualified staff at the coordinating beneficiary. The project also hosted 13 internships from seven European countries. Multiple Bachelor- and Master theses directly involved students in the project work. The project hosted nearly 50 school classes and multiple excursions in the frame of university courses and hence contributed to environmental education on multiple levels.

Transferability and replicability

Both methods and developed equipment like the container hatchery are replicated in the successor project as well as for other conservation purposes such as a project by the coordinating beneficiary for restoration of grayling (*Thymallus thymallus*) or served as a blueprint for a further container hatchery for Atlantic sturgeon (*A. oxyrinchus*). The methodology and gear can also be simplified in order for non-qualified staff to be operated in small scale conservation projects for local populations of fish species. Similar systems have now also been developed for commercial production of African Catfish (*Clarias sp.*) in recirculating mode.

Best practice and innovation value

While the project funded on available best practice guidelines for *ex situ* conservation and release of sturgeons by WSCS, FAO and IUCN, results and new observations led to the requirement for adaptation and refinement. Therefore, the projects' results will be incorporated in new *ex situ* guidelines to be developed in LIFE-Boat 4 Sturgeon and the proposed SCUTE project under tender ENV/2022/OP/0019. The combination of applied conservation work with targeted research and higher education as lived in the project is not only the basis for innovation but also the sustainment of know-how and dedication of people to environmental targets.