After Life Conservation Plan

Conservation and restoration of the allis shad in the Gironde and Rhine watersheds

LIFE09 NAT/DE/000008

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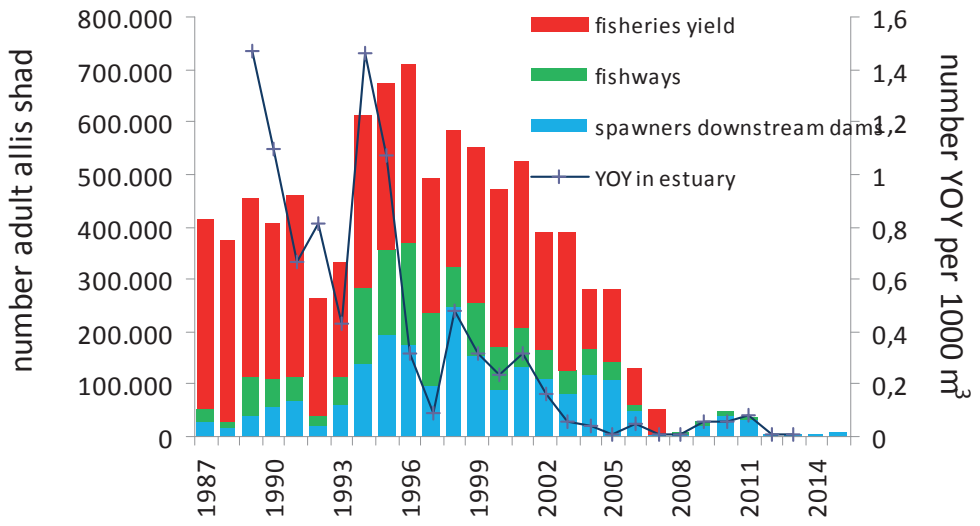
Preface

This report is the last deliverable product of the LIFE+ project Alosa alosa (Consrvation and restoration of the Allis shad in the Rhine and Gironde watersheds – LIFE09 NAT/DE/000008). It presents an assessment of the current situation after the projects official termination and aims on illuminating how the LIFE+ projects objections will be continued and how the progress and success will be monitored.

Background and objectives

In a combined European approach the LIFE+ Project Alosa alosa was focussing on two different main objectives: the reestablishment of a self-sustaining allis shad population in the River Rhine basin as well as the conservation of the formerly largest remaining population in the Gironde basin. In the Rhine basin, the actions comprised the releasing of allis shad larvae, which were obtained from the only existing allis shad hatchery in the French Aquitaine, the monitoring of the YOY following their release, as well as well as the monitoring of the returning of allis shad from the past stocking and spawning activities in the Rhine, in order to proof the success of the reintroduction programme and the onset of a natural population development in the Rhine basin. The hatchery, breeding, marking and releasing techniques have been developed in a previous Life project (LIFE06 NAT/D//000005), in which already 4.8 million allis shad larvae had been released in the Rhine basin between 2008 and 2010. These have, according to the regular life cycle duration of the species, to be expected back about five years after the beginning of the reintroduction project from 2013 onwards, i.e. during the LIFE+ projects duration. Besides the continuation of the achievements of the previous LIFE project the LIFE+ project also aims to develop and implement techniques for monitoring the returnees. It should be noted that these actions furthermore represent the first attempt to reintroduce the allis shad in Europe into a river system in general.

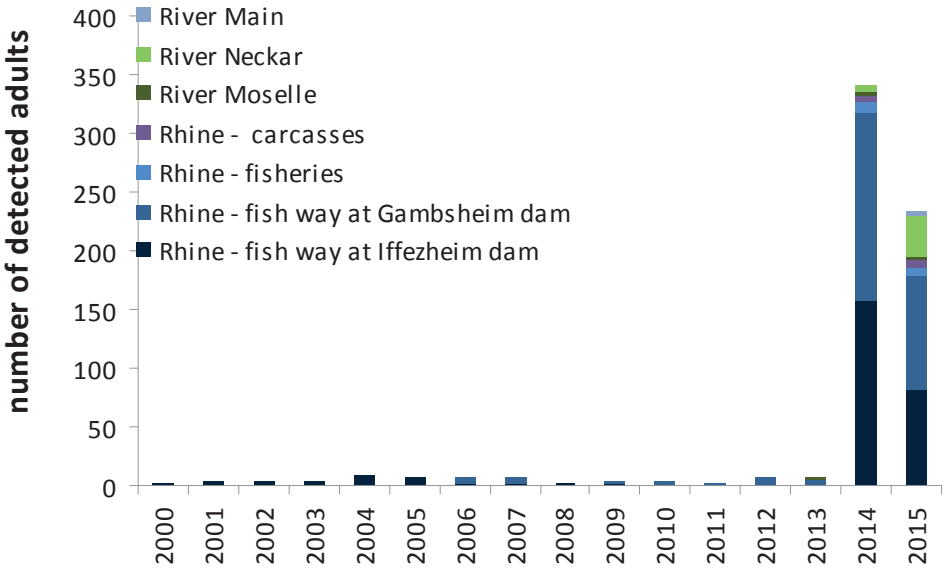


By the beginning of the 20th century, this anadromous clupeid species still occurred widespread across the river basins between North Africa and South Sweden draining into the Atlantic Ocean, the North Sea and Western Mediterranean Sea and was very abundant and economically important. In the biggest part of the original distribution area, amongst these in the Rhine basin, the population collapsed due to combination of factors of which the most important were over-exploitation, habitat loss and fragmentation as well as water pollution. The species is today listed in the annexes II and V of the EU habitat directive. Vital allis shad populations remained only in the very South-West of the distribution area in some rivers in France, Portugal and Morocco,

of which area in the Gironde-Garonne-Dordogne system was until one decade ago the largest and economically most important. For this reason, it was also selected to serve as the donor population for the reintroduction project in the Rhine basin. In 2006, around the time when the proposal for the first LIFE project was submitted, this population began to decrease sharply and unexpectedly. Although there was a fishing moratorium imposed in 2008, the population did not recover on its own. Already in 2003, a monitoring of the YOY allis shad in the Gironde estuary yielded a decrease of the YOY – yet at that time the spawner stock was still large and apparently vital. Obviously, these findings already indicated problems in the recruitment, which became more and more apparent in the following years with a related and ongoing decrease of the numbers of adults returning for spawning. As no major changes that could explain this collapsing which occurred in the river basin, and no relevant habitats were lost or cut-off by newly created obstacles for migrating shads, the decrease must be related to other factors. To identify these and to point out how the situation could be improved was the objective of the Life+ project in the Gironde watershed part of the project area. At the time when the proposal for the Life+ project was submitted, impairments of migration caused by the inefficiency of technical fish ways as well as with regard to the survival of the YOY in the first weeks of life, seemed to be the most likely hypothesis and were addressed by specific surveys in the proposal. These addressed specifically issues constituted in the freshwater phase (spawning, survival of the YOY before reaching the estuary in summer and autumn) as most likely determinants of the rapid and steep decreasing. Furthermore, pilot studies on ex situ techniques for allis shad and an associated study on the maturation of the shads in captivity aimed to contribute to the conservation of the species and future stocking measures. No specific sites (apart from the fishways) or habitat types were targeted in either basins. The major socio-economic aspect is to improve the prospects of allis shad fisheries as many of the formerly numerous fishing companies had to give up business in the meanwhile.

Main achievements

The developments and main achievements in the two river basins of the project area differ considerably. In the Rhine basin clear signs for the success of reintroduction measures implemented in the LIFE+ and of course the previous LIFE project from 2013 onwards were obtained. They imply a steep increasing of the numbers detected while passing through fish ways in the Upper Rhine and major tributaries, by-catches by professional fishermen, as well as observations of natural spawning and numerous YOY which proof the spawning to have been successful and mark the onset of a natural population development in the basin. On the contrary, the negative population trend in the Gironde-Garonne-Dordogne basin has not stopped yet in the recent years and it seems



to have stabilised on an alarming low level. The decreasing numbers of returning adult allis shad had also direct repercussions on the implementation of the action in the Life+ project, as a) less than intended

numbers could be trapped for the conduction of telemetric studies, b) the artificial reproduction in order to produce larvae for the releasing programme in the Rhine basin was limited and also c) caused a smaller natural reproduction in the rivers Garonne and Dordogne followed by less abundant YOY, which are to be monitored in a survey on their survival in the rivers. Nonetheless, all these actions could be implemented successfully and interesting results were secured, in terms of the suitability of the applied methods for monitoring purposes as well insights into the behaviour of the shads in the different phases of their life that will help to improve the management of the population. Furthermore and regardless of some setbacks, the establishment of ex situ techniques has revealed a high potential for future conservation tasks and reintroduction actions. Not least the LIFE+ project has reached a notable public perception and addressed experts, managers, political decision makers, various stakeholders and the broad public as well and showed that the concerning situation of the allis shad in Europe has been moved into the focus.

- The strengths of the project can be addressed to emerge from the German-French cooperation, the expertise allocated and the different focuses in the two river basins. Assessments about the situation in the opposite river basins were a prerequisite for the development and establishment of the methods applied in the different technical, management and dissemination actions. The project received ideal great support from the authorities in the states and regions involved

- The weakness of the project was that the implementation of the ex situ stock action was depending on external financial support (which granting was a strength on the other hand) and the somewhat naive planning of the action. The challenges and potential problems going along with the implementation have been simply underestimated.

- The main opportunities were going along with the networking of the project, which enabled the project team to obtain and process information important for the assessment of the project. Additional support was gained for the future, which was surely promoted by the impressing achievements made. Even hitherto sceptical stakeholders like the federal states of Baden-Württemberg, Rhineland-Palatinate, the Alsace region and Switzerland promised to support the project objectives in the Rhine basin ideally and financially.

- The threat for the project can be addressed with the even worse than expected development of the allis shad population in the GGD basin as it had direct negative implications on the implementation of the project actions and imposed a threat to reaching the deliverable marks in some cases. These developments also constituted a threat scenario of less support in stakeholders in France to provide shads for the production of larvae for re-establishing a population in the Rhine

In the following it will be explained how and what will be done to keep the project's achievements alive in the After-LIFE-time and how the future implementation can be assured.

Responsibilities and actors

As the project team consisting of the coordinating beneficiary the LANUV, the associated beneficiary RhFV (both located in North Rhine-Westphalia, Germany), and the French associated beneficiaries, the Association MIGADO, Irstea, Sméag, Epidor (all located in the Region Aquitaine-Limousin-Poitou-Charentes and the Region Languedoc-Roussillon-Midi-Pyrénées, respectively) and Onema (Paris, with regional branches) will no longer exist after the project termination, the implementation of tasks and the communication will, despite intensive exchanges between the former partners, be solved in the respective territories. Monitoring data will be obtained from external institutions and organisations, like the Association Saumon-Rhine, the Regierungspräsidium Karlsruhe, the Landesfischereiverband Baden-Württemberg, the Bundesanstalt für Gewässerkunde, the land Hesse, the Stiftung Wasserlauf, the Sportvisserij Nederland, Imares etc. to name a few. Much of the implementation of future tasks will depend on the financial means to be recovered. All these issues are part of a LIFE project application and will be presented additionally.

Main tasks for the After-Life-Time

1. Surveys on the development of a population of the allis shad in the Rhine

The probably most remarkable objective reached in the Life+ project is the increasing of adult allis shad returnees as well as the proof of offspring from natural reproduction in the Rhine in the years between 2013 and 2015. This result can be attributed to the stocking efforts carried out in the years 2009 to 2011 as part of the preceding Life project (until 2010) and the Life+ project (from 2011). According to the stocking efforts in the following years, further adults are expected to return to the Rhine in the coming years, which additionally applies to recruits from natural spawning from 2017 onwards. As in the recent years information about shad returnees will be mainly obtained by the routinely monitoring of the fishways at the Iffezheim and Gambsheim dam on the Upper Rhine, the two lowest transversal obstacles for migrating fish in the Rhine in general, as well as in the monitoring facilities at the lowest obstacles in tributaries like the rivers Moselle (weir Coblenz), Main (weir Kostheim), Neckar (weir Ladenburg) and Sieg (weir Buisdorf). Networks have been established which ensure that all information about observations of allis shad in monitoring studies carried out in the Rhine basin will be directly passed on to the institutions entrusted with the project management of the Life+ project, the LANUV NRW and the RhFV, where the data will be analysed. By spreading the information about the Life+ project to various stakeholders and publishing flyers and additional material that allow to securely determining shads along the entire Rhine course down to the Netherlands, it is engineered to even further receive notifications about catches or findings

from non-public sources. Even though the allis shad detected this way presumably only represented a diminishing part of the population, the information gained this way will at least under normal discharge conditions in the rivers allow to get an impression of the populations development, whereas flood conditions are suspected

to conceive the actual situation as the shads tend to stop their upstream migration and accumulate elsewhere.

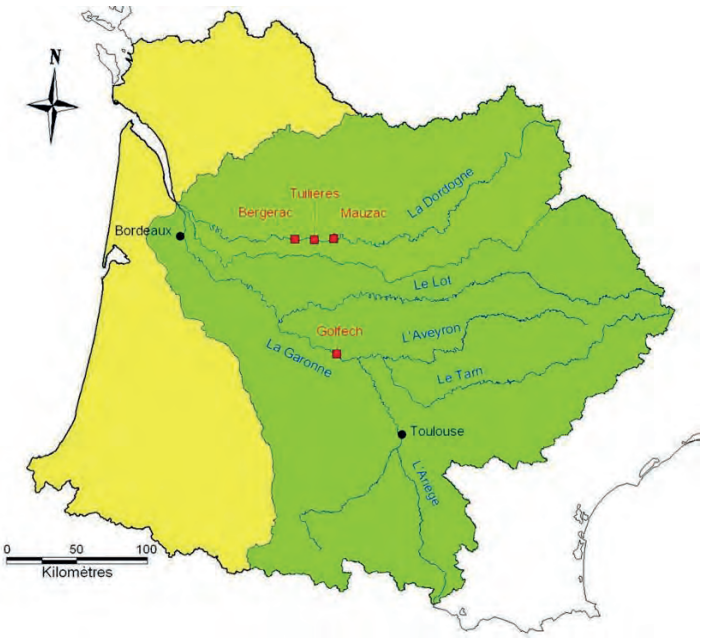
Further measures that aim to allow to monitoring the development of the population precisely are under consideration but will depend on additional financial means. Such measures comprise the counting of the spawner population in the basin downstream the first transversal obstacles. This so-called bull-monitoring was developed and established in the Gironde basin by the Association MIGADO, associated beneficiary in the Life+ pro-

ject and allows, in combination with counts of migrants surmounting the dams, a very detailed assessment of the entire adult stock. After identifying active spawning sites in the Rhine basin and providing the infrastructures for permanent recordings at these spots, information about the spawner stock in the Rhine per year can be

won accordingly. Furthermore, obtaining subsamples of adults and either inspecting their otoliths for OTC marks (all allis shad larvae have been marked with OTC prior to stocking in the past) or genetic tools information about the origin of the specimen will be won. In order to obtain information about the YOY emigrating from the river and to assess the recruitment from natural reproduction and stocking actions as well, it is intended to build up monitoring facilities in terms of stow-net stations and sampling cooling water abstraction facilities during the emigration period. Both methods have been proven to be able to trap YOY shads, which can be assigned to the origin of stocking or natural reproduction in the same way as sampled adults (see above). These specific monitoring schemes are part of Life project application, which was submitted in October 2015 and cannot be realised without external funding. The continuation of the stocking measures in the Rhine basin by breeding shad from adults returning to the Rhine in a local hatchery and successively expanding the stocking effort is also part of this project application. A basic stocking effort of about 1 million larvae per year is intended to be covered by obtaining shad larvae from the existing hatchery in Bruch, which is envisaged to be made possible even without further LIFE support.

2. Improving the conditions for migration and natural reproduction of the allis shad in the Gironde watersheds

One of the core hypotheses for the decreasing of the allis shad population in the Gironde watersheds was the limited access to suitable spawning areas due to either restricted efficiency of fish ways at the dams on the Garonne and the Dordogne and a lack of gravel substrate causing insufficient survival of spawned eggs in the downstream sections. The action A2 that addressed the efficiency of fish ways located on the lower part of the Gironde Garonne Dordogne basin confirmed that only a negligible small proportion of shads tagged with radio-transmitters succeeded in passing through the fishways. For three of the fishways at the dams of Golfech (Garonne), Bergerac and Tuilières (Dordogne) suggestions for improvement with regard to attraction flow, traceability of the entrances and surmountability of the facilities as a whole have been compiled. Together with the results of the A1 action, in which a synthesis of knowledge of shad passage facilities in North America and Europe has been yielded, this information flows into concrete measures that aim to improve the conditions for shad migration in the rivers Garonne and Dordogne:



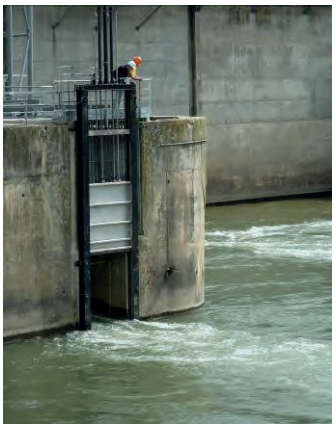
- At Golfech, a study for the improvement of the junction of the two entrances channels should be implemented in 2016 or 2017

- At Bergerac, the study for the building of a second entrance oriented towards the power plant should be yielded in 2016 or 2017

• At Tuilières, the necessity of a new fish pass in the left bank is now an official question, particularly in the context of the solution which should be chosen for the downstream migration facility, that will consist to increase the flow and then the attractiveness of the dam,

• At Mauzac, a new fishpass will be built at the dam in 2017

These projects should be financed by EDF and Agence de l'eau Adour-Garonne. Both supported the Life+ project as co-financiers.
In order to additionally improve the conditions in selected traditional spawning sites downstream of the dams, a pilot activity was started in which the lack of bed load and the analogue deficit of coarse gravel in the bottom substratum was to be compensated by adding gravels to the respective spots in the river channel of the Dordogne downstream of the Tuilières dam. A study of the possibility of this measure was yielded by EPIDOR in 2015, but this measure is very expensive and no prospects of funding are known at this time.



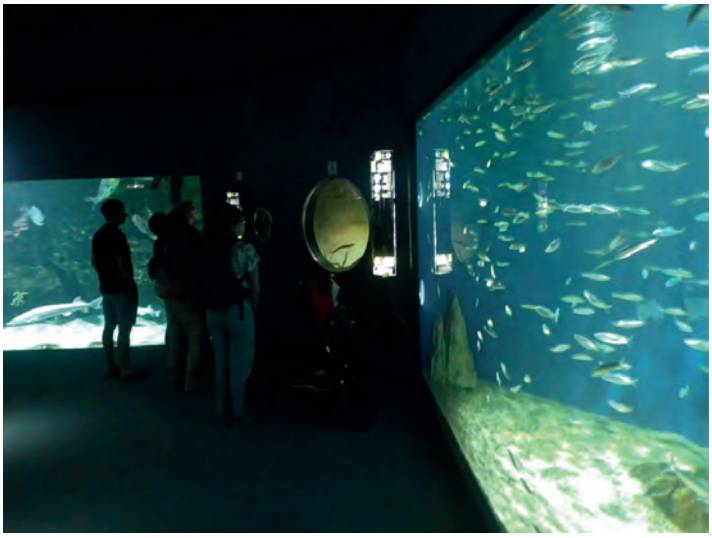
Information about of the efficiency of the improved and newly built fishways will be obtained through video surveys of the fishways and the monitoring of spawning allis shad, which are conducted routinely by the Association MIGADO, associated beneficiary in the Life+ project "Alosa alosa". The effects on the recruitment can possibly be seen in terms of increasing numbers of the YOY at downstream migration. However, no such specific monitoring studies are envisaged routinely. The implementation of this action will depend on the granting of another project with LIFE support, which was applied in October 2015.

3. Dissemination of the Life+ project activities in the future

The Life+ project has received a remarkable feedback in the media, mainly in Germany, but also in the Netherlands and in France. This could be attributed to an apparently still existing cultural rooting in the Rhine region and the former abundance and economic importance of the species on one hand and intensive dissemination activities on the other hand. The close cooperation and heading for synergies with other institutions involved into the topic of migratory fish and the historical aspects of shad fisheries, for instance the Poller Maigeloog have surely multiplied the presence of the Life+ project in the media and the public perception. At celebrations of the Poller Maigeloog, and the famous "Maispill" celebrated on the 1st of May of each year, as well as press conferences, reference is given to the Life+ projects and the efforts of bringing the allis shad to the Rhine and to saving the population in the Gironde basin. The Life projects are also addressed in an exposition about the history of allis shad fisheries and the anchorage and significance of this species in the culture of the Rhineland and all over Europe. The exposition is shown on varying occasions, amongst these also on the Life+ allis shad symposium in Bergerac.

Press releases and conferences held on this occasion report of recent developments, achievements and allis shad festivals and stocking events by using different channels, like the ministries of environment of North-Rhine-Westphalia and Hesse, the involved beneficiaries or related organisations for example the watercourse foundation, have created countless online and print media articles. A total of eight TV-reports which directly addressed the Life+ project and covered the topics of allis shad festivals, releasing and research about shads have been produced. The majority of these are available on YouTube in the “Grande alose” channel. The same applies to the three language versions of the project documentary, which are also linked on the two official project websites under the domains www.alosa-alosa.eu and www.lifealose2015.com. The first website mainly addresses German language users, whereas the second domain addresses French and English language users and was established for the Life+ shad symposium held in October 2015. This symposium not only contributed to extend the network about shads in Europe but also raised awareness in local politics and involved decision makers and the various stakeholders for the sake of allis shad in the Gironde basin in the future. A summary about the symposium, the press review and all presentations and talks given at the symposium, as well as further project deliverables and dissemination material such as brochures and reports are available one the sitefor downloading and print versions can be obtained from the beneficiaries and adjacent organisations.

The websites and the YouTube-Channel and all the contents thereon will be available in the After-Life-Time and news and recent developments around the allis shad in the Rhine and Gironde basin will be published here. In



the case of the granting of a new Life project, the domains will be used accordingly.
North Rhine-Westphalia the allis shad has been, besides eel and salmon, declared one of the flagship species of the migratory fish programme NRW, which means that particular measures are undertaken to ensure the conservation of the species, i.e. releasing of YOY (see the current brochure of the migratory fish program for details). In the future public releasing events and school class programmes will continue to be carried out in order to make the objectives and actions undertaken to bring back the allis shad accessible and vividly perceptible to pupils and the interested public. Such events will be conducted by the Stiftung Wasserlauf (Watercourse Foundation). Synergies will be used by participations in networks and in international events, like the World Fish Migration day.ilot facilities for ex situ stocks and knowledge gathered within.

4. Pilot facilities for ex-situ stocks and knowledge gathered within

The probably most ambitious action of the Life+ project was the inauguration of ex situ stocks in Germany and in France (action C1). Severe obstacles and setbacks were encountered by trying to reach the objective to rear allis shad from larvae into adult fish in both pilot facilities.

In the Aquarium La Rochelle in France a blackout occurred on the 5 November 2011 in the recirculation systems the fish were kept in. This accident led to mortality in groups of allis shads of different origins:

- A batch from the 2008 cohort, transferred from St Seurin experimental facility (Irstea) in 2008 in the framework of the first Life project. A total of 139 juveniles died (no survival).
- A part of the batch 2011 cohort transferred from the Bruch facility (Migado) in October 2011. A total of 255 juveniles died and 54 survived.

The batch transferred in June 2011 as larvae was not affected by this blackout. A total of 539 juveniles were then available for rearing and monitoring of gonad development in captivity.
The initial objective toestablish an ex situ stock on the grounds of a sturgeon hatchery inside the Bi-

blis nuclear power plant in Hesse needed modification before it could be started. Due to the political decision to give up nuclear energy production in Germany and to shut down the Biblis nuclear power plant immediately in March 2011, an alternative location for installing the ex situ stock pilot facility needed to be identified at short notice. The reason was the objective to have mature specimen available at the end of the project and the fact that female allis require five years to reach maturity. This demanded to found the stock in the 2011 rearing season in which larvae for the founding could only be obtained by the end of June at the latest. Thanks to the commitment of the district government Giessen of the federal state of Hesse an alternative spot was found on the grounds of a recycling and waste treatment facility, the so-called Trockenstabilat facility of the Hermann Hofmann Group in Aßlar. Additional funds were discovered by the opportunity to invest eco points for the compensation of deforestation for the construction of wind parks by the Hermann Hofmann Group granted by the federal state of Hesse, which enabled the Life+ project to obtain not only electricity and heated water from a power plant in the Trockenstabilat facility free of charge. In addition, it was also possible to build a recirculation system with three voluminous round tanks to be able to keep some

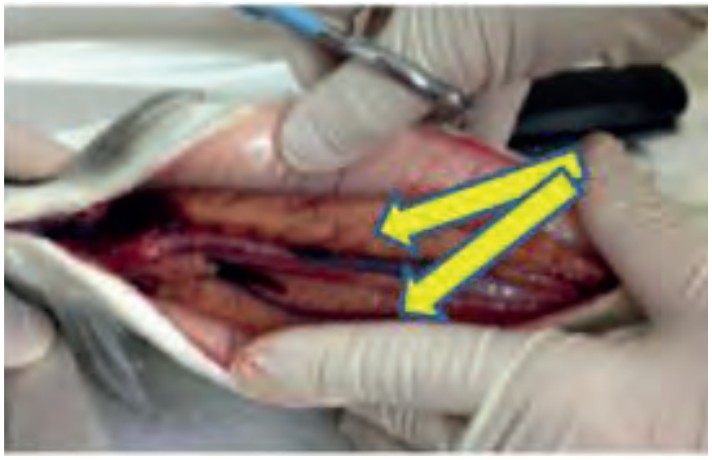
hundreds to thousands of shads of different cohorts and a small breeding facility for breeding larvae and rearing these into juveniles before transferring into the big recirculation facility containing brackish water in order to simulate the marine part of the shads life cycle. At this time, the only disadvantage compared to the initial plan to settle the ex situ stock at Biblis nuclear power plant was the unavailability of the expertise by a fish farmer to oversee the pilot facility.

The recirculation systems were planned and constructed by an expert (Per Thuesen - DDT Aquaculture design). The hall including the electricity, water supply and heating devices was built by the staff of the Trockenstabilat facility without charging any costs for the equipment to the LIFE+ project. This way it was possible to stock the

facility with a first cohort of shad larvae in June 2011. In 2012, when the facility was officially and festive inaugurated, the first larvae also obtained from the hatchery in Bruch hatched in the facility out of their eggs. Although, high mortalities were encountered in the weeks following hatching, mainly due to direct and indirect effects of malformations of the mouth and heads in the larvae and juveniles, more than 500 specimens could be transferred to the big recirculation system in autumn. Even in the stock in the Aquarium La Rochelle the development of such malformations was found to be a major cause of mortality.

After the promising beginning of the Aßlar ex situ facility was there were severe setbacks encountered in the years following 2012. In March 2013 the Hermann Hofmann Group was forced to shut down the Trockenstabilat facility, which meant for the ex situ facility not only the end of obtaining heating water and energy for the ex situ facility free of charge, but also the loss of the staff of the Trockenstabilat facility, which were formerly involved in the maintenance of the ex situ facility and took care of the stocks in half hourly intervals even at night time and thus substituted an alarming system for the facility. This lack could hardly be compensated by the external assistants commissioned by the LIFE+ project. An installation of an alarming system turned out to

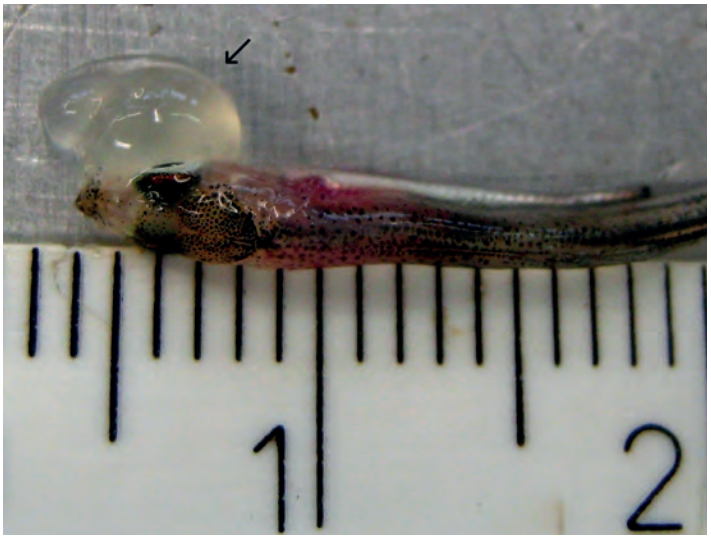
be too expensive and impracticable due to the lack of network coverage around the remote facility. Ironically, as a consequence of retrofitting works in the ex situ facility, a blackout occurred in the night of the 4th December 2013 which led to the death of all specimens in the facility. The inspection of the fish revealed large differen-



ces with regard to head and mouth malformations which were nearly absent in fish from the 2011 cohort (which was stocked in tanks that were just sheltered by a tent which enabled the young shads to prey on insects and their tank-born) and very abundant in fish from the 2012 cohort. As the malformations could not be attributed to parasites, diseases or toxics and were also observed in shads reared in the Aquarium La Rochelle and the Aquazoo, it was decided to take the loss of the stock as an opportunity to combine the restocking of the facility with experiments on the effect of diet on the health and condition of the shads in ex situ stocks. These experiments were conducted by Johanna Heinrich and supervised by Patrick Schubert of the University of Giessen in 2014 and 2015. It turned out that providing the larvae and juvenile fish with increased levels of fatty acids and prebiotic compounds not only prevented the development of malformations, furthermore the specimens suffered much lower mortalities and were in a significantly better condition and performed a much more relaxed behaviour than in the previous years. These findings are essential for future rearing actions.

Besides the malformations, further sources of mortality were encountered in both pilot facilities. Escaping from the tanks in older juvenile specimens, water quality deterioration and particularly increased NO2 levels due to an accumulation of waste and food rests within the recirculation system and insufficient efficiency of the biological filters systems, as well as associated parasitic and bacterial pathology were the most prominent. In the shads in the La Rochelle stock an additional source of mortality was found to come from calcareous nodules in the shad's kidneys "nephrocalcinosis" which is promoted under high concentrations of dissolved CO2 and low pH values. The recirculation system was modified by improving the biological filter system and adding a degassing column.

Taking into account the losses caused by blackouts and that according to the objectives of the action the whole stock in the Aquarium la Rochelle needed to be successively sacrificed in order to monitor the gonad development and onset of maturity in captivity it can be concluded that it turned out to be principally possible to keep the shads in captivity for the duration of a life-cycle. Problems going along with the keeping in recirculation systems could be identified and widely solved. Great improvements have been made with concerning the feeding and related effects on health and condition of the shads. Finally, at least for the four year old allis shad in the Aquarium La Rochelle, the onset of maturity could be determined in several males and one female specimen (please note that the results of the final survey in the 4.5 year old fish, which will allow to conclude about



the maturation in captivity will not be available by the beginning of June, i.e. after the submission of this report).

Added value from this action has been reached by involving PhD and master students at the Universities of Giessen and Koblenz-Landau, which not only contributed additional knowledge and improvements to the ex situ techniques and the stocks but also scientific publications about the topic. Furthermore, specimen for Aquarium exhibitions in the Aquazoo Löbbecke Museum in Düsseldorf and the Aquarium in La Rochelle , which have been marvelled by hundreds-of-thousands visitors,

have been obtained from the ex situ stocks.
After all, the initial objective to recruit offspring from ex situ stocks in the future seems realistic, however further research and application is required, particularly with regard to the optimization of the recirculation systems and the effect of feeding on the gonad development. This topic was thus addressed in a project proposal for a new Life project, in which the lessons learnt will be incorporated and improved ex situ stocks techniques will be implemented in a new, professionally conducted and highly efficient facility at University of Giessen. The idea to found a future ex situ stock with the remaining cohorts from 2014 and 2015 still kept in the facilities in Aßlar and the University of Giessen in order to ensure that the first shads which will be old enough to reach maturity and to be available yet two to three years after the inauguration of the new facility, will not be implemented as intended, as the ex situ facility was affected by another severe setback in April 2016. Due to an overheating of the side channel compressor and a related melting of the PVC tubes toxic gas emissions went with the aeration into the recirculation system and killed the entire 2014 cohort. This incident underlines that a future ex situ stock facility needs not only the capacities to realistically reach the objective of breeding shads from ex situ stocks, but also be under the permanent supervision and maintenance of approved scientists and have access to energy supply. Due to its remote location, its limited capacities and the missing space and potential for expansion and the high costs for energy, this objective cannot be reached in the facility in Aßlar, which compounds will where possible be integrated in the new facility. For the meantime (in terms of a soon granting of the means in a new Life project proposal) the costs for energy, consumable material and the personnel (i.e. external assistance) are covered by the federal state of Hesse in order to ensure the durability of the ex situ stock if the Life project application will be granted.

5. Production and stocking of allis shad larvae

The techniques and the infrastructures for the breeding of allis shad larvae, in terms of the construction of the allis shad hatchery in Bruch in the Aquitaine, have been developed in the Life Project “Maifisch” between 2008 and 2010 and refined in the Life+ project duration. This enabled the responsible beneficiary, the association MIGADO, to breed a total of about 11 million larvae in the eight years of operation. Even though the efficiency of the breeding procedure could be increased and it turned out to be possible to breed more than 1 million larvae by using only 40 genitor fish (up to 70,000 larvae per female genitor), which are trapped in the fishways of the Garonne and the Dordogne on their spawning run, setbacks have been encountered in years in which the spawning run and the natural spawning was impaired by floods and cold weather conditions in the spawning season. In such years the number of larvae obtained per female genitor dropped to values of less than 20,000, which was additionally at least partially influenced by insufficient mode of action encountered at the necessarily switch to an alternative hormone, which is required to induce the spawning in the hatchery. By now no technical solutions to compensate these natural boundaries of spawning efficiency have been developed. Median

values of breeding efficiency are 54.444 (±61.515) larvae per female genitor in the Life+ project duration compared to 13.633 (±19.162) in the Life project duration (± quartiles). As the number of genitors recruited for the hatchery was around one percent of the GGD spawner population of a year, from the conservation point of view there are no objections to continue the larvae production in the hatchery in Bruch, unless the population will not decrease significantly. The breeding techniques and infrastructures are well established and the hatchery can

be maintained by the association MIGADO even after the Life+ project termination in terms of producing larvae for continuing the reintroduction programme on the Rhine as well as for an upcoming scientific releasing project in the GGD basin itself.

According to the management plan of the Life project "Maifisch" the releasing of allis shad larvae should be continued for, if possible, three generations (15 years) in order to be able to thoroughly assess the success of the programme, from which another five years would be covered by funds of the Life+ project. For 2016, the first year of the After-Life-Time, the continuation of the releasing programme will be ensured by private support coming from the HIT environmental foundation nd the Rheinfischereigenossenschaft NRW, both co-financiers of the Life and the Life+ project. The larvae will be obtained from the hatchery of Bruch and, as a similar number of genitor fish can be trapped, will amount to a similar number as for the annual releasing in the Life+ project. Even in the subsequent years, the hatchery in Bruch will play a crucial role with regard to future allis shad conservation measures. Unless the population will not further and significantly decrease, the hatchery is intended to produce a basic amount of about one to two million larvae per year for the continuation of the re-introduction project on the Rhine. This will apply for both scenarios, actions under the roof of an applied Life project as well as an externally financed small scale project. The latter will be mainly restricted to a production amount as delineated above.

In the case of the granting of the LIFE project, it is intended to breed one million for releasing in each of the rivers Rhine, Garonne and Dordogne. The launching of the releasing programme in the Aquitainean Rivers will aim to assess the survival of the YOY in the river's downstream passage and possibly transgression into the estuary by conducting downstream monitoring studies as part of the project. By implementing these measures it is expected to be able to answer one of the basic questions emerging in the recent years and not yet addressed by the actions of the Life+ project: the effects of the YOY survival in the context of the decreasing of the population. By transferring the experience gained in the successful releasing actions on the Rhine and implementing in the GGD basin it is hoped that the releasing will additionally lead to increasing numbers of returnees and benefits to the population. Additionally to the breeding of larvae in Bruch, the hatchery will also serve as a template for an even more modern allis shad hatchery to be built on the Upper Rhine in order to produce larvae out of adults returning to the Rhine as an action of the

new LIFE project. Given that the numbers of allis shad surmounting the fishways at the Upper Rhine will be in the same range as in 2014 and 2015 and the breeding efficiency will be comparable to the hatchery in Bruch it is intended to breed another 2 million larvae in the

hatchery on the Upper Rhine in the coming years and to become less and less dependent from utilizing genitor fish from the Gironde basin and by breeding larvae from Rhine returnees to additionally accelerate the adaptation process of the developing population in the Rhine. The larvae obtained from both hatcheries will be marked with OTC and identifiable not to come from natural sources. As in the Gironde watersheds, downstream monitoring studies will thus help to determine the ratios coming from the different origins and to estimate their contribution to the recruitment. These studies will depend on future LIFE support. Their implementation means a great step forward with regard to either the conservation measures carried out in the two river systems and additionally successively closing the still wide gap of knowledge about the allis shad and the stock and recruitment relationships, which will be transferable even to other river basins housing shad populations or being subject of future reintroduction projects. Both hatcheries will be supervised by the association MIGADO ensuring best practice implementation. Exchanges about the breeding and monitoring techniques in Germany and France furthermore ensure demonstration and pilot characters aspects of the project.

Project partners

Landesamt für Natur, Umwelt und Verbraucherschutz Nordrhein-Westfalen

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