

Case Report

A Review of Two Decades of In Situ Conservation Powered by Public Aquaria

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Abstract: The European Union of Aquarium Curators (EUAC) boasts a membership of 150 dedicated individuals, standing as a vital cornerstone within the European public aquarium community. Since 2004, the EUAC Conservation Fund has granted over a quarter of a million euros to approximately 50 conservation projects spanning the globe. These initiatives, diverse in nature and scale, have yielded tangible impacts on local populations and their focal species. This paper delves into the outcomes of these conservation endeavors and proposes enhancements to ensure that the funding is unequivocally channeled towards conservation efforts. One resounding observation gleaned from the array of projects spotlighted in this study is the profound community engagement that emerges, irrespective of the final project outcomes. These endeavors serve as a catalyst for local communities, shedding light on subjects that would otherwise remain shrouded in obscurity. Furthermore, the EUAC-backed projects illuminate the expansive reach of public aquarium initiatives, transcending the confines of acrylic tank walls and institutional boundaries to resonate globally, heightening local awareness about the imperative to safeguard biodiversity. These findings underscore a prospective trajectory for both the EUAC and the public aquaria it comprises: an intensified advocacy and collaboration with legislative bodies to fortify in situ conservation measures. In essence, it is imperative that the public comprehends the pivotal role played by aquaria in preserving a multitude of species and acknowledges that their visits directly contribute to funding projects aimed at safeguarding species within their natural habitats.

Keywords: funding; ex situ; education; EAZA; European Association of Zoos and Aquaria; EUAC; European Union of Aquarium Curators; conservation



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1. Background

Public aquaria emerged in the mid-nineteenth century as vital portals into the natural world, providing access to wonders otherwise beyond public reach. Over the ensuing century, their mission evolved to center on the conservation of wildlife diversity, as well as serving as hubs for biological education and research [1,2]. Despite occasional calls for closure and the release of captive animals, it is crucial to recognize the pivotal role public

aquaria play in in situ conservation efforts. These institutions stand as bastions against the relentless encroachment and degradation of natural habitats due to human activities.

For instance, seabeds teeming with marine biodiversity are imperiled by destructive trawling practices [3–5]. Freshwater ecosystems, including rivers, springs, lakes, and rainforests, have faced systematic degradation, endangering thousands of species [6–8]. Additionally, escalating water temperatures and stressors have led to widespread coral bleaching events globally [9]. Destructive fisheries, pollution, runoff, and unregulated tourism have severely impacted coral reefs [10]. Climate change, a sustained threat over the past century, exerts additional pressures on these fragile ecosystems [11].

Public aquaria contribute significantly to species conservation through expert species management and robust public engagement. They serve as advocates for fostering a harmonious relationship between nature and society, providing a platform for conservation communication, and actively participating in both in situ and ex situ conservation projects, with multiple examples provided by [12]. While compliance with modern legislation, such as the European Union's 'Zoo Directive (https://ec.europa.eu/environment/nature/legislation/zoos/index_en.htm accessed 1 June 2023)', is imperative (Council Directive 1999/22/EC), many institutions have exceeded its scope (op. cit.).

The role of public aquaria has evolved from mere recreation and the exhibition of exotic wildlife to encompass three vital functions: education, scientific research, and conservation [1,2]. As emphasized by the European Commission, the Zoos Directive seeks to bolster the role of zoos and aquaria in the conservation of biodiversity, with a primary focus on measures in the wild [12].

While the Zoos Directive places responsibility on member states for enforcement, both the European Association of Zoos and Aquaria (EAZA (<https://www.eaza.net/about-us/eazadocuments/> accessed 1 June 2023)) and the North American Association of Zoos and Aquaria (AZA) have actively disseminated 'Good Practices' manuals to enhance their members' contributions to biodiversity conservation. Additionally, specialized resources like the 'Elasmobranch Husbandry Manual' [13] and 'Advances in Coral Husbandry' [14,15] are freely available to professionals in the field, further underlining the collaborative efforts in advancing conservation endeavors [16].

2. The European Union of Aquarium Curators

Within the framework of conservation-focused initiatives, the European Union of Aquarium Curators (EUAC) emerged during a symposium convened at Basel Zoo on 24–25 May 1972. This visionary gathering of aquarium curators resolved to establish the EUAC, thereby fostering closer collaboration among professionals in the field. The primary objective of this union was to convene regular symposia where pressing topics and challenges of broad interest in the realm of conservation could be addressed. Since its inception, the EUAC has steadfastly convened annual—occasionally biennial—meetings, witnessing a steady rise in both participant numbers and presentations. In a pivotal juncture in 2004, the organization's financial robustness culminated in the establishment of a conservation fund, empowering members to champion in situ conservation initiatives.

These conservation endeavors may take the form of direct action by aquaria or entail intimate partnerships with existing in situ conservation projects. Funding may originate directly from the EUAC or indirectly through other sources dedicated to in situ conservation activities. This support can be facilitated by individual institutions or associations, often bolstered by dedicated public fundraising endeavors. Annually, EUAC members are encouraged to submit their proposals, a process facilitated through a comprehensive application form.

Project categories encompass a wide spectrum, encompassing biological and ecological research, veterinary and conservation medicine, animal welfare, captive breeding, reintroduction, restocking, and translocation efforts, human–wildlife conflict mitigation, education and public awareness initiatives, training and workshops, community-based and social policy interventions, ecotourism and sustainable development ventures, sus-

tainable resource utilization, wardening and law enforcement, as well as protected areas management. These projects are strongly encouraged to involve local communities and secure approval from local authorities. Detailed documentation, including information on the study species, its IUCN Red List status, project objectives, and a budget breakdown, is a prerequisite. Moreover, applicants are mandated to demonstrate match funding, exemplifying a proportionate commitment to the project.

Subsequent to the submission of applications, a dedicated review panel meticulously assesses each proposal, assigning scores based on predefined criteria. The EUAC Committee then scrutinizes these evaluations and, contingent on current funding allocations, extends financial support to one or more meritorious proposals. Recipients of funds bear the responsibility of presenting their results orally and submitting a comprehensive written report detailing the accomplishments of their projects.

Hereafter, we present a compendium of achievements spanning nearly two decades of EUAC funding support (refer to Figures A1 and A2 in the Appendix A), illustrating how targeted, short-term financial backing can serve as a catalyst for conservation efforts and provide crucial backing to dedicated teams worldwide, engendering innovative methods for species survival. Figure A1, compiled in 2019, documents forty-two projects, while Figure A2 (in the Appendix A) introduces an additional seven endeavors. Through sustained dialogue with project managers, we have been able to amalgamate additional results, culminating in the compilation of Figure A3 (Appendix A).

3. Action—Projects

Below are more detailed explanations on some of the projects funded thus far, including outcomes and results.

3.1. Title of Project: *Assessing the Condition of the Noble Pen Shell (Pinna nobilis Linnaeus, 1758) in the South Adriatic Sea*

Project leader: Milena Mičić EUAC member: Aquarium Pula

Year supported: 2019 Amount supported: 9000 €

Website: <https://aquarium.hr/en/ocuvanje-plemenite-periske-pinna-nobilis-u-jadranskom-moru> (accessed on 18 December 2023)

3.2. Summary of Project

The primary goal of this project was to evaluate the status of the noble pen shell population (Figure 1) in the South Adriatic with a focus on conservation efforts. Findings from the surveyed regions revealed alarmingly high mortality rates, sometimes reaching 100%. In response, healthy individuals were carefully relocated from their natural habitat and placed in controlled ex situ environments. The noble pen shell population has been severely impacted by a devastating disease in its native habitats, resulting in the decline of populations in Spanish and Mediterranean waters.

The urgency of addressing this critical issue, along with the disappearance of other populations, served as the driving force behind this project, which garnered strong support from the Croatian Ministry of Environmental Protection. Within the controlled aquarium system at Aquarium Pula, dedicated efforts were made to facilitate natural reproduction among the pen shells. The knowledge and insights gained from this endeavor have significantly contributed to our understanding of the species' biology and how best to care for them under human supervision.

This initiative saw fruitful collaboration between Aquarium Pula and universities in Zagreb, Pula, and Hungary, alongside the Croatian Veterinarian Institution. Together, these partners worked tirelessly to advance the cause of noble pen shell conservation. Throughout the project, regular media coverage was maintained to ensure that the broader public was informed and engaged in our conservation efforts.



Figure 1. *Pinna nobilis* in the south Adriatic Sea. Photo: Aquarium Pula.

3.3. Title of Project: *In Search of the Last Remaining Representatives of the Only Recently Described and Already Critically Endangered Spotted Softshell Turtle, Pelodiscus Variegatus, in Vietnam*

Project leader: Thomas Ziegler EUAC member: Cologne Zoo

Year supported: 2018 Amount supported: 4900 €

Website: <https://www.koelnerzoo.de/en/artenschutz-3/#eigeneprojekte> (accessed on 18 December 2023)

3.4. Summary of Project

A groundbreaking discovery has unveiled a new species of softshell turtle (Figure 2), identified through comprehensive genetic and morphological analyses. This significant finding spurred a dedicated conservation initiative focused on assessing the current status of wild softshell turtle populations.

To accomplish this mission, the project managers meticulously explored potential freshwater habitats, engaged with local fishermen to gather valuable insights, and thoroughly investigated farms and local markets where turtle trade occurs. Through rigorous genetic screening conducted in a specialized molecular laboratory, individuals were carefully examined to confirm the presence of distinctive markings on their bellies, indicative of this unique species.

When a genetically pure specimen was identified, it was swiftly relocated to a designated local rescue station, where a specialized conservation breeding program was established. This critical step ensures the preservation and future prosperity of this newly discovered softshell turtle species. By taking these proactive measures, this project actively contributes to the safeguarding of this remarkable and ecologically important species.



Figure 2. Thomas Ziegler with *Pelodiscus variegatus* at Melinh Station for Biodiversity in Vietnam. Photo: C. T. Pham.

3.5. Title of Project: *Mapping the Mediterranean Pillow Coral (Cladocora caespitosa) Habitats in Medulin Bay, Istria, Croatia*

Project leader: Milena Mičić EUAC member: Aquarium Pula

Year supported: 2018 Amount supported: 7000 €

Website: not available

3.6. Summary of Project

The core objective of this project was to meticulously assess the well-being of coral colonies in light of the numerous anthropogenic threats they face, including nautical tourism, pollution, and unsustainable fishing practices. Furthermore, the mission extended to the formulation of comprehensive guidelines for the sustainable management of Medulin Bay (Figure 3), ensuring the enduring protection of these invaluable colonies.

In the project's commitment to amplify the urgency of coral conservation, it conceived an impactful outdoor poster exhibition, hosted at Aquarium Pula, with the intent of reaching a broad audience and fostering awareness. This exhibition served as a powerful visual testament to the profound impact of unsustainable human activities on the degradation of corals and their interconnected ecosystems. Through this initiative, the team endeavors to inspire collective action for the preservation of these vital marine habitats, both locally and on a global scale.



Figure 3. *Cladocora caespitosa* in Medulin Bay, Istria, Croatia. Photo: Pula Aquarium.

3.7. Title of Project: Coral Husbandry Workshops, Maldives

Project leaders: Nicole Kube and Pablo Montoto Gasser EUAC members: German Oceanographic Museum and Zoo Aquarium Madrid, Spain

Year supported: 2017 and 2018 Amount supported: 12,000 € (total)

Website: <https://www.deutsches-meeresmuseum.de/en/science-research/projects/current-projects/project-maldives-1> (accessed on 18 December 2023)

3.8. Summary of Project

In the Maldives archipelago, the well-being of local communities hinges on the health of coral reefs, which serve as the backbone of their livelihoods through fisheries and tourism. However, the alarming decline of coral reefs, exacerbated by anthropogenic impacts, coral bleaching, and habitat loss due to construction activities, has spurred urgent efforts for reef restoration. This imperative extends to both resort islands and local communities alike.

This project was dedicated to empowering local individuals (Figure 4) with the knowledge and skills required for effective coral husbandry and restoration techniques, thereby enhancing the success of restoration endeavors and fostering greater community involvement in the protection of coral reefs. The workshops covered a range of essential topics, including in-depth understanding of coral reef ecology, biodiversity, and the imminent threats they face. Additionally, participants gained valuable insights into the diverse coral species found on the islands and their current conservation status. Emphasis was placed on implementing a mindful sampling strategy (Figure 5) that minimizes reef impact while maximizing species collection.

Practical lessons in fragmentation techniques, various attachment methods, and optimal growth locations were also provided, complementing the theoretical knowledge shared. These workshops took place in Maafushi, Ukulhas, and Rasdhoo (Alif Alif Atoll, Maldives) and encompassed both classroom instruction and hands-on work beneath the waves. Ultimately, the overarching aim of this project was to mobilize local communities in safeguarding the invaluable coral reefs right at their doorstep. Through these workshops, participants were equipped to independently continue this crucial work once the team's involvement concluded. This collaborative effort serves as a beacon of hope for the sustained health and vitality of the Maldives' coral ecosystems.



Figure 4. Practical lesson for attaching coral fragments with school class in Ukulhas, 2019. Photo: Coral Doctors Association.



Figure 5. Lesson about planting coral fragments directly in the reef, Konotta. Photo: Coral Doctors Association.

3.9. Title of Project: *Project Batagur baska*

Project leader: Anton Weissenbacher EUAC member: Vienna Zoo

Year supported: 2019/2017 Amount supported: 5000 €

Website: <https://www.zoovienna.at/natur-und-artenschutz/artenschutzprojekt-batagur-baska/> (accessed on 18 December 2023)

3.10. Summary of Project

The primary objective of this conservation project was to gain critical insights into the migration patterns and overall survival of the northern river terrapin (*Batagur baska*) within its native habitat (Figures 6 and 7). Building on the release of five males in a prior initiative, this submission marked the release of an additional five individuals into the Sundarbans mangrove forest in Bangladesh. To monitor their movements and behaviors, satellite transmitters were carefully affixed to each terrapin.

The collective data gathered from the 10 males released in 2018 and 2019 will play a pivotal role in determining the viability of a sustainable reintroduction program. This information, particularly survival rates, will directly influence management recommendations for the ex situ population bred and raised in captivity.

This project serves as a testament to the vital support provided by EUAC funding. The northern river terrapin (*Batagur baska*) has suffered a devastating decline, to the point where its existence in the wild can be considered ecologically nonviable. The initial breeding success at the Vienna Zoo in 2010 provided a beacon of hope for this Critically Endangered species. Through collaborative efforts, a breeding population was established in the terrapin's native environment in Bangladesh. A designated conservation area was created within Bhawal National Park, initially housing 84 juveniles [17].

Thanks to EUAC's financial backing, the project was able to optimize its conservation strategy by establishing a second breeding facility in the historical range of the species, the Sundarbans. To mitigate risk, the breeding group was divided, and dedicated hatcheries, ponds, and breeding grounds were established within the Karamjal conservation center under the Bangladesh Forest Department. By early 2021, Project Batagur had successfully head-started 406 juveniles in both Bhawal National Park and Karamjal Center, thereby securing the survival of this critically endangered species.



Figure 6. Project *Batagur baska*—transmitter being fixed on a male. Photo: Rupali-Ghosh, Vienna Zoo.



Figure 7. Project *Batagur baska*—Male with transmitter being released in the Sundarbans. Photo: Rupert Kainradl.

Furthermore, EUAC funding played a pivotal role in advancing the project’s scope, enabling the first-ever quantitative and qualitative observations of migration routes of adult terrapins within the brackish river system and coastal areas of Bangladesh. Over two consecutive years, ten males were equipped with satellite transmitters and released into the Sundarbans mangrove forest. Initial findings illuminated the precarious status of terrapin survival in their natural habitat, providing a data-driven foundation for discussions surrounding sustainable reintroduction and management strategies. This comprehensive effort underscores the invaluable role of EUAC funding in driving forward critical conservation initiatives.

3.11. Title of Project: Conservation of *Achondrostoma Occidentale*: A Freshwater Fish Endemic to the Westernmost Tip of Europe (2017)

Project leader: Maria de Fátima Santos Gil EUAC member: Aquário Vasco da Gama

Year supported: 2017 Amount supported: 8800 €

Website: not available

Social media: <https://www.instagram.com/p/Cv2yDrhNE-1/?igshid=MTc4MmM1YmI2Ng==> (accessed on 18 December 2023)

3.12. Summary of Project

Achondrostoma occidentale, a small cyprinid species, is endemic to three small river basins (<40 km) situated in the westernmost region of Europe. This unique species has been isolated from its closest relatives for over 7 million years, over the course of multiple geological changes that eliminated a once giant basin within the Iberian Peninsula. As this basin grew smaller and smaller it eventually dwindled down to multiple small rivers, where species such as *A. occidentale* became isolated. It thrives in characteristic Mediterranean-type intermittent rivers, experiencing winter floods and summer droughts of varying intensity. The dry season poses a significant threat to these fish, as it leads to habitat reduction and population fragmentation, resulting in genetic bottlenecks. This situation exposes them to

heightened competition for limited resources and deteriorating water quality. Additionally, habitat destruction, pollution, and the spread of the exotic crayfish *Procambarus clarkii* further jeopardize their survival.

The severe drought-induced risk of extinction for *A. occidentale* prompted the initiation of an ex situ conservation program in 2007. Captive populations, established with wild-caught adults, are meticulously cared for at the Aquário Vasco da Gama (AVG) and no mortalities occurred during transfers to the aquarium. Reproduction is carefully managed under natural conditions to prevent the relaxation of natural selection. To date, over 8000 captive-bred fish have been released (Figures 8 and 9) back into their natural habitat, reinforcing the population and consequently reducing the risk of in situ extinction. This was achieved over three different seasons (three springs), and three distinct populations of wild breeders and captive-bred young were released to their original grounds. This was done to prevent losing genetic diversity. As this program was pioneering in Portugal, it garnered significant attention from the media and local communities, who were actively engaged in restocking efforts and environmental education initiatives.

This project has successfully achieved its original objectives:

1. Evaluate the in situ impact of recent restocking efforts by monitoring current population density and comparing it with previously collected baseline data.
2. Provide logistical support for a third restocking effort.
3. Implement in situ conservation measures, involving local students, to emphasize the importance of community involvement in the protection of the riverine ecosystem. Without this funding, restocking efforts would lack formal engagement from society.
4. Allocate resources for genetic analyses to advance the captive breeding program for this species. Assessing potential losses in genetic diversity is crucial for informing future procedures. While this objective has been partially met, ongoing DNA analyses are being conducted to determine if current genetic diversity levels are satisfactory.



Figure 8. Fish release in Alcabrichel. Photo: Aquário Vasco da Gama.



Figure 9. Presenting fish to school children. Photo: Aquário Vasco da Gama.

3.13. *Title of Project: Safeguarding the Critically Endangered Siamese crocodile (Crocodylus siamensis) through Combined In Situ and Ex Situ Conservation Measures (2016)*

Project leader: Thomas Ziegler EUAC member: Cologne Zoo

Year supported: 2016 Amount supported: 5000 €

Website: <https://www.koelnerzoo.de/en/artenschutz-3/#eigeneprojekte> (accessed on 18 December 2023)

3.14. *Summary of Project*

The dedicated efforts of the author, Thomas Ziegler, generously supported by EUAC funding, have resulted in a series of impactful conservation projects. These initiatives have not only expanded our understanding of various endangered species, but have also laid the groundwork for their protection and survival:

1. Investigation of the Anthropogenic and Environmental Behaviors of the Endangered Crocodile Lizard (Figure 10) in Vietnam, with Direct Implications for Species Conservation (2015)
2. Conservation Translocation Program of *Shinisaurus crocodilurus* to Bolster the Drastically Diminished Wild Population in Vietnam (2014)
3. Ecological Research and Population Analysis of the Chinese Crocodile Lizard in Vietnam (2012)
4. Assessment of the Freshwater Fish Community Ecology in the Menangat-Kenohan Suwi Wetlands of Kalimantan, Indonesia (2012)
5. Preliminary Assessment of the Siamese Crocodile Population in Indonesia (2010)
6. Breeding and Research Program for Rare and Endangered Amphibians from Vietnam (2008)



Figure 10. Thomas Ziegler with *Crocodylus siamensis* at Saigon Zoo, Vietnam. Photo: D. A. T. Tran.

The collective findings from these projects culminated in a comprehensive publication [18]. The following summary specifically pertains to the 2016 project.

The Siamese crocodile (*Crocodylus siamensis*) is classified as critically endangered on the IUCN Red List, as natural populations within its range have experienced an alarming 80% reduction in recent decades. Historically, this species thrived in mainland southeast Asia, spanning Cambodia, Indonesia, Lao PDR, and Vietnam. However, due to rampant hunting, populations in Vietnam have likely been eradicated. Those in Cambodia, Lao PDR, and Thailand face severe fragmentation and imminent threats. Many populations consist of fewer than ten individuals, raising concerns about their long-term viability.

Recent surveys conducted by the project team near Ban Soc, Bualapha District, Khammouane Province, Lao PDR, led to the discovery of a previously unknown population of Siamese crocodiles. This significant find also marked the rediscovery of the species in Khammouane Province. Similar to previous observations, this population comprises only a handful of documented individuals. Based on external morphology, these individuals were identified as pure Siamese crocodiles. Insights from local interviews further corroborated that the observed crocodiles represent remnants of a once-thriving natural population. To confirm their purity and rule out any potential escapees from farm hybrids, molecular testing of non-invasively collected samples from the site is currently underway.

One of the most economically viable conservation strategies for this species involves restocking depleted wild populations across its range, and potentially reintroducing it in specific cases to suitable habitats where it has become locally extinct. Notably, in Vietnam, the first population was introduced in Cat Tien National Park in the early 2000s, with subsequent breeding documented, showcasing initial success. A critical challenge in bolstering restocking and reintroduction efforts lies in identifying purebred individuals from captive programs in the range countries. This process was meticulously implemented in the introduction program in Cat Tien National Park through genetic screening of captive individuals using microsatellite markers and mitochondrial genes. However, the remaining captive colonies in Vietnam and Laos have not been subject to sufficient monitoring to affirm the purity of Siamese crocodile individuals held in these facilities.

3.15. Title of Project: In Search of the "Red Girl" in Madagascar

Project leader: Brian Zimmerman EUAC member: Zoological Society of London
Year supported: 2016 Amount supported: 9045€
Website: not available

3.16. Summary of Project

The expedition's central objective was to empower and enhance the conservation efforts at the Andapa aquaculture facility, a vital haven for a range of critically endangered Malagasy endemic freshwater fish species. This facility not only serves as a sanctuary for these precious species but also supports the livelihoods of its owner and the local workforce he employs. The training provided encompassed essential aspects such as water quality analysis, pond design and infrastructure enhancements, responsible fish handling and transport, as well as a comprehensive review of species-specific diets and nutrition, all tailored to meet specific requests.

Furthermore, the expedition team revisited the collection site in the Amboaboia River to evaluate any alterations in the habitat and to secure additional members of the focal species. This strategic effort was aimed at fortifying the genetic diversity and integrity of the captive population in Andapa (Figure 11), thereby contributing to the long-term conservation of these invaluable aquatic species.

The central mission of this project was to champion the conservation of over twenty critically endangered Malagasy freshwater endemic species housed at the Andapa aquaculture facility. The key objectives were carefully designed to ensure the well-being and future sustainability of these invaluable species:

1. Elevate the welfare: enhance the care and well-being of the diverse collection of Malagasy freshwater species at the Andapa facility, ensuring their physical and mental health are prioritized.
2. Foster breeding success: implement a comprehensive review of environmental triggers for spawning and ecological requirements, aiming to significantly bolster the breeding success of each species within the Andapa facility.
3. Secure genetic health: establish and maintain robust, genetically healthy populations of each threatened Malagasy species, safeguarding their long-term viability for future restocking programs and conservation efforts.
4. Expand captive populations: acquire and safeguard stable captive populations of currently unmanaged threatened Malagasy freshwater fish species, including an adequate number of *Paretroplus gymnopteropectus*.
5. Raise awareness: amplify awareness of Madagascar's unique endemic freshwater fish species, both locally and globally, emphasizing their ecological importance and cultural value to the community.
6. Enhance husbandry practices: provide specialized training in husbandry techniques to the Andapa aquaculture facility, aiming to enhance breeding success and establish sustainable, sizable populations for future generations.
7. Proficient fish handling: equip employees at the Andapa facility with advanced skills in fish handling and transport to optimize survival rates during translocation exercises, minimizing stress and ensuring successful relocations.
8. Water quality management: deliver training on effective water quality management to facility employees, promoting vigilant monitoring of critical parameters and preventing potential losses due to suboptimal conditions.
9. Collaborative workshop: facilitate a collaborative workshop in Madagascar, bringing together relevant stakeholders to develop a conservation management plan focused on safeguarding threatened freshwater fish species. This collective effort will serve as a blueprint for their long-term preservation.



Figure 11. Searching for the critically endangered Mangarahara cichlid and taking water quality samples from one of the locations, with the help of the local community. Photo: Tim McCaskie.

3.17. Title of Project: Marine Fishes of São Tomé and Príncipe

Project leader: Nuno V. Rodrigues EUAC member: Flying Sharks

Year supported: 2015 Amount supported: 10,000 €

Website: not available

3.18. Summary of Project

São Tomé and Príncipe, a sovereign African nation nestled in the Gulf of Guinea and straddled by the equator, boasts a rich tapestry of marine life, featuring unique endemic species of extraordinary beauty. Recognized as a marine biodiversity hotspot by researchers [19–21], this island nation's marine fauna remains one of the least explored in

the world. Sadly, signs of overexploitation persist, with local authorities expressing concern over the dearth of information gleaned from recent scientific expeditions.

In light of this, urgent action was imperative to (1) advance scientific understanding of fish communities in São Tomé and Príncipe, (2) cultivate environmental consciousness to facilitate responsible resource management, and (3) critically, enhance knowledge dissemination to local authorities and relevant stakeholders.

The majority of São Tomé and Príncipe’s populace directly relies on artisanal fishing for sustenance. Recent studies have unveiled distressing evidence of coastal fish overexploitation and its detrimental ripple effects. Notably, large species like sharks, groupers, and snappers are on a declining trajectory, while reefs grapple with an escalation of lost fishing equipment. The market has witnessed an upsurge in small, previously non-edible species such as filefish and boxfish. Based on the applicant’s firsthand observations and input from local fishermen, overfishing can be attributed to heightened fishing activity, increased boat and engine capacity, and the adoption of destructive practices like the deployment of mosquito nets or scuba divers in seine-net fisheries. Consequently, local authorities have called for collaborative efforts to augment environmental awareness and bolster local capacity for sustainable resource management, including the establishment of marine protected areas.

In the course of this project, an illustrative poster showcasing all commercially harvested species (Figure 12) was created, featuring high-resolution photographs captured by the applicant. Additionally, the bilingual book Coastal Marine Fishes of São Tomé and Príncipe (Figure 13) was published, comprising 123 pages in Portuguese and English, with a print run of 1200 copies. The book launch, hosted at the Oceanário de Lisboa, drew a diverse audience of marine biology enthusiasts, naturalists, and journalists.



Figure 12. Poster with commercially exploited marine fish species in São Tomé and Príncipe.



Figure 13. The book *Coastal Marine Fishes of São Tomé and Príncipe* bilingual (Portuguese and English) edition.

Furthermore, around 100 copies of both the poster and the book were generously distributed to government officials, notably those from the Fisheries Board, with whom Flying Sharks (the applicant) established a partnership agreement for future collaboration. While concrete cooperation did not immediately materialize, numerous lectures were delivered across São Tomé, in schools and dive clubs, sounding the alarm on the perils of overfishing. Local dive clubs played a pivotal role in disseminating this crucial message, as did various NGOs, including 'ATM—Associação de Tartarugas Marinhas', 'Projecto Tatô', 'MARAPA', and 'Príncipe Trust', who rallied alongside the project in pursuit of a shared conservation vision.

3.19. Title of Project: *Integrating Freshwater Fish into Biodiversity Conservation in Turkey* (2010)

Project leaders: Anton Weissenbacher and Brian Zimmerman EUAC members: Vienna Zoo and Zoological Society of London

Year supported: 2010 Amount supported: 1522 €

Website: <https://www.zsl.org/what-we-do/projects/fish-net> (accessed on 18 December 2023)

3.20. Summary of Project

The genus *Aphanius* encompasses several species with exceedingly restricted distributions, making them highly vulnerable to threats. These small fish, measuring a maximum of 6 cm, are found in fresh and hypersaline waters surrounding the Mediterranean Sea, the Arabian Peninsula, and regions of Africa, Turkey, Pakistan, and India. Remarkably, *Aphanius* thrive in extreme environments, displaying resilience to elevated salt and sulfur levels, as well as enduring daily temperature fluctuations of up to 20 °C. Despite their tenacity, nearly all *Aphanius* species and subspecies face significant endangerment, with some members of the group already extinct. This perilous situation is exacerbated by habitat destruction, including coastal areas repurposed for hotel developments, extensive water extraction for agricultural and drinking water needs, and the introduction of non-native fish species.

These economically inconspicuous fish lack advocacy and often find themselves at odds with national interests such as mass tourism and conventional economic progress. Initiatives to safeguard *Aphanius* only began a decade ago. Presently, Vienna Zoo houses and successfully breeds approximately twenty species and six subspecies of this genus, three of which are already extinct in the wild. Offspring from these successful breeding programs are distributed to other zoos and organizations as part of broader conservation efforts.

The research project focusing on the Azraq killifish, *Aphanius sirhani*, has yielded invaluable insights into its temperature requirements and egg development. These findings are pivotal in informing appropriate measures for the long-term conservation and restoration of this species' natural habitat.

In collaboration with the Zoological Society London, the University of Ankara, and Birdlife Turkey, Vienna Zoo initiated a research endeavor to assess the conservation status of *Aphanius* species in Turkey. This comprehensive project encompassed genetic and morphological studies conducted in partnership with the University of Vienna and other esteemed institutions. The outcomes revealed that at least one of the examined populations was identified as an independent, previously undescribed species. This discovery underscores the importance of continued research and conservation efforts to safeguard the rich diversity within the *Aphanius* genus.

3.21. Title of Project: Fish Net Greece

Project leader: Brian Zimmerman EUAC member: Zoological Society of London

Year supported: 2005 Amount supported: 7715 €

Website: <https://www.zsl.org/what-we-do/projects/fish-net> (accessed on 18 December 2023)

In 2005, the EUAC Conservation Fund played a pivotal role in supporting the inaugural survey of the entire known and suspected range of the critically endangered killifish, *Valencia letourneuxi*, across western Greece and the Ionian Islands [22]. Subsequently, the species was taxonomically split into two distinct species (*V. letourneuxi* and *V. robertae*), constituting two out of only three species from the Valenciidae family, exclusively confined to the Mediterranean Basin in Europe [23]. These remarkable fish are exclusively found in lowland spring habitats, with the third species restricted to spring areas along the Mediterranean Spanish coast [24].

The EUAC-funded survey was executed through two expeditions, meticulously sampling 92 sites across multiple basins, ranging from Corfu Island in the north to the Pinios River basin in the south Peloponnese region (Figure 14). The invaluable findings of this survey were documented in a report produced by the Institute of Marine Biological Resources and Inland Waters (IMBRIW). This report, in turn, served as the foundation for numerous subsequent monitoring expeditions and publications detailing the distributional findings and imminent threats to the species [25,26].



Figure 14. Sampling for the critically endangered Corfu killifish, *Valencia letourneuxi*. Photo: Yannis Kapakos.

This pioneering expedition laid the groundwork for the establishment of an enduring partnership, ‘Fish Net Greece’, uniting the Hellenic Centre for Marine Research (HCMR) and the Zoological Society of London (ZSL), which endured until 2020. At that point, the UK component of the partnership transitioned to the Bristol Zoological Society (BZS). Throughout this collaborative effort, subsequent funding streams catalyzed multiple research and conservation initiatives. These ranged from supporting several PhD studies and orchestrating a conservation translocation operation to conducting live teleconferencing sessions for school-based conservation education and establishing safeguarded populations of both Balkan *Valencia* species in ex situ facilities within Greece.

The initial seed funding from EUAC precipitated a substantial surge in knowledge acquisition, which was widely disseminated within the scientific and conservation community, particularly for these two species. A PhD student’s specialized focus on utilizing environmental DNA (eDNA) for monitoring cryptic species, such as the *Valencia* killifish, led to the widespread adoption of this protocol for monitoring freshwater basins in Greece for endemic and highly imperiled species [27]. The EUAC’s investment in a species-based conservation endeavor, targeting a relatively obscure yet critically threatened freshwater teleost, serves as a resounding testament to the profound impact that seed funding for small-scale projects can yield over time.

4. Consequences—Discussion

Since 2004, the EUAC Conservation Fund has been a beacon of support, awarding over a quarter of a million euros to 49 projects spanning the globe (Figures A1 and A2 in Appendix A). Many of these projects have demonstrated a significant positive impact on local populations and their focal species, as highlighted in their descriptions earlier. While a few were less extensive in scope, the majority exhibited meaningful contributions

to conservation efforts. A total of 19 projects were part of larger initiatives, with 11 of them initially receiving funding from EUAC, and 14 subsequently receiving follow-up support. In 2020, five projects were temporarily on hold, largely due to the challenges posed by the COVID-19 pandemic and associated financial constraints.

Nearly 70% of the projects (Figure A3 in Appendix A) continue to make strides in conservation, securing additional funding and resources. Some projects have even witnessed remarkable expansions, such as the transformation of the turtle rescue station in Naples into an Excellence Centre with an annual research budget of 100,000 €. Similarly, Aquarium Pula in Croatia secured an additional 600,000 € to invest in a new turtle rescue station. Freshwater fish projects have thrived, obtaining further funding to sustain their work in Greece, Turkey, and Madagascar, receiving an additional 100,000 €, 15,000 €, and 80,000 €, respectively. Others have found enduring support, like the Vasco da Gama Aquarium project in Portugal.

Projects led by Zoo Vienna, Cologne Zoo, and Zoo Leipzig benefit from steady funding through their respective zoos' conservation funds. Around 50% of the projects have produced numerous peer-reviewed articles (Figure A3 in Appendix A), while roughly 50% are directly involved in species protection programs, often targeting imperiled species.

The results from previously mentioned projects unequivocally demonstrate that conservation goals were indeed achieved through the funding provided by EUAC. It is also crucial to acknowledge the high-quality outcomes attained with limited financial support, as projects typically received less than 10,000 € in funding.

Furthermore, a majority of funded projects reported that they successfully accomplished their goals, many of which centered around raising awareness within local populations about threatened species. While the direct impact on species conservation is not entirely clear, one could argue that, at least during the duration of each project, local communities were actively engaged with the researchers involved.

Projects such as the conservation of *Achondrostoma occidentale* in Portugal, *Batagur baska* in Bangladesh, *Crocodylus siamensis* in Indonesia, *Valencia letourneuxi* in Western Greece, and initiatives related to corals in the Maldives and Croatia, as well as fisheries in São Tomé and Príncipe, all exemplify this trend. While these projects may not have entirely resolved the underlying conservation issues, they undeniably raised significant awareness about the subject during their duration. They also advanced knowledge on conservation solutions and provided training to local stakeholders.

The project on *Crocodylus siamensis* stands out as a notable example, since Professor Thomas Ziegler's extensive involvement in conservation initiatives across southeast Asia has significantly contributed to the preservation of biodiversity in the region. These endeavors stand as testament to the crucial role of research and funding in safeguarding our natural heritage for future generations. Through projects funded by EUAC, dedicated efforts have not only led to tangible conservation outcomes but also generated a valuable and extensive body of published work [18,28–107].

Such projects—and likely others not included in this report—could greatly benefit from continued efforts on two fronts: (1) evaluating whether any progress can be attributed to efforts conducted during the project, in collaboration with the local communities originally involved, and (2) advocating for legislation that aligns with the project's goals, in partnership with local governments.

It is evident that a major challenge facing conservation efforts, not just EUAC's, lies in the effective translation of financial aid into tangible species conservation. While EUAC-funded programs largely focus on gathering fundamental scientific knowledge and raising awareness within local communities, future endeavors could/should consider assisting local populations in establishing sustainable businesses that derive a positive use of species, generating revenue for the community. This approach mirrors the successful conservation efforts for sharks and sea turtles, where activities like shark diving and turtle-related ecotourism have yielded far more revenue than previous practices centered around harming these animals. Notable examples of such conservation strategies can be found in

works by Anderson and Waheed [108] (p. 3), Topelko and Dearden [109] (pp. 108–128), Clua et al. [110] (pp. 764–770), Conte [111] (pp. 1–33), Tanner [104] (pp. 9–12), Mieras et al. [112] (121–153), and González-Mantilla et al. [113].

Conservation projects must become more embedded in the real world, capable of operating within the sphere of human impact. This entails recognizing our limitations in conserving untouched environments, while also actively engaging local communities, particularly younger generations, in conservation efforts. This inclusive approach can foster innovative strategies to counteract the escalating loss of biodiversity.

Simultaneously, small-scale funding sources like EUAC play a vital role by providing swift and targeted options when scientific knowledge is scarce. Ecological understanding, behavior, and community dynamics remain pivotal factors in the success of conservation initiatives, offering an informed and quantifiable means to preserve biological diversity and educate others. Short-term funds similarly offer crucial opportunities to explore new conservation directions in specific habitats or pioneer ex and in situ research as building blocks for larger future projects. The streamlined application process of small-scale funding options also enables projects to respond promptly to imminent extinction risks, swiftly implement new scientific findings, or address unforeseen events in a reasonable timeframe.

From an operational standpoint, project leaders of EUAC-funded programs have consistently highlighted the challenge of balancing their conservation efforts with their primary responsibilities. These projects often serve as secondary undertakings, with their main focus primarily directed towards the care and management of animals within their affiliated institutions. It would greatly benefit the cause of conservation if more public aquariums and zoos designated dedicated staff to handle conservation-related matters, including the pursuit of funding and the hands-on implementation of projects, followed by comprehensive follow-up actions. A notable example is the Zoological Society of London, where the team working on *Valencia letourneuxi* has seamlessly integrated conservation responsibilities into their job descriptions. Unfortunately, this level of integration is not commonplace in most other institutions, where limited staff and resources hinder the establishment of a department exclusively focused on in situ and/or ex situ conservation efforts.

The limitations imposed by these circumstances were evident even during the preparation of this manuscript. It is acknowledged that the document may fall short in providing an exhaustive account of every single project. Various factors contributed to this, ranging from the lack of project updates to challenges in evaluating project outcomes and potential loss of information stemming from projects conducted many years ago. Most projects also lacked a dedicated website, or even social media coverage, which severely hinders these efforts' outreach to the general public. Recognizing this, the establishment of a dedicated 'Conservation Department' within EUAC is underway. This department will be tasked with closely monitoring the activities of funded programs and evaluating their true impact on local communities. This development is likely to be one of the more tangible outcomes resulting from the preparation of this report and the compilation of essential information.

5. Conclusions

The projects outlined in this work underscore a crucial point: they actively engage local communities in the preservation of species, a subject that might otherwise remain unfamiliar to them. It is also important to recognize that EUAC-funded projects extend well beyond the confines of the aquarium walls. They have a global reach and play a vital role in raising awareness within local communities about the importance of biodiversity conservation. This emphasizes the need for EUAC and its member public aquariums to take a more assertive stance in lobbying legislative bodies. This advocacy is essential for ensuring the implementation of robust and effective in situ conservation measures. In light of various debates surrounding the role of aquaria and zoos, it is imperative that the public understands the significant contribution of aquaria in conserving numerous species.

Visiting these facilities also directly supports the funding of critical projects dedicated to safeguarding species in their natural habitats.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Notes

(1) Bagnoli station is closed but a new facility opened at Stazione Zoologica Anton Dohrn in Naples, now a center for excellence in sea turtle Rescue and Research with much bigger facility and veterinary unit. Annual budget: 20,000 € without personnel plus 100,000 € p.a. for Research Projects (1 + 1 Life).

(2) NGO is still active: <https://www.facebook.com/naturetropicaleong/> (accessed on 18 December 2023).

(3) Project grew into a long series of projects in Afresh, Pacim, and Decagon under the umbrella of 'Fish Net Greece'.

(4) A total of 13 new species (one frog, six lizards (Echsen), sox snakes), scientifically described, Building of Rescue Centre together with Zoological Society Frankfurt, region became NP with enlargement, UNESCO World Heritage site, EAZA Conservation Award for Cologne Zoo.

(5) EUAC support was more important than the actual money, specifically networking and acknowledgement opportunities; annual budget in 2022 is 2 million euros; SCORE is a prime example of how public aquaria can be a platform for research and conservation.

(6) A significant ZSL project with an abundance of funders but contribution of EUAC money helped with certain questions.

(7) NGO is still active: <https://www.facebook.com/naturetropicaleong/> (accessed on 18 December 2023)

(8) Part of Greek Fish Net Project.

(9) Yielded a PhD and publication; total project budget was 250,000 €.

(10) Yielded a PhD and publications; total project budget was 300,000 €.

(11) Received Darwin Scoping grant.

(12) EDGE projects are done with foreign students and have limited duration.

(13) Project duration 2 years.

(14) Led to red list status of this species and CITES level was raised from WA II to WA I; project focused on Vietnam with separate population unit, genetic screening for species protection and identification, ex situ in Zoo Köln (Vietnamese form) bred to F2 generation; conservation breeding in Cologne Zoo and Melinh Station for Biodiversity in Vietnam; monitoring of wild population in Vietnam ongoing.

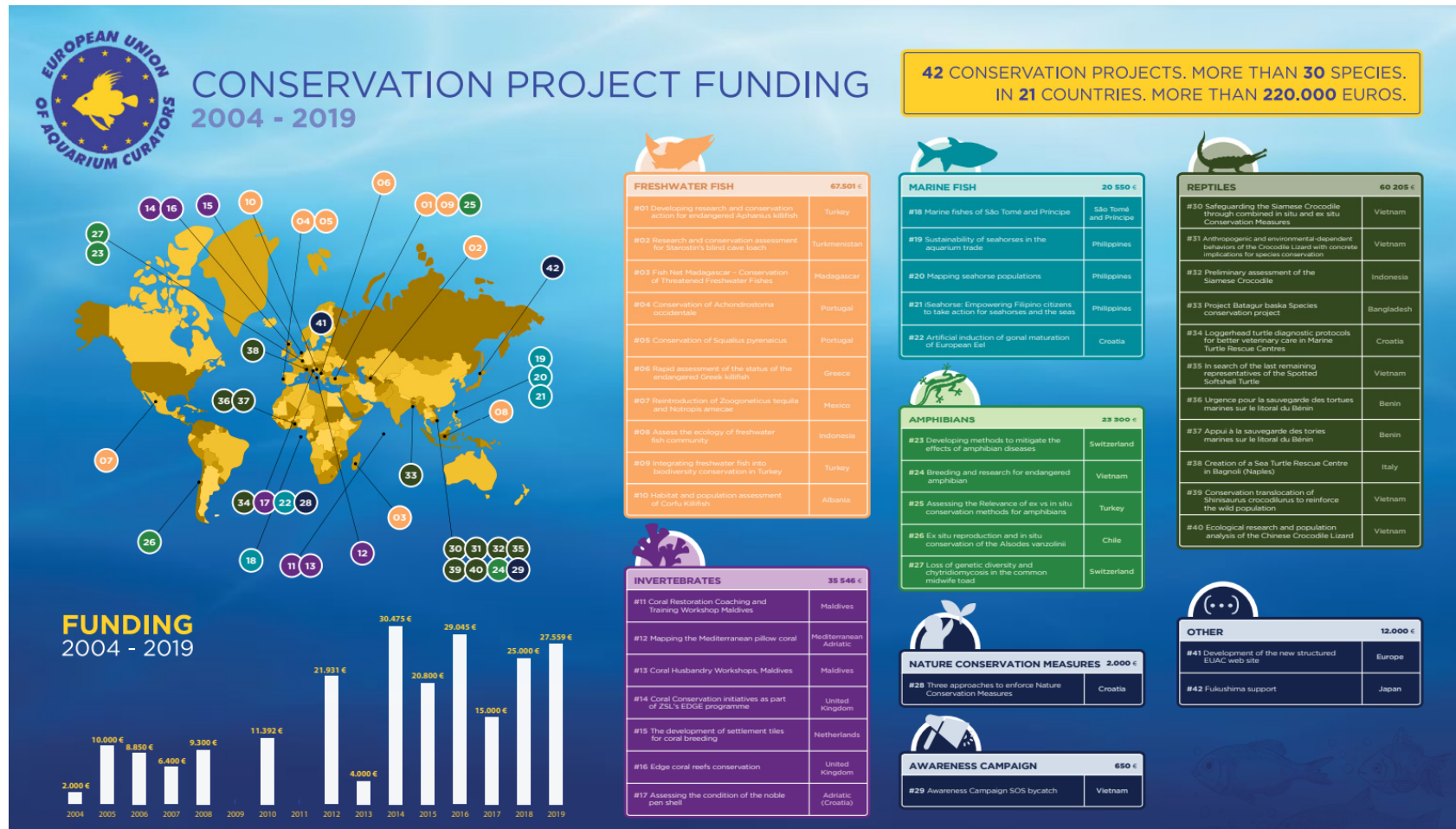


Figure A1. Projects funded by EUAC between 2004 and 2019 (42). The number in the small circle next to a country represents the project number. Example: number 7 next to Mexico means project number 7 in the list next to the map in the freshwater fish table.

Year	Title	funded	Location	Focal species	Recipient	Funding	Running	Follow-up	Amount	Publications	Extinction	Obs.
2004	Creation of a Sea Turtle Rescue Centre in Bagnoli (Naples)	2000 €	Italy	<i>Caretta caretta</i>	Stazione Zoologica Anton Dohrn, Itlay	P	Y	Y	100 000 €	Y	n.a.	1
2005	Emergency for the protection of sea turtles on the Benin coast	2285 €	Benin	Seaturtles	Nature Tropicale ONG Bénin	P	Y	n.a.	n.a.	n.a.	n.a.	2
	Rapid assessment of the status of <i>Valencia letourneuxi</i> , an endangered Greek killifish	7715 €	Greece	<i>Valencia letourneuxi</i>	ZSL London, UK	I	Y	Y	100 000 €	Y	Y	3
2006	Three approaches how to enforce Nature Conservation Measures in Phon Nha-Ke Bang Vietnam	2000 €	Vietnam	Multiple species	Cologne Zoo Germany	P	Y	n.a.	n.a.	Y	Y	4
	The development of settlement tiles for coral breeding as a part of the Secore Project	2500 €	Caribbean	<i>Acropora</i> sp.	Rotterdam Zoo/SECORE foundation	P	Y	Y	2 000 000 €	Y	n.a.	5
	Sustainability of seahorses in the aquarium trade	4350 €	Philippines	<i>Hippocampus</i> sp.	ZSL London	P	Y	n.a.	n.a.	n.a.	n.a.	6
2007	Support for the safeguarding of marine turtles on the Benin coast	2250 €	Benin	Seaturtles	Nature Tropicale ONG Bénin	F	Y	n.a.	n.a.	n.a.	n.a.	7
	Artificial induction of gonad maturation of European Eel	2500 €	Croatia	<i>Anguilla</i> sp.	Pula Aquarium, Croatia	I	N	N	n.a.	Y	n.a.	
	Awareness Campaign SOS bycatch	650 €	Unspecified or multiple	Unspecified or multiple	Unspecified or multiple	n.a.	n.a.	n.a.	n.a.	n.a.	Y	
	Habitat and population assessment of Corfu Killifish in Albania	1000 €	Albania	<i>Valencia letourneuxi</i>	ZSL London, UK	P	N	N	n.a.	n.a.	Y	8
2008	Breeding and research program for rare and endangered amphibian amphibians from Vietnam	3000 €	Vietnam	Various amphibians	Cologne Zoo, Germany	P	Y	n.a.	n.a.	Y	Y	
	Loss of genetic diversity and chytridiomycosis in the common midwife toad <i>Alytes</i> population in Switzerland	6300 €	Switzerland	<i>Alytes</i> sp.	Zoo Zürich, Switzerland	P	N	N	n.a.	Y	n.a.	9
2010	Developing methods to mitigate the effects of the emerging amphibian disease chytridiomycosis	3000 €	Switzerland	Various amphibians	Zoo Zürich, Switzerland	F	N	N	n.a.	Y	n.a.	10
	Integrating freshwater fish into biodiversity conservation in Turkey	1522 €	Turkey	<i>Aphanius</i> sp.	ZSL London, UK	I	Y	Y	15 000 €	n.a.	Y	11
	Edge coral reefs conservation	2500 €	UK	<i>Corals</i> sp.	ZSL London, UK	P	n.a.	n.a.	n.a.	n.a.	n.a.	12
	Mapping seahorse populations across the Danajon Bank Philippines	2500 €	Philippines	<i>Hippocampus</i> sp.	ZSL London, UK	F	Y	n.a.	n.a.	Y	n.a.	
	Preliminary assessment of the Siamese Crocodile population in Indonesia	1870 €	Indonesia	<i>Crocodile</i> sp.	Cologne Zoo, Germany	I	N	n.a.	15 000 €	Y	Y	13
2012	Ecological research and population analysis of the Chinese Crocodile Lizard (<i>Shinisaurus crocodilus</i>) in Vietnam	3300 €	Vietnam	Crocodile lizard	Cologne Zoo, Germany	P	Y	n.a.	10 000 €	Y	Y	14
	Assess the ecology of freshwater fish community in the Menagan-Kenohan Suwi wetlands of Kalimantan Indonesia	3985 €	Indonesia	Freshwater fishes	Cologne Zoo, Germany	I	Y	n.a.	n.a.	Y	n.a.	15
	Coral Conservation initiatives as part of ZSL's EDGE programme	2646 €	UK	<i>Corals</i> sp.	ZSL London	F	N	n.a.	n.a.	n.a.	n.a.	16
2013	Ex situ reproduction and in situ conservation of the Critically Endangered <i>Alsodes vanzolinii</i>	4000 €	Chile	<i>Alsodes vanzolinii</i>	Zoo Leipzig	P	Y	Y	20 000 €	Y	Y	17
2014	Project Batagur baska Species conservation project for the Northern River Terrapin (<i>Batagur baska</i>)	6200 €	Bangladesh	<i>Batagur baska</i>	Zoo Vienna, Austria	P	Y	Y	25 000 €	Y	Y	
	Conservation translocation program of <i>Shinisaurus crocodilurus</i> to reinforce the dramatically small wild population in Vietnam	4500 €	Vietnam	<i>Shinisaurus crocodilurus</i>	Zoo Cologne, Germany	F	Y	Y	n.a.	Y	Y	18
	conserving endangered freshwater fish in Turkey	9975 €	Turkey	<i>Aphanius</i> sp.	ZSL London, UK	F	Y	Y	80 000 €	Y	Y	19
	Research and conservation assessment for Starostin's blind cave loach (<i>Nemacheilus starostini</i>) in Turkmenistan	9800 €	Turkmenistan	<i>Nemacheilus starostini</i>	ZSL London, UK	I	N	N	n.a.	n.a.	n.a.	20
2015	Coral Restoration Coaching and Training Workshop Maldives	7900 €	Maldives	<i>Corals</i> sp.	Germany	F	Y	Y	3 000 €	n.a.	n.a.	
	Marine fishes of São Tomé and Príncipe	10,000 €	São Tomé and Príncipe	Various fishes	Flying Sharks Ltd.	I	N	N	n.a.	n.a.	n.a.	21
	Anthropogenic and environmental-dependent behaviors of the Endangered Crocodile Lizard (<i>Shinisaurus crocodilurus</i>) in Vietn	2900 €	Vietnam	<i>Shinisaurus crocodilurus</i>	Cologne Zoo, Germany	P	Y	Y	8 000 €	Y	Y	22
2016	Conservation Measures	5000 €	Vietnam	<i>Crocodylus siamensis</i>	Cologne Zoo, Germany	P	Y	Y	15 000 €	Y	Y	23
	Loggerhead turtle diagnostic protocols for better veterinary care in Marine Turtle Rescue Centres	10,000 €	Croatia	<i>Caretta caretta</i>	Aquarium Pula, Croatia	P	Y	Y	600 000 €	Y	n.a.	24
	Project <i>Batagur baska</i>	5000 €	Bangladesh	<i>Northern River terrapin</i>	Vienna Zoo, Austria	F	Y	Y	25 000 €	Y	Y	
	Fish Net Madagascar – Conservation of Threatened Freshwater Fishes	9045 €	Madagascar	Freshwater fishes	ZSL London, UK	F	Y	Y	32 400 €	n.a.	Y	
2017	Seahorse : Empowering Filipino citizens to take action for seahorses and the seas	1200 €	Philippines	Seahorses	ZSL London, UK	F	Y	n.a.	n.a.	n.a.	n.a.	
	Project <i>Batagur baska</i>	5000 €	Bangladesh	<i>Northern River terrapin</i>	Vienna Zoo, Austria	F	Y	N	25 000 €	n.a.	Y	
	Conservation of <i>Achondrostoma occidentale</i> - a freshwater fish endemic to the Westernmost tip of Europe	8800 €	Portugal	<i>Achondrostoma occidentale</i>	Portugal	I	Y	Y	4 000 €	Y	Y	25
2018	Mapping the Mediterranean pillow coral	7000 €	Mediterranean/Adriatic	Pillow coral	Pula Aquarium, Croatia	I	standby	N	n.a.	n.a.	n.a.	26
	and diversity in palmate newts <i>Lissotriton hevereticus</i> in the wild and in captivity.	7000 €		<i>Palmate newts</i>	Cologne Zoo, Germany	P	Y	Y	n.a.	n.a.	n.a.	
	Reintroduction of <i>Zoogoneticus tequila</i> and <i>Notropis amecae</i>	7000 €	Mexico	<i>tequila/Notropis amecae</i>	Haus des Meeres Aquarium, Austria	P	Y	Y	n.a.	n.a.	Y	
	Coral Husbandry Workshops, Maldives	4000 €	Maldives	Stony corals	Germany	F	Y	Y	13 000 €	n.a.	n.a.	27
	Reintroduction of the extinct in the wild species <i>Skiffia francescae</i> to its natural habitat, the springs of the Teuchitlán River	10,000 €	Mexico	<i>Skiffia francescae</i>	Haus des Meeres Aquarium, Austria	P	Y	Y	33 000 €	n.a.	n.a.	
Conservation of <i>Profundulus oaxacae</i> in one of its habitats	2000 €	Mexico	<i>Profundulus oaxacae</i>	Haus des Meeres Aquarium, Austria	P	Y	Y	2 500 €	n.a.	n.a.		
2019	Softshell Turtle <i>Pelodiscus variegatus</i> in Vietnam	4900 €	Vietnam	softshell turtle	Cologne Zoo, Germany	I	Y	Y	5 000 €	Y	Y	28
	Assessing the condition of the noble pen shell <i>Pinna nobilis</i> in the South Adriatic Sea	9000 €	Adriatic (Croatia)	<i>Pinna nobilis</i>	Pula Aquarium, Croatia	I	Y	Y	150 000 €	Y	Y	
	Project <i>Batagur baska</i>	5000 €	Bangladesh	<i>Northern River terrapin</i>	Vienna Zoo, Austria	F	Y	Y	25 000 €	n.a.	Y	29
	Conservation of <i>Squalius pyrenaicus</i> , a freshwater fish endemic to the Iberian Peninsula	8659 €	Portugal	<i>Squalius pyrenaicus</i>	Portugal	F	Y	Y	4 000 €	n.a.	Y	30
2020	In situ Shark & Ray Conservation in Baucau, East Timor	5000 €	East Timor	Sharks, rays & other megafauna	Flying Sharks Ltd., Portugal	n.c.	standby	n.a.	n.a.	n.a.	n.a.	31
	Development of sustainable livelihood and upscaling reef restorations in Palau	10,000 €	Palau	Corals	London, UK	n.c.	standby	n.a.	n.a.	n.a.	n.a.	
	Harbour porpoise photo-identification research in the Eastern Scheldt, the Netherlands	4980 €	Netherlands	Harbour porpoises	Burgers Zoo, Netherlands	n.c.	standby	n.a.	n.a.	n.a.	n.a.	
	Kura Kura (saving sea turtles in Indonesia)	8610 €	Indonesia	Seaturtles	Brno Zoo, Slovakia	n.c.	standby	n.a.	n.a.	n.a.	n.a.	
Total (€)		210,342 €							3,309,900 €			
Total (no. projects)		45										

Figure A2. Projects funded by EUAC between 2004 and 2020 (49). Funding: initial funding (I); part of bigger project (P); follow-up (F). Running: project still running? (Y/N). Follow-up: follow-up funding received? (Y/N). Amount: additional funding received. Publications: peer-reviewed publications from project? (Y/N). Extinction risk: involvement in protection of threatened species? (Y/N).

- (15) Fish list being compiled together with ZFMK (Zoological Research Museum Alexander König).
- (16) EDGE projects are done with foreign students and have limited duration.
- (17) Zoo Leipzig and Universität Chile, built a station from a container.
- (18) Led to red list status of this species and CITES level was raised from WA II to WA I; project focused on Vietnam with separate population unit, genetic screening for species protection and identification, ex situ in Zoo Köln (Vietnamese form) bred to F2 generation.
- (19) Follow-up from 2010.
- (20) Part of a fixed termed project.
- (21) Yielded a book, poster, multiple lectures to locals, and a partnership with the Fisheries Board of São Tomé.
- (22) Yielded Vietnamese population ex situ breeding up to F2 generation, exchange with European zoos, extensive new enclosure, positive outcome of the project result as member of staff now works for the German Ministry for Conservation.
- (23) Yielded offspring of genetically tested Siamese crocodiles in Laos, raised for conservation breeding network/release.
- (24) Sea turtle program still running, with the construction of a new rescue station to begin immediately.
- (25) Predominantly yielded educational outputs and increased networking; the Portuguese navy finances the project, which also receives support from the municipality.
- (26) Exhibition; option to continue.
- (27) 150 people educated in three workshops, exhibition, and presentation, follow-up with sexual reproduction currently in progress.
- (28) Search for genetically pure individuals, ex situ breeding successful, specimen for rescue stations, exchange with zoos and release to wild, One Plan Approach and habitat analysis.
- (29) Contribution to project purpose.
- (30) Predominantly yielded educational outputs and increased networking; the Portuguese navy finances the project, which also receives support from the municipality.
- (31) Project will be shifted to Azores/Portugal due to political issues in East Timor after the pandemic.

	I	P	F	Y	N	n.a.	n.c.	standby	Total
Funding	11	19	14	0	0	1	4	0	49
Running	--	--	--	34	8	2	0	5	49
Follow-up	--	--	--	24	8	17	0	0	49
Publications	--	--	--	23	0	26	0	0	49
Extinction risk	--	--	--	23	0	26	0	0	49

Figure A3. Status of 49 projects funded from 2004 to 2020 by the European Union of Aquarium Curators. Funding: initial funding (I); part of bigger project (P); follow-up (F). Running: project still running? (Y/N). Follow-up: follow-up funding received? (Y/N). Publications: peer-reviewed publications from project? (Y/N). Extinction risk: involvement in protection of endangered species? (Y/N). n.a.: information not available; n.c.: not counted; standby: project on hold (usually due to COVID-19 pandemic).

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