

### Final Evaluation Report

Your Details	
Full Name	Ergi Bahrioğlu
Project Title	Determination of population status and migration period of European eel (Anguilla anguilla L.) in Güllük Lagoon, Turkey
Application ID	39611-1
Date of this Report	26 May 2024



1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
species identification with DNA barcoding approach				There were a few obstacles in this step of the project. We had planned DNA barcoding using the Cytochrome Oxidase Subunit 1 (COI) gene region of glass eels/elvers, yellow eels, and silver eels. We successfully collected elvers, yellow eels, and silver eels. DNA extractions were successful. However, we have used specific primers designed for Anguilla anguilla which did not result a successful PCR. Therefore, we identified and used a few more oligonucleotides sequences for this objective. Finally, we were able to conduct PCR and sequencing analysis to obtain the targeted DNA sequences of European eel samples collected from Güllük Lagoon, Muğla, Turkey. Phylogenetic analyses were done with the obtained sequences. The phylogenetic tree was built using various sequences derived from NCBI GenBank representing 24 European eel population and locations. The results were supporting the idea of "there would be random mating and random distribution of glass eels".



Monitoring the migration of Elvers and glass eels		Glass eel and elver migrations were monitored weekly from February to the end of May 2024. However, we could not catch any glass eels or elvers in the estuary. We were able to catch a few individuals with the fyke nets deployed in the wetlands. As a result, we can assume that there are two possible causes: either no recruitment of glass eels occurred, or our gear was insufficient to catch glass eels and elvers. Either way, we must continue to monitor this area to determine which outcome is true.
Monitoring the spawning migration of Silver Eels		These activities were completed as planned. As planned, fish were caught using fyke nets. The spawning migration of eels was properly identified using the catch per unit effort (CPUE) method in the region. The migration of silver European eels occurs between November and February. In addition, we had planned to do some indexing analysis to identify biological features of the population. However, as mentioned in the proposal, we were working on a doctoral thesis with another fund. We were able to gather preliminary data on the biological characteristics of the population before September 2023, which was the planned starting month for sampling for the present project.



		The results of the PhD thesis showed that the population is in an alarming state. Therefore, we decided to take measurements that are not harmful to European eels. After each measurement, we released the fish samples back into their habitat.
Education activity for knowledge- based eel fishing		During the project, we collaborated with a couple of fishermen in the field. At the same time, communications were established with the personnel of the Muğla Provincial Directorate of Agriculture and Forestry and its Fisheries and Aquaculture Branch. The fishermen were eager to learn about European eel biology, feeding behaviour, and migration periods. Moreover, their interest in eels was primarily related to how they could catch more eels rather than conservation efforts. A successful meeting was held with the attendance of a few fishermen and local authorities. Brochures were distributed, and it was reported that the eel stock in the region was decreasing, and that illegal fishing should be stopped. During the discussion with the authorities, it was learned that all the fishermen in the region were fishing illegally. At the meeting, the project results were shared with the authorities, and opinions were exchanged regarding future applications



	and conservation efforts. It was learned that the primary reason for illegal fishing is bureaucratic deficiencies, and no organisation, including the fisheries cooperative, has been officially operating for fishing in the region for the last 3 years. In conclusion, we can report that there is a positive development regarding this issue is that it was reported that the necessary permits will be given to the fisheries cooperative in the Güllük region to protect the eel
	Güllük region to protect the eel and prevent illegal fishing.

#### 2. Describe the three most important outcomes of your project.

#### a) European eel population shows decreasing trend in Güllük Lagoon.

In our project, we collected fishing data from September 2023 to January 2024, involving local fishermen. This period was determined by the results of a previous project funded by "The Scientific and Technological Research Council of Türkiye (TÜBİTAK)." In the previous project, data was collected from February 2022 to January 2023. In the present project (June 2023-May 2024), we obtained similar results that support the finding that the migration period of silver European eels starts in November and ends in February. These results suggest that regulations on European eel fishing should be strictly implemented from November to February. We had only one historical dataset to evaluate population growth in Güllük Lagoon. According to that data, we can sadly assume that a 90% decrease has occurred in the study area since 2007.

### b) Phylogenetical analysis of local eels supports panmixia and contribution to global population.

Sometimes, researchers are prone to ask the question, "Does this population contribute to the global population?" There are many ways to find an answer to this concern. We believe that the phylogenetic approach is one of the methods to determine if relatively small European eel populations can interact with global populations. Our phylogenetic tree showed a cluster between different localities. For example, the Güllük Lagoon population clustered with populations from Bristol (England), Rio Minho (Spain), and Ringhals (Sweden). Additionally, we included sequences reported from European eel populations



in İzmir (Turkey) and the Asi River (Turkey) to the phylogenetic tree. Those individuals were also closer to other localities than to the Güllük Lagoon (Turkey).

# c) We have identified some bottlenecks that reduce success in eel conservation efforts.

Project results revealed that there are some bottlenecks to investigating and contributing to the conservation of the European eel population in Güllük Lagoon (Turkey). Firstly, we gathered various methods from the literature, including work done by the project advisor in Fethiye, Turkey in 2005. The most efficient method mentioned in that study was hand scooping. Compared to those methods, there are two possible outcomes: if the method worked well, we must assume that there was no glass eel recruitment in Güllük Lagoon in 2024. As we do not want to make a strong decision on glass eel recruitment at this moment, we also can assume that hand scooping does not work well in Güllük Lagoon to investigate glass eel recruitment. Therefore, finding proper sampling methods is important to make strong decisions. The second bottleneck arises from local fishermen's tendency to catch more fish and their non-compliance with regulations.

# 3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

The nets designed for glass eel sampling were not appropriate for the region as the sampling area is wide and shallow. In this situation, we have concluded that the planned sampling repetitions at the glass eel sampling site would be insufficient. In response to this situation, sampling frequencies were increased to weekly intervals (4 hours per day for 2 days each week). Communication with local fishermen was not ensured at an adequate level. The reasons for this were investigated, and it was determined that fishing activities, which are generally carried out by fishermen as side jobs, are usually done illegally at night or early in the morning. Regarding this situation, information and advice were received from the local government institution, a meeting was held with the authorities, and interaction was made with local fishermen, albeit in a small number. The planned DNA analyses were conducted successfully; however, several materials and accessories essential for electrophoresis were either broken or missing. Given that our DNA barcoding methods necessitate cross-checks with gel electrophoresis at each step, it became imperative to reallocate a portion of the budget for the purchase of a new electrophoresis tank, casting trays, and consumables.



# 4. Describe the involvement of local communities and how they have benefitted from the project.

Due to illegal fishing, the information obtained from fishermen was insufficient and due to their illegal fishing activities, we couldn't reach as many as we would. However, the fishermen who were willing to conserve European eels were informed about the issue. Brochures were distributed, and it was reported that the eel stock in the region was decreasing, and that illegal fishing should be stopped. At the meeting where the results of the project were discussed, the amount that should be caught during the migration periods of eels, the amount that should be released back to nature, distinguishing between migratory and settled individuals, stock status and the behaviour of fish during migration were explained to the participants. Officials attending the meeting shared their plans for regional measures, emphasising the need for realism regarding legal regulations and addressing bureaucratic obstacles.

#### 5. Are there any plans to continue this work?

Local authorities and their associates will continue to monitor the European eel stock in the region. However, the work and budget allocated were insufficient to identify glass eel recruitment in the area. There is much missing information on eel populations in Turkey. As a result of our previous research, we found that the thresholds used in the "silvering index" derived from literature were inadequate for separating silver eels and yellow eels in Turkey's eel populations. This means that sampling from all habitats will be necessary to develop thresholds for the silvering index to overcome this bottleneck for Turkey's European eel populations. We have also found that the methods used to determine glass eel recruitments were not applicable for all habitats in Turkey. Therefore, habitat-based methods should be determined.

It is found that locals are prone to catching more eels when they learn about their feeding and migratory behaviours. These types of social behaviours make it difficult to establish citizen scientist systems. Especially if we teach locals how glass eel recruitment happens, they may start hunting glass eels for economic purposes. Additionally, we know that there is research where they have successfully monitored glass eel recruitments for years, and researchers have started to monitor glass eel recruitments, restocking, and developing regulations at the same time by including citizen scientists. From these outputs, we can develop at least five to six low-budget projects to continue the work.

#### 6. How do you plan to share the results of your work with others?

We are going to attend a symposium and publish the data in an international scientific journal. We will also share the project results with the Directorate of Fisheries and Aquaculture.



### 7. Looking ahead, what do you feel are the important next steps?

Even though we could not achieve some of the planned outputs in the project, we identified the reasons behind the obstacles. To obtain accurate data from the field, illegal fishermen must first be trained with certificate training, and permits must be issued. For this purpose, provincial directorates of fisheries and aquaculture are required to organise certification programmes at regular intervals and apply catch quotas to fishermen. In addition, strict measures must be taken against out-of-quota and uncertified fishing, and the concept of reporting needs to become widespread against illegal fishing throughout the region. The second step is to identify glass eel recruitment with proper equipment and technologies. Long-term monitoring activities should be carried out following the successful implementation of methods. Additionally, restocking should be started following the identifying adequate gear for sampling.

### 8. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the Foundation receive any publicity during the course of your work?

We used logo in our university's webpage (Link 1, Link 2). News about our project released in various web based local newspapers (Link 3, Link 4, Link 5). Logo has been used in Link 3. We also used the logo in leaflets and presentations.

### 9. Provide a full list of all the members of your team and their role in the project.

Ergi Bahrioğlu had leading role in the project. Done all the field work, seminars and communication with the associates.

Fahrettin Küçük was advisor of the project. He had role in advising the project where the bottlenecks appear.

We have other contacts in the field where they are not included as project members. However, their contribution to work was too important to be underestimated. We thank to Fisherman for their work in field and thanks to the Osman Kurt (Muğla Directorate of Fisheries and Aquaculture) for his contribution to project.

#### 10. Any other comments?