Conservation efforts of uceng native fish \textit{(Nemacheilus fasciastus)} through domestication in Temanggung, Central Java, Indonesia

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\textbf{Abstract}. Uceng \textit{(Nemacheilus fasciastus)} is a native fish species from Temanggung. In the past three years, uceng catches have declined due to increased fishing intensity, invasive fish species, and illegal fishing. The purpose of this study is to describe the uceng domestication as an ex-situ conservation effort. This research used a descriptive method design with observation, interview, and documentation techniques. The result showed that the domestication of uceng has been successfully adapted to cultivation conditions. In 2015-2018, the Fisheries Agency of Temanggung collaborated with the Center Research and Development Freshwater Aquaculture Bogor to conduct research and development on domestication with the aim of breeding and restocking into public waters to preserve the population. Fish uceng farming uses natural spawning processes that take six months. The water quality conditions are the same as their natural environment habitat, with temperatures ranging from 24-28°C, pH between 7-9, and dissolved oxygen above five ppm. In one breeding process, approximately 1000 eggs are produced with the potential to become 60-70\% larvae. Research and development efforts are still being conducted by domesticating the uceng technical team for restocking in public waters. They are expected to provide added value for stakeholders in related sectors.

\section{1 Introduction}

Uceng, one of the native fish in Temanggung Regency, has become an endangered species. The imbalance of the general aquatic environment as a native habitat of uceng from time to time is steadily increasing due to illegal fishing, the introduction of invasive or predatory fish species, environmental pollution, and natural factors. Within the last three years of 2020-2022, there has been a downward trend in the number of uceng stocks in nature. Indicates a decrease over three past years of 39\% in (2020), 32 \% in (2021), and 27\% in (2022). Therefore, it is necessary to restore the abundance of uceng in the waters of Temanggung Regency through domestication.

The domestication of wild uceng \textit{(Nemacheilus fasciastus)} was carried out to increase its survivability, consume artificial feed, grow, and reproduce in aquaculture conditions [1]. The

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goal of domestication is generally to allow fish that live in the wild (uncontrolled) to be manipulated to breed.

The research on evaluating the potential genotype and phenotype of uceng from Bogor, Temanggung, and Blitar was conducted in 2017 by [2]. The study revealed that uceng from Temanggung exhibited heterozygosity and the highest level of polymorphism, which were 0.153 and 34.69%, respectively. Regarding genotype and phenotype, the uceng population from Temanggung demonstrated its potency as a genetic source for cultivation, exhibiting the highest level of genetic diversity, survival, and inclusivity. This species (uceng from Temanggung) also showed a higher domestication success rate than uceng from Bogor and Blitar.

The population of uceng in nature is declining due to overfishing [3]. Generally, Temanggung fishermen catch uceng using fish nets, fishing rods, and fish stunners. The development of uceng farming through domestication needs to be carried out to restore fish stocks from uceng fishing activities in nature by conducting breeding programs. Domestication is the process of taming an organism of natural origin (wild type) to be cultivated in controlled conditions [4]. The domestication program of local Indonesian fish that have been successfully carried out comprised *Trichopodus pectoralis* [5], *Trichopodus pectoralis* [6], *Osteochilus kelabau* [7], *Osteochilus hasselti* [8], and *Tor douronensis* [9]. Although much research focuses on fish domestication, the analysis focusing on fish domestication as conservation efforts, mainly uceng, has never been conducted. The purpose of this study is to describe the uceng domestication program as an ex-situ conservation effort.

### 2 Materials and methods

This research was conducted at the UPTD BBI Temanggung laboratory, Central Java, Indonesia, starting April-May 2023. This laboratory was the facility for the first domestication of uceng in Central Java. The method used in this research is a descriptive method design with observational data collection techniques, interviews, and documentation. The descriptive analysis was chosen to describe, explain, and obtain in-depth information about the uceng domestication program as an ex-situ conservation effort. The data sources used are primary and secondary data from research instruments and interview guides. Data analysis techniques include data collection, reduction, display, and conclusions.

### 3 Results and discussion

According to [10] in animal taxonomy, the classification of uceng:

- **Family**: Nemacheilidae
- **Genus**: Nemacheilus
- **Species**: *Nemacheilus fasciatus*

The Nemacheilidae family comprises over 845 species distributed in Southern China and Southeast Asia [11]. Fish from the genus *Nemacheilus* are characterized by relatively short dorsal fins (7-8 rays), a longitudinal line forming a band along the entire body towards the caudal fin, and large black-colored eyes. The nostrils are close together and tubular but not elongated as barbels. The mouth is semi-circular, with slightly fleshy and deeply wrinkled lips, and the upper lip bears a pair of barbels [12]. Uceng (*Nemacheilus fasciatus*) (Figure 1) is a freshwater fish species with a native habitat of river waters. Uceng is usually found in a river in mountainous areas with rocky bottoms shallow, clear, and moderate to heavy water flows. Morphologically, whitefish have a small body size (maximum only 10-12 cm), a flat stomach characteristic, a grunt, and an elongated flat body with black stripes.
The uceng fish inhabited river waters with moderate to swift flow and a rocky bottom as their shelter. Uceng fish were known to be able to survive in low oxygen content and high-water turbidity conditions. They had small body sizes, with a maximum length reaching only 10-12 cm. Uceng fish tended to prefer aquatic habitats with high water quality.

Uceng was an omnivorous fish that tended to consume plants and spawned during the rainy season [13]. According to Fishbase [14], uceng fish were classified as herbivorous fish, feeding on benthic organisms such as plankton and detritus. Therefore, in this context, uceng fish is predatory to plankton and aquatic plants in general.

Uceng fish was one of the native fish species in Temanggung Regency that was gradually facing the threat of extinction. The imbalance in the public water environment, which served as the natural habitat of uceng fish, became increasingly significant due to continuous fishing, illegal fishing practices, and the introduction of invasive fish species. Uceng fish, in addition to consumption, is also traded as an ornamental fish commodity. However, the sustainability of this fish began to be disrupted due to the high level of fishing and the quality of the environment and river water in its habitat that decreased, thus affecting the abundance of this fish in nature. Therefore, there is a need for domestication efforts for cultivation and conservation purposes so that this species remains sustainable. Efforts are needed to restore the abundance of uceng fish in the waters of Temanggung Regency. One of the approaches is through the domestication of uceng fish. Domestication is the process of taming an organism from the wild to be kept and cultivated in controlled environments [15]. The purpose of domestication is to adapt uceng fish from their natural habitat to the specific conditions of aquaculture that have been established, allowing them to adapt to the cultivation facilities, feed, and thrive in terms of reproduction. Aquaculture is frequently seen as the sole solution to meet the growing demand for fish products, as the harvest of wild fish stocks has reached its maximum capacity, which relies on cultivating various species using natural resources [16].

In 2015-2018, the Fisheries Agency of Temanggung collaborated with the Center Research and Development Freshwater Aquaculture Bogor to conduct research and development on domestication to breed and restock into public waters to preserve the population. The research collaboration was successful. Uceng could adapt to the artificial environment in aquariums and fiber fish tanks, respond to artificial feed, and be spawned by induced breeding methods. This method succeeded in producing approximately 1500 larvae per fish brood (F1).

The induction mating method was used as the process of breeding uceng at the beginning of its development. Currently, it uses a natural spawning process. The culture container is made identical to its native habitat and is treated with sand or small gravel at the bottom of the pond in an aquarium measuring 70x40x40 cm. The aquarium is filled with clean water as high as 25 cm and equipped with aeration. The water quality conditions are the same as their natural environment habitat, with temperatures ranging from 24-28°C, pH between 7-9, and dissolved oxygen above five ppm. The fish are fed with (Tubifex sp.) and high protein pellet feed (39%) at a dosage of 2% of the biomass weight.
Before the broodstock fish are spawned, gonads that are more than six months old are selected by visual observation. Selected and mature gonads are then spawned in separate aquariums. In 1 aquarium, there is one female and one male. The spawning process lasts 8-10 hours. When laying eggs, the female looks for a place in the water between the sand and stones. At the same time, the male fish releases sperm, resulting in external fertilization. The hatchery and spawning process are presented in Figure 2.

![Hatchery of Uceng Mungseng Laboratory and Spawning Process](image1)

**Fig. 2.** Hatchery of Uceng Mungseng Laboratory and Spawning Process

Successful spawn is indicated by the presence of foam on the surface of the water and a fishy smell in the aquarium. After spawning is complete, the male and female are returned to the broodfish tank for recovery. The hatchery layout is presented in Figure 3.

![Basic Hatchery Layout of Uceng Fish in UPTD BBI Mungseng Temanggung Laboratory](image2)

**Fig. 3.** Basic Hatchery Layout of Uceng Fish in UPTD BBI Mungseng Temanggung Laboratory

Domestication represents an ex-situ conservation effort [17]. Ex-situ conservation of aquatic species refers to the preservation and restoration efforts for endangered or rare aquatic species outside their natural habitat. This method is employed when the natural conditions are not feasible or when there are threats to the survival of the species in their original habitat. Ex-situ conservation is often combined with in-situ conservation (in their natural habitat) to achieve better outcomes in species and ecosystem preservation [18]. The advantages of ex-
situ conservation include protecting species from extinction, providing opportunities for research and education, and enabling population recovery in emergencies. Concerning this study, ex-situ conservation of uceng fish through domestication is being conducted to preserve and restore the uceng fish species.

The production of uceng fish begins with the spawning process in the BBI Munseng in the Temanggung laboratory. Currently, natural spawning is utilized instead of the induced breeding method. The initial stage of uceng fish domestication involves preparing cultivation containers that resemble their natural habitat. The cultivation containers are aquariums measuring 70x40x40 cm, designed to resemble their natural habitat by placing sand or gravel at the bottom. The aquariums are filled with clean water to a height of 25 cm and equipped with aeration. The water quality conditions are maintained similar to their natural environment, with a temperature ranging from 24-28 °C, pH level between 7-9, and dissolved oxygen above five ppm. According to [19], water quality in the uceng fish rearing aquariums is a crucial variable that significantly influences survival rates, reproduction, growth, management, and fish production. Temperature and dissolved oxygen parameters are most important in aquaculture monitoring systems. The temperature of the water is a crucial factor that significantly impacts the metabolic activities of fish, particularly their oxygen consumption [20]. Uceng fish have a natural habit of hiding in sand or gravel, which must be considered during the domestication process. The use of aquariums without sand causes uceng fish to suffer from injuries to their abdomen, ultimately leading to death. Once the containers are ready, uceng fish are captured with the involvement of local fishermen who catch uceng fish near the Progo River using environmentally friendly fishing gear made of bamboo called "telik" or "bubu". These specific fishing tools aim to prevent stress and mortality in the fish. The telik fishing method involves setting up the telik in relatively shallow waters in the evening and retrieving it the following morning, with the catch being collected and then kept in a prepared quarantine aquarium. The captured fish are then transported to the domestication site (laboratory).

The existing stock of uceng broodfish consists of 150 male and 200 female. The feeding regime for uceng broodfish, initially a mixture of (Tubifex, sp.) and artificial feed, has now transitioned to a high-protein pellet (39%) as the sole feed. Feeding is conducted twice a day at a dosage of 2% of the biomass weight. Before spawning, selection is done through visual observation of broodfish over six months old. The selected broodfish, which have matured gonads, are placed in separate aquariums for spawning. One female and one male broodfish are introduced into each aquarium. Spawning occurs 8-10 hours after the fish are paired. During spawning, the female broodfish search for a spot among the sand and rocks in the water, while the male broodfish release sperm, resulting in external fertilization. Successful uceng fish spawning is indicated by the presence of foam on the water surface and a distinct fishy smell in the aquarium. After spawning is complete, the male and female broodfish are returned to their respective broodfish aquariums for the recovery process. Uceng fish eggs sink and can be seen at the bottom of the aquarium. Fertilized eggs are transparent and hatch after 6-8 hours. The larvae do not require feeding for the first three days as they still have yolk reserves. On the 4th day, the larvae are fed boiled, mashed, and diluted egg yolk. This feeding regime continues for one week, after which the larvae are provided with artificial feed in the form of flour (39% protein) for two weeks. Subsequently, the larvae are given paste-form artificial feed for one month, with the addition of (Tubifex sp.) as natural feed until the fish fry reaches approximately two months of age. After being reared in aquariums for two months, the fish are transferred to fiber tanks for the nursery stage. In the subsequent rearing process, which takes about four months, uceng fish measuring 4-7 cm in size and totaling 250-300 individuals are produced and ready for release into natural waters. The application of uceng fish breeding can be conducted in an indoor system without requiring extensive space. The uceng fish breeding process still needs further research and
development to make it widely beneficial for conservation and commercial/aquaculture endeavors [21].

The leading cause of overfishing in various fishing areas is the unregulated exploitation of fish in their natural water habitats, disregarding their long-term sustainability [22]. Hence, it is crucial to focus on developing domestication methods to enhance fish production with a sustainable concept. As part of the reciprocal effort with the management of public waters, which is one of the sustainable fisheries resource utilization efforts, it is necessary to be conducted wisely, including restocking as an ex-situ conservation measure.

From the implementation of uceng domestication activities, in 2022, a total of 15,600 uceng (parents from F2 and F3 generations) have already been released. These fish were distributed in several rivers, which are the native habitats of uceng. Through collaboration with the community of freshwater enthusiasts in Temanggung Regency, the Uceng fish stocking activities are better controlled, both in terms of selecting the release locations and post-release monitoring evaluations. Additionally, the presence of Pokwasmas (Community Surveillance Groups) greatly assists in monitoring public water. The stocking of uceng will be conducted continuously every two months to ensure that the Uceng fish population in the public waters of Temanggung Regency remains stable so that the local community can avoid seeking Uceng fish from outside the region.

Conservation is the protection and preservation of aquatic life that is essential for maintaining the balance of nature and supporting the availability of resources for future generations [23]. To ensure the sustainability of endemic and native fish resources, conservation efforts are required, including ex-situ conservation. In-situ conservation efforts aim to preserve endemic and native fish species outside their natural habitats [24]. Restocking is carried out to conserve uceng fish by reintroducing them to their natural habitat after domestication activities. The objective of restocking is to increase the stock of fish that the local community can catch and to preserve the fish seed resource.

Uceng fish was highly favored by the community due to its delicious, savory taste and high nutritional content. It was commonly used as a food source and widely enjoyed by the people in Temanggung as a valuable animal protein. Uceng fish belongs to the order Cypriniformes and is rich in unsaturated fatty acids such as omega-3 and omega-6, including derivatives such as EPA and DHA, which are beneficial for brain development and growth [25]. Uceng fish was not only sold fresh but also processed into fried uceng fish, which has a longer shelf life and can be packaged in various sizes and flavors, making it attractive for marketing. Uceng fish became a favorite among fishermen due to its high economic value in the market. The selling price of fresh uceng fish ranged from IDR60,000 to IDR100,000 per kilogram, while fried uceng fish reached IDR300,000 to IDR350,000 per kilogram. With the increasing market demand and business competition for uceng fish, conservation efforts must be undertaken because the main source of uceng fish still relies heavily on natural capture. Moreover, fried uceng fish has been recognized as a Geographical Indication product by the Ministry of Law and Human Rights of the Republic of Indonesia, signifying that it is a unique product from Temanggung acknowledged nationally.

The process and results of domesticating uceng need to be conveyed to researchers, academics, and the public to be developed to increase fishery production and conserve the species for sustainability. The development of uceng domestication is expected to enhance income in regional fisheries.

Domestication of Uceng fish can be carried out in situ and ex-situ through collaboration with local governments. This is crucial to support fishery production and indirectly preserve the fish population (stock enhancement) by reducing fishing activities in the wild/nature.

As an internal challenge, ongoing experiments have been conducted by the technical team to enable the mass spawning of uceng fish. From 2019 to 2021, a regular stocking program was implemented, releasing 11,500 uceng fish into several rivers in Temanggung, their
natural habitats. In 2022 and 2023, the target is to release 10,000 uceng fry into public waters. Therefore, efforts are being made to increase the intensity so that the production of uceng fry can meet the target. Mass spawning is yet to be possible, so spawning is carried out twice a month, with 3 to 4 pairs of breeders each time. In the future, the production of uceng fry can be further increased to meet the demand for restocking and potential aquaculture for consumption.

The declining catch of uceng fish, as represented in Figure 4 indicates a decrease over the three past years of 39% in (2020), 32 % in (2021), and 27% in (2022). This is believed to be caused by the introducing of invasive species, posing an external challenge. The external challenge threatening the uceng population is introducing invasive fish species into public waters, specifically the Progo River. Interviews with fishermen around the Progo River revealed that the catch of uceng fish has been decreasing over the past five years, from 2018 to 2023, due to the introduction of the invasive fish species known as hampal (Hampala macrolepidota) by the fishing community. Currently, fishermen no longer catch uceng fish in the Progo River as the catch has become scarce or non-existent. This is consistent with [26], which states that one of the main threats to biodiversity and natural ecosystems worldwide is introduction of invasive exotic species, also known as invasive alien species. The extinction of freshwater fish caused by the introduction of alien species accounts for 30% of the global decline in biodiversity, second only to direct habitat destruction. The introduction, spread, and use of various alien species, whether intentional or unintentional, that subsequently become invasive have resulted in significant ecological, economic, and social losses. These include the disintegration of local and native/endemic fish communities, genetic damage to local fish populations due to hybridization, disease transfer, and the socio-economic impact on the affected communities around water bodies [27].

![Fig. 4. Data of Uceng Catch in 2020-2022](image)

The solution to the external challenge posed by introducing invasive species is the need for regulations to govern this issue. In addition, the regulation and supervision of fishing gear are necessary to prevent damage to specific fish populations and habitats. The participation of the community is crucial in enhancing surveillance against illegal fishing, pollution, and
the introduction of invasive fish species that can disrupt ecosystem balance and hinder the reproductive success of stocked uceng fish.

4 Conclusion

The domestication process of the uceng fish has been successfully carried out through both induced breeding and natural spawning processes. Domestication is conducted as an ex-situ conservation effort. In the past three years, from 2020 to 2022, there has been a downward trend in the number of uceng fish stocks in the wild due to the increased introduction of invasive species/predators in public waters, threatening the existence of uceng fish. Currently, research on the mass domestication process is still ongoing. The cooperation of various stakeholders is necessary to support domestication and conservation activities through regulations. Public awareness is needed to constantly engage in fishing using environmentally friendly fishing gear, as the utilization of fisheries resources in the public waters of Temanggung Regency is becoming increasingly uncontrolled, resulting in an imbalance between the catch and recovery.

Acknowledgement

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