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EXTREMOPHILE FISHES FROM EX-TIN MINE LAKE IN NIBUNG VILLAGE, CENTRAL BANGKA, BANGKA ISLAND

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Abstract

Tin mineral in Bangka Island has been mined since the 18th century until now. Tin mining has a positive impact on the economy in Bangka and Belitung, but has a negative impact on the environment with the formation of many new lakes called Kolong. Some ex-tin mine lake have extreme water quality with a low pH. One of them is a lake in Nibung Village, Central Bangka Regency, which has been identified as having an acidity of 3.37. Several fish species were found in the waters with high acidity values, namely *Rasbora einthovenii, Trigonopoma pauciperforatum, Rasbora bankanensis, Betta edithae, Brevibora dorsiocellata*, and *Aplocheilus panchax*. The six species can be categorized as extremophile fish. These fish have the ability to adapt to extreme environments so that they have the potential to be used as phylogeographic models and historical distributions

Keywords : *Acid, Bangka, Extremophiles, Ex-Tin Mine*

INTRODUCTION

Tin mining on Bangka Island has been going on for more than 300 years. Until now, excavations to exploit tin minerals from the bowels of the earth on this island continue to be carried out. Tin mining is getting more massive when people participate in mining independently. The emergence of illegal tin mines that do not take into account the reclamation and restoration of ex-mining land. As a result, an increasing number of former tin mines have formed an artificial lake known as a pit. Even from the plane that will land at Depati Amir airport, Pangkalpinang can clearly see the expanse of holes scattered on the mainland of the island.

Hundreds of pits are scattered on the mainland of the island of Bangka. The number will be even greater when combined with under the island of Belitung. Some of the pits have been abandoned from tin mining for a long time. Generally, under the age of more than 10 years and referred to as old pits have water quality that is close to suitability for fish farming. This condition makes many pits used for fish cultivation, both with tancap cages and floating net cages (Triswiyana et al., 2019). In fact, the productivity of tilapia cultivation in ex-tin mine lakes is higher and more profitable than cultivation in soil ponds (Pepayocha et al., 2022). Some of the pits used for fish cultivation such as under Jeruk, Pedindang, and Pemali have water quality and heavy metal content in accordance with class 3 water quality standards intended for fishery activities (Prasetiyono, 2015).

The quality of under water that is young or recently abandoned by miners, has high water acidity. Under 1 year old or those that are still being mined generally have an acidic pH of up to 3 (Sudiyani et al., 2011). Similar conditions were found in the pit in Nibung Village, Central Bangka Regency which was identified as having water with a low pH. This pit has clear waters and has been overgrown with weeds on the edges, but have 3.37 pH value. Despite the extreme water conditions, Nibung pit has a diversity of ichthyofauna that live and thrive in it.

Freshwater fish that are able to live in acidic water conditions are very interesting to identify. These fish are categorized as extremophile fish (Bierbach et al., 2013; Mustikasari et al., 2022; Kurniawan et al., 2022). These fish have the potential to be used as a deterrent to the development of mosquitoes that spread malaria and dengue fever. Fish that survive under harsh environmental conditions potential to be used to identify fish distribution patterns without being affected by environmental changes.

METHODS

The study was done from July – September 2022. Exploration of extremophilic fish was carried out under Nibung in Nibung Village, Koba sub-district, Central Bangka Regency (Figure 1). Fishing is done using traps. The identification of the fish found was carried out in the Aquaculture Laboratory, Bangka Belitung University.

Figure 1. Exploration sites for extremophile fish in Nibung Ex-tin mine lake, Koba, Central Bangka.

Fish caught in traps are kept alive. The dead fish were preserved using 5% formalin. The fish are then identified by naming their species based on their morphological characters. The suitability of the character is done using the description of Weber and Beaufort (1916). Fish identification results were analyzed descriptively to explain their distribution, adaptability and potential in extreme waters.

RESULT

There were six species of fish obtained from the ex-tin mine lake in Nibung (Figure 2). The six species are morphologically similar to *Rasbora einthovenii, Trigonopoma pauciperforatum, Rasbora bankanensis, Betta edithae, Brevibora dorsiocellata*, and *Aplocheilus panchax*. *Rasbora einthovenii* and *Trigonopoma pauciperforatum* are known locally as Seluang fish, *Brevibora dorsiocellata* as Bebidis fish, *Rasbora bankanensis* as Kenancat Fish, and *Aplocheilus panchax* as Tin Head Fish.

Figure 2. Fish identified in Nibung Ex-tin mine lake. a) *Rasbora einthovenii*, b) *Aplocheilus panchax,* c) *Trigonopoma pauciperforatum*, d) *Rasbora bankanensis*, e) *Betta edithae*, f) *Brevibora dorsiocellata*.

DISCUSSION

Rasbora einthovenii

Fish with a yellow color on top and white on bottom with a horizontal black line separating have similarity to the description of Weber and Beaufort (1916). The color of the formol specimen is dark brown above, yellowish underside. The two colors are separated by a black band from the snout to the tip of the tail, which increases in width from the snout to under the back. The beauty of this fish makes it one of the aquarium ornamental fish, including aquascapes. This fish known as Brilliant rasbora in international traded.

This fish, also known as blue line rasbora, is a native Sundaland species. This fish is found on the islands of Sumatra, Borneo and the Malay Peninsula. There has been no record of this freshwater fish specimen on the islands of Bangka and Belitung (GBIF, 2021). This shows that no specimens of R. *einthovenii* from the two islands have been recorded in the zoological museum, although Syarif and Prasetiyono (2019) have reported the findings of this species on Bangka Island. Lumbantobing (2020) explained that this species is in the category of least concern in the IUCN redlist.

Until now, there has been no publication on the use of this fish. Sharif et al. (2021) and Ravelia et al. (2024) saw that its attractive color pattern made it potential to be developed as an ornamental fish and tried to domesticate it until it succeeded in increasing gonad maturity in artificial containers. This lack of attention allows R. *einthovenii* to be a model for fish distribution in Sundaland. Its ability to adapt to extreme environments allows its existence in the areas it reaches in its distribution. Irawan et al. (2019) showed that this fish species was able to survive being reared at pH 5 even though it experienced a decrease in growth. The role of humans in its distribution is also minimal so that it can predict the geographic barrier that affects its distribution.

Trigonopoma pauciperforatum

The fish known as the Glowlight Rasbora or Redstripe rasbora is also a popular aquarium ornamental fish. The horizontal line of the pink bar is his trademark. T. *pauciperforatum* is one of the popular ornamental fish in the aquarium trade in Greece (Papavlasopoulou et al., 2014). Its resistance to extreme conditions allows the distribution of this fish trade from Southeast Asia to Europe. There are not many

morphological records of this species. These conditions allow Lumbantobing & Vidthayanon (2020) to categorize this species as least concern. Redstripe Rasbora and Glowlight rasbora are the international common names of this species. The distribution of this fish is also spread on the islands of Sumatra, Bangka, Belitung, Kalimantan, and the Malay Peninsula.

Rasbora bankanensis

Rasbora bankanensis was first collected in 1934 (Alfred, 1965). R. *bankanensis* is characterized by round black pigmentation on the anal fin (Siebert, 1997). Weber and Beaufort (1916) described this fish as having a brownish specimen color with a lighter belly. There is a black lateral stripe on the back of the body, located in a dark band, which descends anteriorly in extension. Median dorsal black line; dark line above the base of the anus, which can be continued to the tail. This freshwater fish is still commonly found in Bangka. Rachmatika et al. (2006) also reported that this fish is the most abundant in several rivers in Riau. Likewise in the Muller mountains, Central Kalimantan (Haryono, 2004).

The high population in nature is predicted to make this fish included in the least concern category in the UICN redlist. Its distribution is predicted to be on the eastern side of the island of Sumatra, the Malay peninsula and Kalimantan (Amhad, 2019). Figure 3c shows that most of the findings are in southern Sumatra, West Kalimantan and the Malay peninsula.

Brevibora dorsiocellata

This fish was originally included in the genus Rasbora (Webber and Beaufort 1916). However, the difference in the number of predorsal scales makes this fish included in the genus Brevibora (Liao et al., 2010). This species is mostly found in inland waters of Bangka Island. This fish with black spots on the dorsal fin is potential as an ornamental fish native to Indonesia (Zambawi et al., 2020). Gbif (2021) shows the distribution of this fish in Sumatra, Kalimantan and the Malay Peninsula (Figure 3d). There are no zoological records of this fish on the islands of Bangka and Belitung, although several publications have listed it as one of the freshwater iktiofauna of both islands.

The IUCN categorizes this fish as an endangered species or threatened with extinction. When a fish is threatened with extinction, it is necessary to have a domestication process so that its trade as an ornamental fish does not depend on natural catches. Until now, there is no indication of over-exploitation of this fish in Bangka Island for both trade and consumption.

Aplocheilus panchax

Aplocheilus panchax known as the Tin Head Fish is one of the larvivora fish that has the potential to be a predator of larvae of larvae (Abubakar et al., 2019). This fish is characterized by the presence of white spots on the head, so it is called the Tin Head. The white color is like tin mineral which is widely mined on the islands of Bangka and Belitung (Mustikasari et al., 2020). Tin Head Fish is a species of fish that lives spread in open waters in Indo-Burma, Sunda Shelf, Philippines, to Wallace. On the other hand, this fish is also commonly found in acid mine waters in the Province of the Bangka Belitung Islands. Tin Head Fish are able to adapt in fresh water to the sea with extreme differences in water characteristics. One of the habitats of the Tin Head Fish is fresh waters such as lakes (under) after tin mining which is under 1 year old to more than 50 years old (Kurniawan and Mustikasari, 2021).

Betta edithae

Together with *Betta uberis*, *Betta edithae* is one of the wild Betta fish found in Bangka and Belitung. Wild Betta fish inhabit swampy waters with a fairly low pH (Syarif et al., 2020). *Betta edithae* has a distribution in Sumatra and Kalimantan (Hadiaty, 2001). Records in Bangka and Belitung have not appeared because there are no records of biological specimens. Wild betta fish has its own value for ornamental fish hobbyists during the Betta fish boom. This condition allows natural catches that endanger the population. Low (2019) categorizes this fish as least concern in the IUCN redlist.

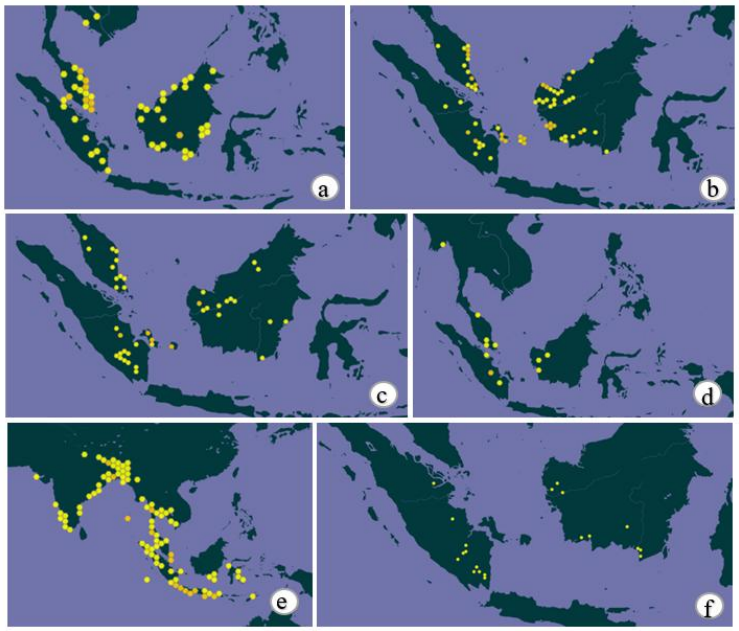

Figure 3. Map of the distribution of the six extremophile fish in Southeast Asia (GBIF, 2021). a) *Rasbora einthovenii,* b) *Trigonopoma pauciperforatum,* c) *Rasbora bankanensis,* d) *Brevibora dorsiocellata,* e) *Aplocheilus panchax,* f) *Betta edithae.*

Communities often observe the presence of these extremophile fish in ex-tin mining ponds and perceive that the waters are suitable for fish farming (Kurniawan et al., 2025). However, not all ponds are appropriate to be utilized as aquaculture sites for food fish such as catfish, tilapia, and gourami (Anjani et al., 2025). Blackwater fish such as *Osteochilus spilurus* have been found in acidic waters, which are at high risk if used for aquaculture (Saputra et al., 2025).

The ability of these fish to adapt to extreme environmental conditions allows for their wide distribution. Acidic waters, high heavy metals, and large temperature fluctuations do not prevent these fish from living and breeding. In species that have minimal relationship with humans, it has the potential to be a model for phylogeography and the history of the distribution of freshwater fish in the past.

Further research should explore the potential utilization of extremophile fish beyond their ecological significance. These species may serve as valuable models for understanding genetic and physiological adaptation to harsh environments, which can contribute to evolutionary biology and biotechnology. In addition, their unique tolerance to acidic and heavy metal-contaminated waters could be developed for applied purposes, such as bioindicators of ecosystem health or experimental organisms for toxicological studies. Exploring the potential domestication and selective breeding of extremophile fish may also provide insights into aquaculture development in challenging environments.

CONCLUSION

Freshwater fish that are able to live in acidic water conditions are very interesting to identify. *Rasbora einthovenii*, *Trigonopoma pauciperforatum*, *Rasbora bankanensis*, *Betta edithae*, *Brevibora dorsiocellata*, and *Aplocheilus panchax* found in ex-tin mine lake waters that have a low pH of up to 3. These fish have the ability to adapt to extreme environments so that they have the potential to be used as phylogeographic models and historical distributions. Extremophile fish should be further investigated as bioindicators of ecosystem health and as model organisms for studying genetic and physiological adaptations, with potential applications in biotechnology and aquaculture in challenging environments.

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