Indonesian Journal of Aquaculture Medium

https://journal.unram.ac.id/index.php/jmai/index. E-ISSN : 2798-0553

VOLUME 1, NUMBER 2, DECEMBER 2021

PRELIMINARY STUDY OF POST TRANSPORTATION ADAPTATION RESPONSE OF *Esomus metallicus* (AHL 1923), AN FOREIGN FISH SPECIES IN INDONESIA AND INITIAL DISCUSSION OF ITS UTILIZATION POTENTIAL

Studi Pendahuluan Respon Pasca Transportasi Adaptasi *Esomus metallicus* (AHL 1923), Jenis Ikan Asing di Indonesia dan Pembahasan Awal Potensi Pemanfaatannya

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ABSTRACT

Esomus metallicus is a fish species that is not naturally distributed in Indonesia (non-native). In some cases, non-native fish species have threatened natural ecosystems in public waters. Through scientific expeditions, observations were carried out aimed at assessing the initial post-transport adaptation response, namely the survival and behavior of wild *E. metallicus* fish in controlled containers. Apart from that, an analysis was also carried out on the potential for use in the fields of aquaculture, processing of fishery products, and educational strategies for the public about *E. metallicus* fish. The expedition was carried out for two days in the western part of Java Island. Fish are transported using a closed system for 6 hours. Post-transportation fish maintenance is carried out for 14 days. The results showed that the survival rate of *E. metalicus* fish during transportation was 96.72%. *E. metalicus* fish can adapt well in controlled rearing containers as seen from the final observed survival of 90.96%, active swimming behavior in groups and having eaten artificial food. The potential as an ornamental fish can be seen in the color of its metallic scales, small body size, and group swimming behavior which can make it a fish for aquascapes. Apart from that, the potential use of this fish is as live food for predatory fish, fish meal, laboratory test fish, and food ingredients. Further study of this as a solution to control non-native fish needs to be carried out. Risk analysis shows that *E. metallicus* is a medium risk species. An educational strategy for the public needs to be carried out because the public considers the *E. metallicus* fish to be "benteur" or "paray", which is the local name for fish from the genus Rasbora native to Indonesia due to morphological similarities.

ABSTRAK

Esomus metallicus merupakan salah satu jenis ikan yang persebarannya tidak alami di Indonesia (non-pribumi). Dalam beberapa kasus, spesies ikan non-asli telah mengancam ekosistem alami perairan umum. Melalui ekspedisi ilmiah, dilakukan observasi yang bertujuan untuk menilai respon adaptasi awal pasca pengangkutan, yaitu kelangsungan hidup dan perilaku ikan liar *E. metallicus* dalam wadah terkendali. Selain itu juga dilakukan analisis terhadap potensi pemanfaatannya dalam bidang budidaya perikanan, pengolahan hasil perikanan, dan strategi edukasi masyarakat tentang ikan *E. metallicus*. Ekspedisi dilakukan selama dua hari di Pulau Jawa bagian barat. Ikan diangkut menggunakan sistem tertutup selama 6 jam. Pemeliharaan ikan pasca pengangkutan dilakukan selama 14 hari. Hasil penelitian menunjukkan bahwa tingkat kelangsungan hidup ikan *E. metalicus* selama transportasi sebesar 96,72%. Ikan *E. metalicus* dapat beradaptasi dengan baik pada wadah pemeliharaan terkendali dilihat dari kelangsungan hidup akhir yang diamati sebesar 90,96%, perilaku berenang aktif secara berkelompok dan telah memakan pakan buatan. Potensinya sebagai ikan hias terlihat dari warna sisik metalik, ukuran tubuh yang kecil, dan perilaku berenang berkelompok yang menjadikannya ikan untuk aquascape. Selain itu potensi pemanfaatan ikan ini adalah sebagai pakan hidup ikan predator, tepung ikan, ikan uji laboratorium, dan bahan pangan. Kajian lebih lanjut mengenai hal ini sebagai solusi pengendalian ikan non-pribumi perlu dilakukan. Analisis risiko menunjukkan bahwa *E. metallicus* merupakan spesies dengan risiko sedang. Strategi edukasi kepada masyarakat perlu dilakukan karena masyarakat menganggap ikan *E. metallicus* adalah ikan “benteur” atau “paray”, yaitu nama lokal untuk ikan dari genus Rasbora asli Indonesia karena kemiripan morfologinya.

Kata Kunci	*Respon Adaptasi Pasca Transportasi, Esomus metallicus (AHL 1923), Spesies Ikan Asing*
Keywords	*Post-Transport Adaptation Response, Esomus metallicus (AHL 1923), Alien Fish Species*
Tracebility	Tanggal diterima : 13/9/2021. Tanggal dipublikasi : 12/12/2021
Citation Guide (APPA 7th)	Solahudin, E. A., Fadillah, T. N., Suci, D. T., Putri, N., Fatimah, F. Y., Rizki, E. M., Herjayanto, M., Syamsunarno. M. B., Pratama, G., Zahro, F., Wasistha, I. N. D., Meata, B. A., Hasanah, A. N., Agung, L. A., Roidelindho, K., & Munandar, A. (2021). Preliminary Study of Post-Transportation Adaptation Responses of *Esomus metallicus* (Ahl 1923), an Alien Fish Species in Indonesia and Initial Discussion of Its Potential Utilization. *Indonesian Journal of Aquaculture Medium* 1 (2), 98-112. http://doi.org/10.29303/mediaakuakultur.v1i2.357

INTRODUCTION

Esomus metallicus is a species of fish that belongs to the Cyprinidae group. This fish is small in size, with a total length of 5-7 cm. Naturally, this species lives in the fresh waters of Cambodia, Laos, Malaysia (Malay Peninsula), Myanmar, Thailand and Vietnam (Vidthayanon, 2012). This species is reported to have been introduced in Indonesia, namely on the island of Sumatra (Pulungan et al. 2011, Arbsuwan et al. 2012, Hasan et al. 2020). The existence of similar fish, namely E. cf. metallicus on the island of Java as reported by Hadiaty (2011) in the Cisadane River basin. The presence of introduced fish species (foreign fish) in public waters is a threat to the preservation of native fish in Indonesia because they have the potential to become invasive alien species (Muchlisin, 2011).

A scientific expedition in March 2021 carried out on the western island of Java succeeded in collecting and confirming the presence of E. metallicus fish in natural waters, in rice fields. This fish is found in large populations. Morphologically, this fish has metallic scales, so it is quite attractive as an ornamental fish. Further use in the field of aquaculture requires information on the initial adaptation of E. metallicus fish in a controlled environment. Raising wild fish starts with catching and then transporting the fish from the wild to controlled captivity (Tjakrawidjaja & Subagja 2009, Herjayanto et al. 2018).

Handling during capture and transportation can cause stress to fish. This condition impacts approximately two weeks of initial post-transport maintenance. Fish that cannot recover during this period will die (Nirmala et al. 2012, Hadiroseyani et al. 2016). Therefore, it is necessary to carry out initial observations aimed at obtaining information on the initial adaptation response, namely the survival and behavior of E. metallicus fish in controlled containers. Apart from that, as a solution to control foreign fish, this article describes the initial strategy for the potential use of E. metallicus fish, risk analysis (KKP 2017), and educational strategies for the community.

RESEARCH METHOD

Time and place

The research was carried out from March 12 to April 23 2021. Fish collection was carried out in Sukamaju Village, Cikeusal District (6°12'26.7"S 106°15'37.4"E). Initial maintenance for observing adaptation responses was carried out at the Aquaculture Laboratory, Fisheries Science Study Program, Faculty of Agriculture, Sultan Ageng Tirtayasa University.

Collection, Identification and Transport of Fish

Fishing is carried out using nets with a mesh size of 0.5 mm with a one day fishing pattern. The net is operated by two people by herding the fish to the edge of the water. The fish obtained were put into a 25 L bucket. The E. metallicus fish (Figure 1) used had a total length of 3-5 cm (average 4 ± 0.45 cm). Validation of fish species was carried out by observing meristic characteristics based on Arbsuwan et al. (2012), namely D.II, 6-7 (dorsal fin rays), P.I, 13-14 (pectoral fin rays), V.I, 6-7 (pelvic fin rays), and A.III, 5 (anal fin radius). Transporting fish uses a closed system, namely the fish is placed in plastic packing which has been filled with fresh water. Fish density is 30 fish per bag. The fish were then transported to the laboratory using land transportation for 6 hours.

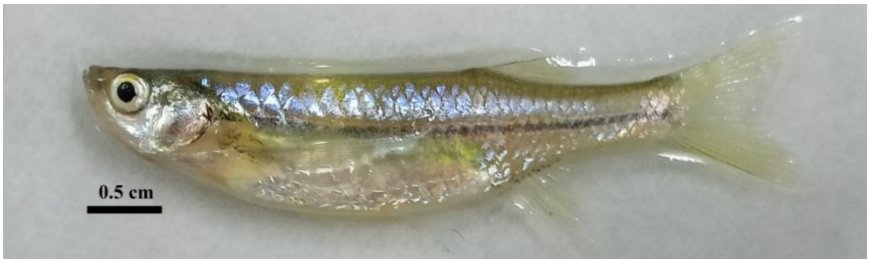

Figure 1. Esomus metallicus fish (Photo by ©M. Herjayanto)

Post-transport Acclimatization and Maintenance

Fish that arrive at the laboratory are first acclimatized by placing plastic containing the fish into a rearing container. Maintenance uses three rectangular fiber tubs measuring 100 cm × 60 cm × 28 cm, filled with 168 L of fresh water, and without using aeration. Before use, the tub is cleaned first. Acclimatization is carried out to adapt fish to the temperature and conditions of the rearing media. After 30 minutes, the plastic was opened and water quality measurements were taken, namely temperature, pH and dissolved oxygen. Temperature is measured using a thermometer, pH using a pH meter, and dissolved oxygen using a dissolved oxygen meter. The number of fish that died during transportation was counted and removed from the plastic. Live fish are slowly put into the rearing container by mixing water from the rearing container into plastic packing. The number of fish per container is 59 fish.

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Risk Assessment

The assessment of the risks that will be faced ecologically and economically from the E. metallicus species refers to the guidelines of the Decree of the Fish Quarantine, Quality Control and Safety of Fishery Products (BKIPM) Number 107/KEP-BKIPM/2017 (KKP 2017).

Prosedur Analisis Data

Survival data during transportation, then survival, behavior (swimming patterns, grouping, response to natural and artificial food) post-transportation maintenance were analyzed descriptively. Data was processed using Microsoft Excel 2010 and presented in the form of figures and tables. Analysis of potential utilization and educational strategies was carried out by describing the results of previous studies.

RESULT AND DISCUSSION

Result

Survival of Esomus metallicus fish obtained after transportation for 6 hours was 96.72%. This closed system transport water quality produces a temperature of 25°C, pH 6.95, and dissolved oxygen of 5.3 mg/L. The death of E. metallicus fish only occurred on the second and third days of rearing. At the end of maintenance, survival was 90.96% (Figure 2).

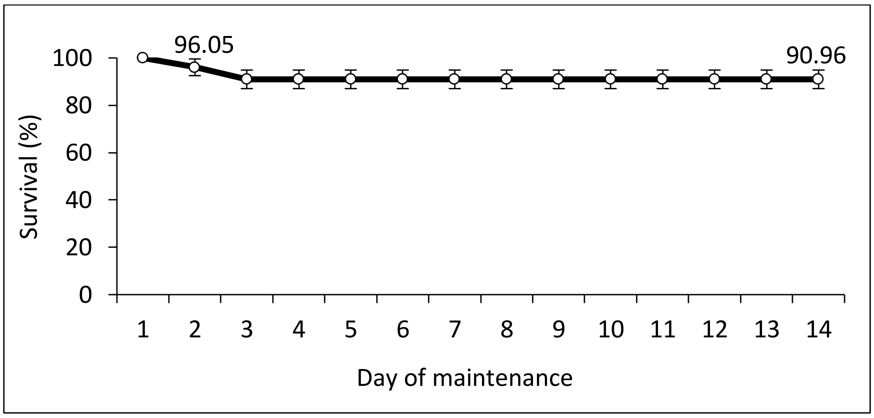

Figure 2. Survival of Esomus metallicus fish during 14 days of post-transportation rearing.

Fish behavior during maintenance: Fish swim actively in groups. Group behavior (schooling) became more visible after 7 days of maintenance. The fish responded well to natural food on the 4th rearing day. The fish's response to artificial food was seen on the 4th rearing day. In the first week, E. metallicus fish took 7-9 seconds to eat the artificial food. After 7 days of maintenance, all the fish had responded well and it took the fastest 2 seconds to eat the food provided (Table 1). Water quality at the end of fish transportation and during post-transportation maintenance is temperature 26-29°C (26±0.74°C), pH 7.07-7.20 (7.14±0.05), and dissolved oxygen 1.70-6.70 mg/L (4.32±2.44 mg/ L).

Table 1. Behavior of Esomus metallicus fish during 14 days of post-transportation rearing.

Day of-	Description of behavior			
	Swimming pattern	Group	Natural feed response	Artificial feed response
1	aktif	+	×	×
2	aktif	+	+	-

3	aktif	+	+	-
4	aktif	+	++	+
5	aktif	+	++	+
6	aktif	+	×	++
7	aktif	+	×	+
8	aktif	++	×	++
9	aktif	++	×	++
10	aktif	++	×	++
11	aktif	++	×	++
12	aktif	++	×	++
13	aktif	++	×	++
14	aktif	++	×	++

Note: ×: not given food, 一: There isn't any, +: there are a few, ++: There are many

Based on the risk analysis of foreign species invasion which refers to the guidelines of BKIPM Decree Number 107/KEP-BKIPM/2017 (KKP 2017), the E. metallicus fish is included in the medium risk species with a value of 36.3 (Table 3).

Table 3. Esomus metallicus risk assessment

No	Factor	Category	Mark		
			Mark	Weight (%)	Total Skor
Income and Distribution Potential					
1	Breeding rate (productivity)	Breeding is slow, fecundity is low, and is not cultivated en masse	30	10	3
		Slow breeding, moderate fecundity, and potential for mass cultivation	60		
		Fast breeding, high fecundity and potential for mass cultivation	100		
2	Ability to spread outside its natural habitat (tolerance and adaptation to waters in Indonesia)	There is no spread outside its natural habitat. Requires a special habitat	30	10	
		There was spread but in a limited area. This species is able to live in 2-3 ecotypes or niches.	60		6
		There is dispersal in large areas outside its natural habitat. Species occupy a wide range of ecotypes or niches.	100		

3	Invasiveness of other species in the same genus	The whole thing is non-invasive	30	8	2,4
		Some are invasive	60		
		The whole thing is invasive	100		
4	Potential entry through transportation (direct or indirect)	The potential for income through transportation is rare	30	8	2,4
		The potential for income through transportation routes often occurs	60		
		The potential for income through transportation routes occurs regularly	100		
5	Regulations to prevent entry and transportation	There are regulations that strictly prevent the entry and circulation of fish	30	6	
		There are regulations that regulate the circulation of fish, but they are not yet effective	60		3,6
		There are no regulations that strictly prevent the entry and circulation of fish	100		
6	Distribution or presence in an area	Only found in 1 (one) region/island in Indonesia	30	5	
		Available in several regions/islands	60		3
		It has spread to almost all regions/islands in Indonesia	100		
Ecological Impact					
7	Impact on Ecosystem processes	There is no impact or light effect on ecosystem processes	30	10	3
		Causing significant changes in ecosystem processes	60		
		Causing major, possibly permanent changes to ecosystem processes	100		
8	Eating habit	The types of food are limited	30	7	2,1
		Eat everything and greedy	60		
		Omnivorous, greedy and predatory	100		
9	Impact on composition, structure and	There is no or little impact on the composition, structure and interactions within the community	30	8	2,4

	interactions within communities	Causes significant changes to composition, structure, and interaction in the community	60 100		
10	Impact on genetic integrity of native species/hybridization potential	No impact on genetic integrity of native species / no potential for hybridization	30	6	1,8
		Hybridization occurs with one or more native species and produces sterile offspring that can reduce the reproduction of native species	60		
		Hybridization occurs with one or more native species and produces fertile offspring that can compete with the native species	100		
Economic Impact					
11	Impact on capture fisheries industry/production	There is no impact or little impact on the capture fisheries industry/production	30	8	2,4
		There is an impact that has the potential to reduce the capture fisheries industry/production	60		
		There are impacts that disrupt the capture fisheries industry/production	100		
12	Impact on infrastructure	No impact or minimal damage to infrastructure	30	4	1,2
		Causing damage to some infrastructure	60		
		Causing serious/major damage to infrastructure	100		
13	Impact on the tourism sector	There is no or little impact on the tourism industry	30	3	0,9
		Causing a detrimental impact on the tourism industry	60		
		Have a significant impact or cause the loss of the tourism industry	100		
Impact on Fish Health					
14	Impact for fish health	There is no impact on fish health	30	4	1,2

		There is an impact on fish health through pathogenic agents carried, causing fish illness and death in relatively low numbers	60		
		There is an impact on fish health through pathogenic agents carried, causing fish to become ill and die in high numbers	100		
Impact on Human Health					
15	Impact on health Human	There is no impact on human health	30	3	0,9
		Causing physical injury (claws, shells from zebra mussels, catfish patils)	60		
		Is a vector of disease for humans or as a disease organism (Zoonosis). It may also cause the death of individuals (toxic).	100		
		Total value			**36,3**

Discussion

The success of fish domestication from nature to a controlled environment can be seen from survival. The capture and transport techniques used in this study provided high survival of E. metallicus, namely >90%. Fish mortality that occurred on the second day, namely 3.95% on the third day and 9.04% (Table 1) is a common thing that occurs in fish adaptation. This phenomenon is termed hauling loss (Nirmala et al. 2012) or delayed mortality syndrome (Hadiroseyani et al. 2016). This is a delayed death due to stress during transportation which occurs approximately two weeks at the start of post-transportation maintenance (Nirmala et al. 2012, Hadiroseyani et al. 2016). The stages that must be considered to produce good survival in efforts to maintain wild fish are catching, turning, packing, transporting and conditioning in a new environment (Tjakrawidjaja & Subagja, 2009). Fishing methods that do not remove fish from the water (Herjayanto et al. 2018), regulating stocking density during transportation (Syamsunarno et al. 2019, Herjayanto et al. 2021) are some things that can improve survival performance during initial rearing.

The behavioral results (Table 1) show that E. metallicus fish quickly adapt to environmental conditions and the type of food provided. Providing natural food at the start of rearing makes the fish respond to eating moving food. E. metallicus does not eat artificial food in the early stages of rearing. The E. metallicus fish is a herbivorous fish which naturally eats phytoplankton as its main food. However, they also eat detritus, small crustaceans and zooplankton (Sukron et al. (2017). On the fourth day, a shift in food begins from natural food to artificial food. This shows that the fish quickly adapt to artificial food. Artificial food is a response well after seven days of rearing. Complete and balanced nutritional content in artificial feed is the main factor in increasing fish growth (Syamsunarno & Sunarno, 2016). There is only one other factor that needs to be studied in more depth regarding the reproduction of these fish so that they can reproduce.

Potential utilization

Keberadaan ikan-ikan asing di perairan umum Indonesia merupakan salah satu ancaman terhadap kelestarian ekosistem alami karena berpotensi spesies invasi (Muchlisin, 2011). Uraian identifikasi potensi bahaya *E. metallicus* dapat dilihat pada Tabel 4. Berdasarkan analisis manajemen risiko (Tabel 3) maka perlu adanya strategi keberlanjutan terhadap ikan *E. metallicus*. Secara ekosistem ikan ini tidak berbahaya sehingga dampak terhadap ekosistem tidak terlalu signifikan (Arthur *et al*. 2010), tetapi perlu dilakukan upaya manajerial untuk mengatasi masalah spesies asing.

Beberapa tahapan yang dapat digunakan untuk mengatasi masalah spesies ikan asing adalah kerja sama antar *stakeholder* terkait yang meliputi pemerintah, peneliti/akademisi, dan masyarakat. Keterlibatan integratif dan kolaboratif dalam manajerial spesies ikan asing dengan cara (1) meningkatkan perencanaan dan pelaksanaan bersama dalam merumuskan penelitian dan tindakan manajemen untuk *E. metallicus* (2) memberikan edukasi kepada masyarakat dan umpan balik kepada pemangku kepentingan sebagai hasil penelitian dan tindakan manajemen (3) meningkatkan kolaborasi dan kemitraan di luar ilmu alam (ilmu sosial) sehingga terjalin keterpaduan bersama dalam merangkai kegiatan manajemen ikan asing yang berada di Indonesia (4) mendiskusikan beberapa saran praktis dan kebijakan terkait untuk meningkatkan keterlibatatan pemangku kepentingan dalam penelitian dan manajemen spesies ikan asing (Shackelton *et al*. 2018).

Saat ekspedisi diketahui bahwa masyarakat setempat menyebut ikan *E. metallicus* dengan nama "benteur" atau "paray" yaitu nama lokal ikan *Rasbora* yang merupakan ikan asli Pulau Jawa, Indonesia. Hal ini disebabkan karena kemiripan warna dan bentuk tubuh (Gambar 3). Beberapa strategi dalam mengedukasi ikan *E. metallicus* kepada masyarakat dari berbagai kalangan usia yaitu memberikan penyuluhan terkait spesies ikan *Esomus metallicus* yaitu (1) akuarium edukasi sebagai sarana dan sumber belajar tersendiri untuk masyarakat, (2) video pembelajaran tentang ikan asli dan introduksi, (3) poster edukasi mengenai ikan *E. metallicus* (Budiantoro & Setiawan 2018, Intaha *et al*. 2020).

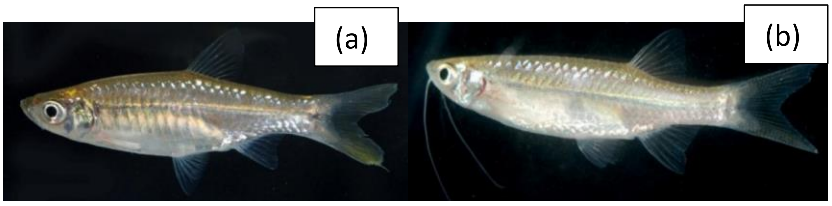

Figure 3. Morphology of Rasbora sp. (a) and *Esomus* cf. *metallicus* (b) (Hadiaty, 2011).

Table 3. Identification of potential dangers of Esomus metallicus in waters

No	A list of questions	Answer	Information
1	Is the fish species/organism predatory?	No	Its food consists of phytoplankton, namely green algae (Cosmarium spp.), blue-green algae (Stigonema spp.) and diatoms (Achnanthes spp.) (Morioka & Vongvichith, 2014), and a little in the form of aquatic zooplankton, insects and insect larvae (Vidthayanon , 2012)
2.	Are fish species/organisms competitors?	No	This fish is a friendly type of fish, as evidenced by the discovery of this fish together with several other fish (Arbsuwan et al. 2012), however, in concept, this fish community could be a competitor fish for other fish in terms of finding food, but this cannot yet be said. This is proven because the presence of this fish does not have a significant impact on an ecosystem.
3.	Does a fish species/organism dominate a habitat/population?	No	This fish is found living together with several other fish such as *Hemirhamphodon pogonognathus*, *Mystacoleucus* sp., *Puntius binotatus*, *P. lateristriga*, *P. tetrazona*, *Rasbora* cf. *aprotaenia*, *R. trilineata* and *Trichopodus trichopterus* (Arbsuwan *et al*., 2012)
4.	Do fish species/organisms have fast reproductive cycles?	No	This fish does not have a fast production cycle so it does not have an impact on an ecosystem (Arthur et al. 2010, Pulungan et al. 2011). However, for the growth of this fish, it is very suitable in the summer (Morioka & Vongvichith, 2014)
5.	Do fish species/organisms grow faster than other species in a habitat/population?	No	This fish does not have a fast production cycle so it has no impact on an ecosystem (Arthur et al. 2010, Pulungan et al. 2011)
6.	Does the fish species/organism have a high tolerance for various environmental conditions?	No	It is one of the indicator fish for waters affected by insecticide pollution when compared to the sepat fish (Trichogaster tricopterus) (Utayopas, 2001). However, this species is resistant to heavy metal pollution, especially arsenic and manganese (Neeratanaphan et al., 2017).

7.	Are fish species/organisms omnivorous/can eat various types of food?	No	Herbivore fish (Morioka & Vongvichith, 2014)
8.	Can fish species/organisms hybridize/reproduce asexually?	No	Morphologically, this fish is a fish with a type of sexual reproduction (Arbsuwan et al. 2012)
9.	Does this species of fish/organism cause health problems/carry dangerous diseases that have a negative impact on the fish itself or other species?	Yes	The metacercarian stage worm parasite Centrocestus formosanus has been identified as being able to infect this fish and can cause fish respiratory problems, resulting in fish death (Mitchell et al. 2005).
10.	Does this species of fish/organism cause health problems in humans?	Yes	Consuming raw cyprinid fish including E. metallicus causes a risk of parasite infection (Opisthorchis viveriini) (Tomokawa et al. 2008), but this fish is also a good source of protein in rural areas of south-central Laos if consumed pre-processed. Apart from consumption, it is also used as an aquarium fish (Vidthayanon, 2012)

CONCLUSION

Esomus metalicus fish can adapt well in controlled rearing containers as seen from the final observed survival of 90.96%, active swimming behavior in groups, and eating artificial food. The potential as an ornamental fish can be seen in the color of its metallic scales, small body size, and group swimming behavior which can make it a fish for aquascapes. Apart from that, the potential use of this fish is as live food for predatory fish, fish meal, laboratory test fish, and food ingredients. Risk analysis shows that E. metallicus is a medium risk species. An educational strategy for the public needs to be carried out because the public considers the E. metallicus fish to be "benteur" or "paray", which is the local name for fish from the genus Rasbora native to Indonesia due to morphological similarities.

ACKNOWLEDGEMENT

We would like to thank the head of the Fisheries Science Study Program, FAPERTA-UNTIRTA, Mr. Dr. Adi Susanto and Mr. Hery Sutrawan Nurdin, M.Si for permission to the team to carry out expedition activities. To the head of the Aquaculture Laboratory and Aquatic Resources Management Laboratory, Faperta-Untirta for permission to use laboratory facilities. To the village head and community of Seminar Village, Sukamaju

Village, Cikeusal District, Serang Regency for their assistance during field activities. The entire HIMAPI-UNTIRTA Aquatic Champion Expedition team, and the Indonesian Aquatic Research Expedition (ERA) team for their assistance in activities.

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