Empowering Environmental Literacy: A School-Based Initiative to Conserve Endemic Freshwater Fish in Bangka Island

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Abstract

Bangka Island in Indonesia harbours seven endemic freshwater fish species that are increasingly threatened by deforestation, tin mining, land-use change, and pollution. These species—many of which are listed as threatened on the IUCN Red List—inhabit fragile peat swamp ecosystems and play a vital role in maintaining local ecological balance. To raise awareness and promote conservation efforts, an educational outreach program was conducted on June 12, 2024, at SD Negeri 13 Pangkalanbaru, involving 22 fourth-grade students. The program followed a three-stage format: pretest, interactive educational session, and posttest. Educational materials included multimedia presentations and interactive discussions on the ecological importance and conservation needs of Bangka's endemic freshwater fish. Results revealed a significant increase in participants' knowledge, with average test scores rising from 51.36 (pretest) to 85.45 (posttest). Students demonstrated strong engagement and enthusiasm throughout the session, with many expressing an eagerness to share their newfound understanding with family and peers. The program's success reflects the effectiveness of participatory and contextual environmental education in fostering awareness and knowledge retention among young learners. Furthermore, it underscores the importance of integrating local biodiversity topics into formal education and highlights the potential role of students as community change agents. Future programs are encouraged to adopt experiential learning methods, such as field visits, and to involve wider community participation for sustainable conservation outcomes.

Keywords

Conservation awareness, endemic freshwater fish, environmental education

Introduction

Bangka Island, located in the Bangka Belitung Islands Province, is known as the "Island of a Thousand Pits" due to the numerous small lakes formed by tin mining. Behind this moniker, however, lies a rich biodiversity, including seven endemic freshwater fish species that play a crucial role in maintaining local ecosystem balance. These species—*Betta burdigala* (Tempalak Mirah), *Betta chloropharynx* (Tempalak Budu), *Betta schalleri* (Tempalak Pungor), *Parosphromenus deissneri* (Gurami Paros), *Parosphromenus juelinae* (Tempalak Igik Labu), *Encheloclarias tapeinopterus* (Kelik Sulung), and *Sundadanio gargula* (Bebieu)—are listed as threatened species on the IUCN Red List of Threatened Species (Syafutra, 2024b; Low, 2020; Low, 2019a; Low, 2019b; Low, 2019c; Lumbantobing, 2019; Ng, 2018).

The natural habitats of these freshwater fish—peat swamp forests and freshwater wetlands with acidic waters—are increasingly under threat. Deforestation due to tin mining and oil palm expansion has not only destroyed native ecosystems but also created artificial mining pits that are ecologically unsuitable for endemic species. These changes have deteriorated water quality and led to the contamination of habitats through toxic runoff from mining and agriculture. Climate change has exacerbated this crisis, bringing more frequent weather extremes, fluctuating water conditions, and disrupted reproductive cycles. Without immediate conservation action, these endemic species may face local extinction, resulting in ecological imbalance and the loss of invaluable biodiversity (Syafutra, 2024b; Syafutra, Ngazizah, *et al*., 2024).

Despite the urgency, public awareness and environmental education efforts on this issue remain minimal—particularly among school-aged children living near critical habitats. The central problem addressed in this school outreach is the lack of localized environmental education targeting the conservation of Bangka Island's endemic freshwater fish. Although several outreach initiatives have focused on general environmental topics or flagship fauna, few programs specifically address endemic freshwater fish conservation through structured, school-based learning modules. This gap in environmental literacy not only hinders the development of pro-conservation attitudes among youth but also limits the broader societal response to ecological threats.

This work differs from previous works in two key ways. First, it uniquely centers on localized education by integrating knowledge about Bangka's endemic freshwater fish into a structured, measurable learning experience for elementary students. Unlike

broader biodiversity education initiatives, this program uses scientifically informed content tailored to the local ecological context. Second, the program employs a three-stage evaluation method—pretest, educational delivery, and posttest—which allows for a quantitative assessment of knowledge improvement. This approach bridges the gap between community engagement and empirical educational evaluation, offering a replicable model for similar biodiversity hotspots across Indonesia.

Given this context, this school outreach introduces a school-based environmental education initiative aimed at increasing conservation awareness among students at SD Negeri 13 Pangkalanbaru. The program aims to empower the younger generation with the knowledge and motivation necessary to protect Bangka Island's unique freshwater biodiversity, fostering early environmental stewardship in areas most directly impacted by ecological degradation.

Method

This school outreach activity was conducted on June 12, 2024, at SD Negeri 13 Pangkalanbaru (GPS coordinates: 2°10'17.19"S, 106°5'17.27"E), located in Pedindang Subdistrict, Pangkalanbaru District, Central Bangka Regency, Bangka Belitung Islands Province (Figure 1). The participants of this activity were 22 fourth-grade students.

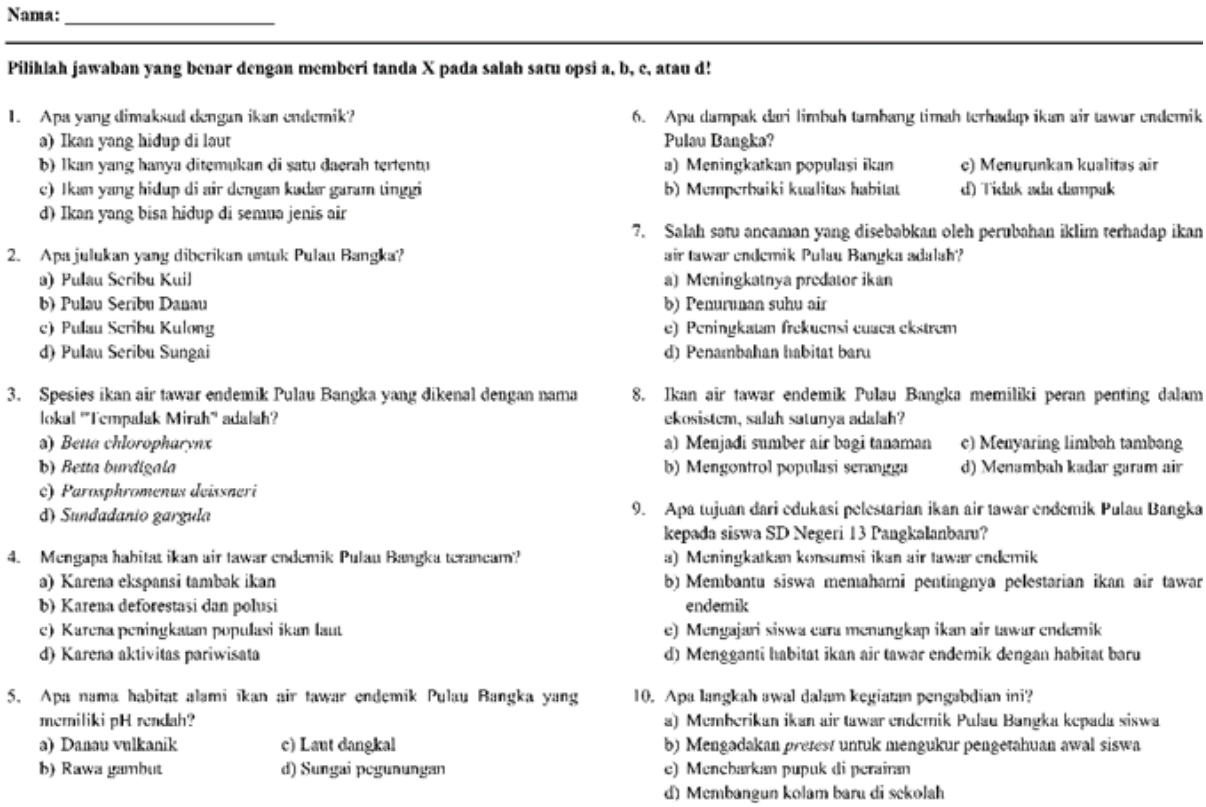
Figure 1. Location of the school outreach program at SD Negeri 13 Pangkalanbaru

The program was carried out in three stages: pretest, educational session, and posttest. The first stage was the pretest, in which participants were given a multiple-choice questionnaire to assess their baseline knowledge of the endemic freshwater fish of Bangka Island and related conservation practices. The test comprised 10 questions, with a total score of 100 points (each question worth 10 points). The pretest served to establish a foundational understanding before the educational intervention (Syafutra, 2024a; Syafutra, Pitriyana, *et al*., 2024; Syafutra & Bayu, 2024).

The second stage involved the delivery of educational content through an interactive presentation. During this session, participants received information about the endemic freshwater fish of Bangka Island and strategies for their conservation. The presentation utilized PowerPoint slides (Figure 2), incorporating engaging visuals and relevant facts to enhance understanding and maintain participants' interest. An interactive Q&A session followed the presentation to encourage active participation and to ensure comprehension of the material (Syafutra, 2024a; Syafutra, Pitriyana, *et al*., 2024; Syafutra & Bayu, 2024; Syafutra, Handayani, *et al*., 2024; Syafutra, Apriyani, Fatmawati, *et al*., 2023; Syafutra, Handayani, *et al*., 2023; Syafutra, Apriyani, Heri, *et al*., 2023).

Figure 2. A slide from the PowerPoint presentation used as an educational medium during the session

The third stage was the posttest. Similar to the pretest, participants completed a multiple-choice test to assess their knowledge after the educational session. The posttest aimed to evaluate the effectiveness of the educational program. It consisted of 10 questions formatted similarly to the pretest to ensure accurate comparisons (Figure 3). Posttest results were then compared with pretest results to measure the extent of knowledge improvement among participants (Syafutra, 2024a; Syafutra, Pitriyana, *et al*., 2024; Syafutra & Bayu, 2024).



Nama: _____

Pilihlah jawaban yang benar dengan memberi tanda X pada salah satu opsi a, b, c, atau d!

1. Apa yang dimaksud dengan ikan endemik?
   a) Ikan yang hidup di laut
   b) Ikan yang hanya ditemukan di satu daerah tertentu
   c) Ikan yang hidup di air dengan kadar garam tinggi
   d) Ikan yang bisa hidup di semua jenis air

2. Apa julukan yang diberikan untuk Pulau Bangka?
   a) Pulau Seribu Kuil
   b) Pulau Seribu Danau
   c) Pulau Seribu Kulong
   d) Pulau Seribu Sungai

3. Spesies ikan air tawar endemik Pulau Bangka yang dikenal dengan nama lokal "Tempalak Mirah" adalah?
   a) *Betta chloropharynx*
   b) *Betta bundtgala*
   c) *Parosphromenus deissneri*
   d) *Sundadanio gargula*

4. Mengapa habitat ikan air tawar endemik Pulau Bangka terancam?
   a) Karena ekspansi tambak ikan
   b) Karena deforestasi dan polusi
   c) Karena peningkatan populasi ikan laut
   d) Karena aktivitas pariwisata

5. Apa nama habitat alami ikan air tawar endemik Pulau Bangka yang memiliki pH rendah?
   a) Danau vulkanik
   b) Rawa gambut
   c) Laut dangkal
   d) Sungai pegunungan

6. Apa dampak dari limbah tambang timah terhadap ikan air tawar endemik Pulau Bangka?
   a) Meningkatkan populasi ikan
   b) Memperbaiki kualitas habitat
   c) Menurunkan kualitas air
   d) Tidak ada dampak

7. Salah satu ancaman yang disebabkan oleh perubahan iklim terhadap ikan air tawar endemik Pulau Bangka adalah?
   a) Meningkatnya predator ikan
   b) Penurunan suhu air
   c) Peningkatan frekuensi cuaca ekstrem
   d) Penambahan habitat baru

8. Ikan air tawar endemik Pulau Bangka memiliki peran penting dalam ekosistem, salah satunya adalah?
   a) Menjadi sumber air bagi tanaman
   b) Mengontrol populasi serangga
   c) Menyaring limbah tambang
   d) Menambah kadar garam air

9. Apa tujuan dari edukasi pelestarian ikan air tawar endemik Pulau Bangka kepada siswa SD Negeri 13 Pangkalanbaru?
   a) Meningkatkan konsumsi ikan air tawar endemik
   b) Membantu siswa memahami pentingnya pelestarian ikan air tawar endemik
   c) Mengajari siswa cara menangkap ikan air tawar endemik
   d) Mengganti habitat ikan air tawar endemik dengan habitat baru

10. Apa langkah awal dalam kegiatan pengabdian ini?
    a) Memberikan ikan air tawar endemik Pulau Bangka kepada siswa
    b) Mengadakan *pretest* untuk mengukur pengetahuan awal siswa
    c) Mencharkan pupuk di perairan
    d) Membangun kolam baru di sekolah

Figure 3. The set of ten pretest/posttest multiple-choice questions

Results and Discussion

The results of this school outreach activity indicate a significant improvement in participants' knowledge regarding the conservation of endemic freshwater fish of Bangka Island, as reflected in the comparison between pretest and posttest scores (Table 1). The average pretest score of 51.36 points suggests a limited baseline understanding among participants. This low initial performance can be attributed to several key factors.

First, environmental topics—especially those concerning local endemic freshwater species—are not prominently featured in the elementary school curriculum. As such, students often receive minimal exposure to these subjects in their formal education. Second, the participating students reside in areas where daily interaction with environmental issues, such as habitat degradation or biodiversity loss, is common, but without adequate guidance or educational framing. This disconnect between lived experience and conceptual understanding results in low environmental literacy.

Moreover, many participants reported that they had never heard of the fish species presented during the session before the program. The endemic species featured—*Betta*

burdigala (Tempalak Mirah), *Betta chloropharynx* (Tempalak Budu), *Betta schalleri* (Tempalak Pungor), *Parosphromenus deissneri* (Gurami Paros), *Parosphromenus juelinae* (Tempalak Igik Labu), *Encheloclarias tapeinopterus* (Kelik Sulung), and *Sundadanio gargula* (Bebieu)—are not well-known outside scientific or conservation communities. This lack of familiarity contributed to students' limited ability to answer pretest questions correctly, as they were encountering these topics for the first time. These findings align with earlier studies emphasizing the need for contextualized environmental education tailored to local biodiversity and conservation challenges (Syafutra, 2024a; Syafutra & Bayu, 2024).

Table 1. Pretest and posttest results of participants

Participant	Pretest Score	Posttest Score
Participant No. 1	50	100
Participant No. 2	50	80
Participant No. 3	50	100
Participant No. 4	40	100
Participant No. 5	20	70
Participant No. 6	50	80
Participant No. 7	60	100
Participant No. 8	70	100
Participant No. 9	50	70
Participant No. 10	50	60
Participant No. 11	50	70
Participant No. 12	50	90
Participant No. 13	60	100
Participant No. 14	40	70
Participant No. 15	50	70
Participant No. 16	30	60
Participant No. 17	20	60
Participant No. 18	70	100
Participant No. 19	70	100
Participant No. 20	70	100
Participant No. 21	70	100

Participant No. 22	60	100
Average Score	**51.36**	**85.45**

The educational methods employed in this program included delivering interactive content, group discussions, and visual demonstrations through audiovisual media. These strategies effectively enhanced participant comprehension, as evidenced by the increase in the average posttest score to 85.45 points. The 34.09-point improvement demonstrates that participatory, active-learning approaches significantly enhance knowledge retention, particularly with local environmental issues (Syafutra, 2024a; Syafutra, Pitriyana, *et al*., 2024; Syafutra & Bayu, 2024).

During the educational session, participant enthusiasm was evident (Figure 4). Students actively engaged in the session, asking questions and expressing opinions about how to preserve the endemic freshwater fish of Bangka Island. This school outreach supports the principles of constructivist learning theory, which posits that active involvement in the learning process enhances conceptual understanding (Suparlan, 2019). The fact that this was the participants' first exposure to in-depth information on the conservation of local endemic fish further underscores the importance of integrating local environmental topics into the elementary school curriculum.

Figure 4. Students showing high enthusiasm during the educational session (left) and award presentation to the five most actively engaged participants (right)

Posttest analysis revealed that several participants experienced substantial score improvements. Participants No. 1, 3, 4, and others achieved perfect scores (100), while others with low initial scores—such as Participants No. 16 and 17—also showed notable progress, although not reaching the maximum score. These differences reflect individual learning variability and highlight the importance of adopting adaptive teaching approaches to accommodate diverse learning needs (Nuriyah *et al*., 2024; Faatin *et al*., 2024).

In addition to quantitative data, qualitative observations during the session also supported the effectiveness of the program. Participants demonstrated a greater understanding of the importance of protecting local aquatic ecosystems after receiving explanations on the impacts of human activities, such as waste disposal and land-use change, on endemic fish populations. The session successfully raised participants' awareness of their responsibility in environmental stewardship, as emphasized in the academic work of Istikhori *et al.* (2023).

The success of the program was reflected not only in improved posttest scores but also in participants' motivation to apply their newly acquired knowledge. Several students expressed a desire to share the information they had learned with their peers and family members. This highlights the potential for educational initiatives to generate a multiplier effect in raising broader community awareness about the conservation of local endemic species. According to Indy *et al.* (2019), involving children as change agents within their communities is an effective strategy for fostering sustainable social change.

Overall, this educational activity has proven effective in increasing participants' knowledge and awareness of the conservation of endemic freshwater fish on Bangka Island. However, several points should be considered for future program development. First, long-term evaluations are needed to assess the retention of knowledge over time. Second, experiential learning approaches—such as field visits to endemic fish habitats—could be integrated to enrich the participants' learning experience. Third, involving other stakeholders, such as parents and local communities, may enhance the overall impact of the educational effort. Accordingly, this school outreach program not only improved the participants' understanding but also laid a strong foundation for the development of more holistic environmental education in the future.

Conclusion

This school-based environmental education initiative significantly improved students' knowledge about the conservation of endemic freshwater fish on Bangka Island, as evidenced by a marked increase in posttest scores compared to pretest scores. The program effectively introduced localized ecological concepts to young learners using interactive methods tailored to their cognitive level, fostering enthusiasm and environmental stewardship. However, this work is limited by its small sample size of only 22 participants, which restricts the generalizability of the findings. Additionally, the

short-term nature of the intervention did not allow for a longitudinal assessment of knowledge retention or behavioral change. The outreach also lacked a control group for comparative evaluation and was limited to a single school setting, highlighting the need for future outreach to include larger, more diverse participant groups and extended follow-up periods to assess long-term impacts. Despite these limitations, the findings provide a promising model for integrating local biodiversity education into elementary curricula in ecologically vulnerable regions.

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