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Short Communication: The biodiversity of aquatic organisms in Anak Laut Lake, Aceh Singkil District, Indonesia

AHMAD MUHTADI♥, RUSDI LEIDONALD, OKTI YOLANDA, RUHHIYAH HARAHAP, NENENG PRATIWI MATONDANG, KHAISYA PUTRI, LAURA F. M. SIMAMORA, GABRIYELLA SITOMPUL

Department of Aquatic Resources Management, Faculty of Agriculture, Universitas Sumatera Utara. Jl. Prof. A. Sofyan No. 3, Medan 20155, North Sumatra, Indonesia. Tel./Fax.: +62-61-8213236, ♥email: ahmad.muhtadi@usu.ac.id

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Abstract. *Muhtadi A, Leidonald R, Yolanda O, Harahap R, Matondang NP, Putri K, Simamora LFM, Sitompul G. 2023. Short Communication: The biodiversity of aquatic organisms in Anak Laut Lake, Aceh Singkil District, Indonesia. Biodiversitas 24: 4837-4844.* Anak Laut Lake is a unique and strategic coastal lake, significantly recognized for its diverse marine biota and the potential to be a spawning, nursery, and feeding ground. Therefore, this research aimed to determine the types of aquatic organisms, including plankton, fish, crustaceans, benthos, seagrasses, and mangroves in Anak Laut Lake. The experiment was conducted in October 2022 in the Anak Laut Lake ecosystem, North Singkil Sub-district, Aceh Singkil District, Aceh Province, Indonesia. The plankton was taken using a plankton net tool, extracted vertically from a depth of 2 m, and pulled to the surface. Fish and crustaceans were observed and caught with purse seines, ring nets, and gill nets. Benthic organisms were directly observed on the edge of the lake, along with the identification of mangroves, while at the bottom, the fishermen dove into the water. The data obtained were analyzed descriptively and compared with similar research. The results showed a rich biodiversity in Anak Laut Lake, with at least 165 species/genera of aquatic biota, 9 species of mangroves, and 2 Seagrass species. The marine nekton found consisted of fish (55 species), shrimp (3 species), and crabs (10 species). The macrozoobenthos found in Anak Laut Lake consisted of 13 species of clams, 12 gastropods, 3 sea cucumbers, 2 sand dollars, 2 horseshoe crabs, and 1 sea urchin. Various species of aquatic biota whose existence was threatened in nature and found in this lake included golden sea cucumber (*Stichopus herrmanni*), seahorse (*Hippocampus comes* and *Hippocampus kuda*) with Vulnerable status (VU), tap ray (*Maculabatis gerrardi*), and sand cucumber (*Holothuria scabra*) with Endangered species status (EN). This shows that this coastal lake is an important and crucial habitat for several species that are vulnerable to extinction. For this reason, in the future, further studies are needed regarding the habitat characteristics and spatial and temporal distribution of aquatic organisms in Lake Laut, so that more appropriate management can be implemented for the sustainability of the lake.

Keywords: Aquatic, biodiversity, coastal lake, crustacean, fish, mangrove, mollusca, species

INTRODUCTION

A coastal lake is a body of water on the coast directly connected to the ocean, which is influenced by tides, waves, and wind (Tagliapietra et al. 2009; Muhtadi et al. 2020a; Leidonald et al. 2023). These lakes are unique and strategic due to the estuarine-like characteristics of water quality and organisms (Muhtadi et al. 2020a; 2023b). In some cases, a coaster lake resembles marine ecosystems in the form of an inundation (Hasudungan et al. 2008; Leidonald et al. 2023) due to the potential to be tidal lakes, where the fluctuations and dynamics of the waters are influenced by the flow of seawater tides (Nontji 2017; Muhtadi et al. 2020a; Leidonald et al. 2023).

Muhtadi et al. (2020) conducted research in Siombak Lake, a coastal lake in Indonesia, located in Medan, North Sumatra. The results showed that Siombak Lake experienced a change in water level every 6 hours, with 2 high and low tides, each occurring in a day, except for the dead (neap) tide. Throughout the year, the water level of Siombak Lake fluctuates following the tidal cycle. The highest water level in Siombak Lake was in November 2018, reaching 227 cm, while the lowest occurred in February 2019 with a height of -24 cm. The water quality of this lake is characterized by the presence of high concentrations of salinity and TDS (Muhtadi et al. 2023b). Similarly, research conducted by Leidonald et al. (2023) in Anak Laut Lake, Aceh Singkil Indonesia, showed a mixed tide pattern with a tendency to double daily. This indicated that within a single day, there are two high and low tides, each with different periods and heights. The mean sea level is 1.27 m, with the highest water level (HAT) value of 1.92 m in May 2022 and the lowest water level (LAT) at 0.62 m in February.

Coastal lakes are strategic due to their rich biodiversity, comprising a variety of freshwater, brackish, and marine organisms (Hasudungan et al. 2008, Leidonald et al. 2019; Muhtadi et al. 2020b; 2022; 2023a; Yulianda et al. 2020). On the shores of these lakes, mangrove plants thrive, growing and developing on the edge (Hasudungan et al. 2008; Madhusmita 2012; Omogoriola et al. 2012; Padmavathy and Anbarashan 2013; Muhtadi et al. 2020c). The geographical location directly connected to the ocean also

facilitates potential spawning, nursery, and feeding grounds (Ocaña-Luna and Sánchez-Ramírez 2016; Jaxion-Harm and Speight 2017; Berkström et al. 2020; Muhtadi 2020) and as a fishing ground for local fishermen (Muhtadi 2020). Therefore, coastal lakes are strategic, exhibiting potential as a source of germplasm in maintaining the sustainability of fisheries production in coastal and marine ecosystems.

Anak Laut Lake is one of the coastal lakes in Indonesia, located on the west coast of Sumatra Island in Aceh Singkil, Aceh Province. Directly connected to the Indian Ocean on the west coast of Sumatra (Leidonald et al. 2023), the water level dynamics of this natural lake dynamics are influenced by the ocean tide, impacting its aquatic organism community (Leidonald et al. 2023). Currently, there is no information regarding the biodiversity of aquatic organisms in Lake Anak Laut. Therefore, this study aims to report the richness of aquatic organisms that inhabit Anak Laut lakes, which include mangroves, seagrass, fish, macrozoobenthic, and plankton.

MATERIALS AND METHODS

Research area

This research was conducted in September-October 2022 in the ecosystem of Anak Laut Lake, North Singkil Sub-district, Aceh Singkil District, Aceh Province, Indonesia. Anak Laut Lake is a shallow lake with an average depth ($\overline{Z}$) ranging from 2.61-3.57 m, an area of 10.55 km^2 at Mean Sea Level (MSL), 11.26 km^2 at high tide, and 9.84 km^2 at low tide. The total water volume reaches 16.51 million m^3, 17.61 million m^3, and 15.40 million m^3 at MSL, high tide, and low tide, respectively (Leidonald et al. 2023). For this research, five stations had been established, i.e. Station 1: 2°14'54.16"N 97°52'23.49"E, Station 2: 2°15'18.13"N 97°51'26.61"E, Station 3: 2°16'12.80"N 97°52'0.99"E, Station 4: 2°16'33.08"N 97°53'23.43"E, and Station 5: 2°16'4.89"N 97°53'33.70"E, Station 6: 2°15'14.93"N 97°53'4.46"E (Figure 1).

Sampling procedures

Plankton samples were taken using a plankton net, which was lowered vertically from a depth of 2 m and pulled up to the surface (Muhtadi et al. 2020b; Hasani et al. 2022). The filtered sample water was poured into a 50 ml polythene bottle and plankton samples were preserved with 4% Lugol's solution until brown-like tea water was achieved. The samples were stored in black plastic polybags, counted, and identified. Furthermore, fish and crustacean samples were caught with purse seines, ring nets, and gill nets. Benthic organisms were observed directly at the edge of the lake along with mangrove identification, while the inner part was identified by fishermen diving at the bottom of the water. For additional data, in-depth interviews were conducted regarding important fish that entered and were caught by fishermen in Anak Laut Lake but were not captured during sampling.

Identification of aquatic biota

Plankton abundance was calculated using Sedgewick Rafter Counting (SRC) at a magnification of 10 x 40. Enumeration was carried out using an Olympus CH-2 model binocular microscope. Morphological identification of phytoplankton used the reference book by Yamaji (1979) and Tomas (1997), while identification of nekton referred to White et al. (2013), as well as Carpenter and Niem (1998, 1999). Benthic organism identification was referred to Carpenter and Niem (1998), mangroves were identified following Giesen et al. (2012), and the identification of seagrass was referred to Den Hartog (1970).

Data analysis

The data were analyzed descriptively and compared with similar research in coastal lakes both in Indonesia and other parts of the world.

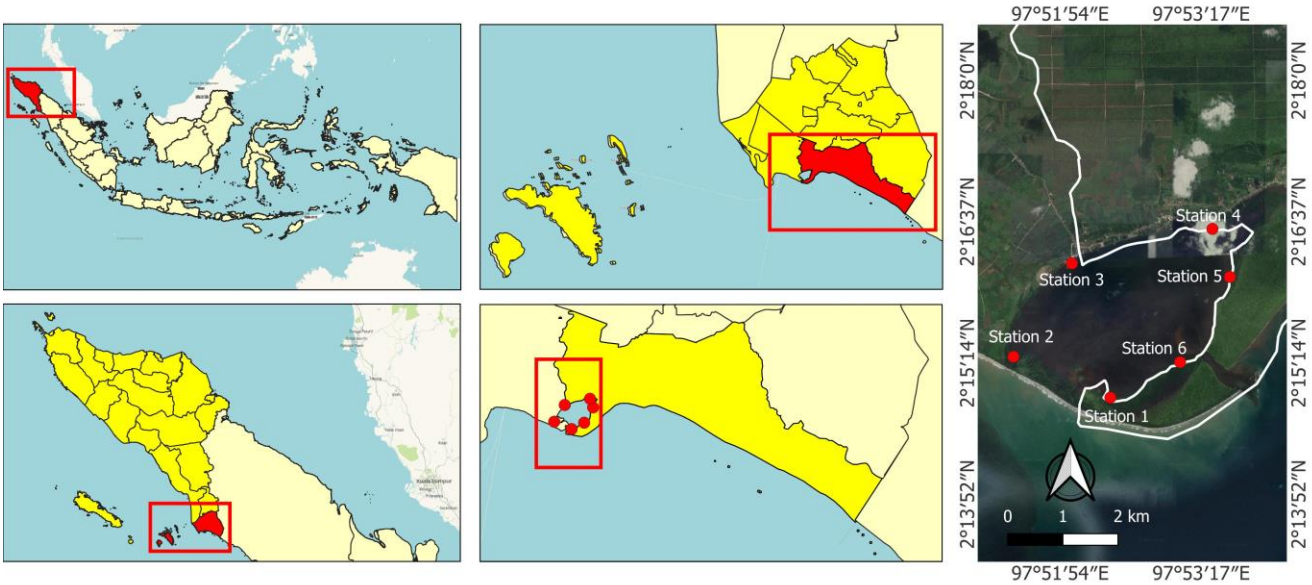

Figure 1. Location of Anak Laut Lake, North Singkil Sub-district, Aceh Singkil District, Aceh Province, Indonesia

RESULTS AND DISCUSSION

Mangroves and seagrass

A total of 9 mangrove species were found around Anak Laut Lake, as presented in Table 1. Among these species, *Rhizophora* was the most abundant mangrove, spreading evenly on the shores, with a high salinity of 28-30 ppt. The number of mangrove species and distribution in Danau Anak Laut was lower compared to the vegetation in the tidal lake of Teluk Belukar (Nias-Indonesia), consisting of 20 mangrove species and 17 types of coastal vegetation in Teluk Belukar Lake (Nias-Indonesia) (Hasudungan et al. 2008). Meanwhile, in Siombak Lake, there were 9 types of primary and 5 secondary mangroves (Muhtadi et al. 2020c). The high diversity of mangroves in Teluk Belukar was attributed to its sheltered nature compared to Anak Laut Lake, which was directly connected to the Indian Ocean. In other tidal lakes, 10 species were observed in Lagos Lagoon (Nigeria) (Olowokudejo and Michael 2020) and Chilika Lake (India) only in 5 species (Madhusmita 2012). This showed that the richness of mangroves in Indonesia is higher than in Africa and other Asian countries. Another aquatic plant found in Danau Anak Laut was seagrass, a submerged aquatic plant growing and developing in seawater. The 2 species of seagrass identified in Danau Anak Laut, including *Enhalus acoroides* and *Thalassia hemprichii*, were commonly found in Indonesia (Rangkuti et al. 2017). However, other coastal lakes, such as Kakaban Lake, only found seaweed, namely *Halimeda opuntia* and *Halimedia tuna* species (Nontji 2017).

Marine nekton

The marine nekton found in Danau Anak Laut consisted of fish (55 species), shrimp (3 species), and crabs (10 species). These species were estuary and marine fish, as also found in Teluk Belukar Lake (Hasudungan et al. 2008) due to its location in direct contact with the sea. However, it was significantly different from the species in Siombak Lake, which consisted of freshwater fish (Yulianda et al. 2020; Muhtadi et al. 2022; 2023a). In other tidal lakes, the fish consisted of 8 species in Teluk Belukar Lake (Hasudungan et al. 2008), and 27 in Siombak Lake (Muhtadi et al. 2023a), and 51 in Nokoue Lake, Benin (Lalèyè et al. 2003). The highest richness was observed in coastal lakes in India, namely in Chilika Lake, consisting of 317 (Lakshmi et al. 2015; Mohanty et al. 2015), and 80 species were found in Lagos Lagoon (Emmanuel and Chukwu 2010), and 33 species in Burleigh Lake (Australia) (Waltham and Connolly 2013). Similarly, shrimps and crabs were commonly found in Chilika Lake, namely 28 shrimp and 38 crab species (Madhusmita 2012), 20 decapods in Vembanad Lake (India) (Mogalekar et al. 2015), and 22 penaeid shrimp in Songkhla Lake, Thailand (Samphan et al. 2015). Meanwhile, in Indonesia, the highest number of shrimp and crabs were found in Siombak Lake, comprising 3 and 13 species, respectively (Muhtadi et al. 2022).

Macrozoobenthos

Macrozoobenthics found in Anak Laut Lake consisted of 13 species of bivalves, 12 gastropods, 3 sea cucumbers, 2 sand dollars, 2 horseshoe crabs, and 1 sea urchin, as illustrated in Table 1. There were 9 species of mollusks in Lake Siombak without sea cucumbers and sea urchins (Yulianda et al. 2020). The difference in biodiversity was because Siombak Lake remained an estuary, while Anak Laut Lake had transitioned fully into a marine ecosystem, similar to Teluk Belukar Lake in Nias, which consisted of sea cucumbers (Hasudungan et al. 2008).

Plankton

The results of plankton enumeration in Anak Laut Lake identified 21 genera of phytoplankton and 10 zooplankton (Table 2), while no significant difference was observed from the 28 genera of plankton found in Teluk Belukar Lake (Hasudungan et al. 2008). However, this plankton richness was still lower than in Siombak Lake, which comprised 54 genera of phytoplankton and 12 zooplankton (Muhtadi et al. 2020b), and 48 species in Ebony Lake (Jakarta-Indonesia) (Pratiwi et al. 2018). Other coastal lakes were also higher, namely the Baja coastal lake in México with 47 genera (Gracia-Escobar et al. 2014), 32 species in Kamil Abdus¸ Lagoon, Turkey (Yilmaz et al. 2018), 77 genera in Yewa Lagoon (Effiong and Inyang 2016) and 233-259 genus in Chilika Lake, India (Srichandan et al. 2015; Mukherjee et al. 2018). In this lake, two species of jellyfish were rarely found in other coastal lake ecosystems, namely *Chrysaora colorata* and *Chrysaora quinquecirrha.*

Discussion

The richness of the aquatic biota in Anak Laut Lake is the highest among coastal lakes in Indonesia, consisting of at least 165 species. Meanwhile, only 13 species were found in Kakaban Lake (Nontji 2017), 57 in Teluk Belukar Lake (Hasudungan et al. 2008), and 135 in Siombak Lake (Leidonald et al. 2019; Muhtadi et al. 2020b,c; 2022; 2023a). This indicates that Anak Laut Lake is an essential habitat for aquatic organisms, including macrozoobenthos groups and migratory organisms, namely fish and crustacean groups. Several ecologically and economically important organisms were also found in the lake, consisting of giant trevally as the top predator with high economic value.

One of the peculiarities and uniqueness of the Anak Laut Lake compared to others in Indonesia is the discovery of two seagrass species found on small islands and associated with coral reefs. Seagrasses are found in the southwestern and central parts with a sandy mud substrate. Additionally, the presence of small pelagic and demersal fish, such as giant trevally in certain seasons, is a special attraction of the Anak Laut Lake. Pelagic fish from the Carangidae, Dasyatidae, and Scombridae groups and other marine fish species also indicate that the lake is a feeding ground for marine organisms. According to Muhtadi et al. (2023a), coastal lakes are one of the feeding grounds for marine and freshwater organisms, including Anak Laut Lake.

Table 1. Aquatic flora and fauna in Anak Laut Lake, Aceh Singkil District, Indonesia

Family	Species	Local name	Indonesian name	Common name	IUCN status*
Mangroves					
Arecaceae	*Nypa fruticans*	*Nipah*	*Nipah*	Mangrove Palm	LC (07-03-08)
Rhizophoraceae	*Rhizophora apiculata*	***Bako***	*Bakau merah*	Red mangrove	LC (07-03-08)
	Rhizophora stylosa		*Bakau*	the spotted mangrove	LC (07-03-08)
Primulaceae	*Aegiceras corniculatum*			black mangrove	LC (07-03-08)
Pteridaceae	*Acrostichum aureum*		*Paku laut*	Leather Fern	LC (07-03-08)
Sonneratiaceae	*Ceriops decandra*				NT (07-03-08)
	Ceriops tagal			Indian mangrove	LC (07-03-08)
	Sonneratia alba	*Pedada*	*Berembang*		LC (07-03-08)
	Sonneratia caseolaris	*Pedada*	*Berembang*	Mangrove apple	LC (07-03-08)
Seagrass					
	Enhalus acoroides				LC (17-10-07)
	Thalassia hemprichii				LC (17-10-07)
Fish					
Ambassidae	*Ambassis urotenia*	*Gegge*	*Serinding*	Banded-tail glassy perchlet	LC (21-09-20)
Anguilidae	*Anguilla bicolor*	*Moa*	*Sidat*	Indonesian shortfin eel	NT (11-08-19)
Apogonidae	*Yarica hyalosoma*	*Kaca-kaca*	*Sirinding*	Humpbacked cardinalfish	LC (09-10-20)
Ariinae	*Netuma thalassina*			Giant Catfish	NE
Bagridae	*Mystus gulio*		*Lundu*	Long whiskers catfish	LC (11-08-19)
Belonidae	*Strongylura leiura*			Banded needlefish	NE
	Tylosurus crocodilus	***Todak***		Hound Needlefish	LC (21-08-12)
Carangidae	*Alepes vari*			Herring scad	LC (04-02-09)
	Atule mate			Yellowtail Scad	LC (06-03-16)
	Caranx ignobilis			Giant trevally	LC (09-03-15)
	Caranx papuensis			Brassy trevally	LC (09-03-15)
	Caranx sexfasciatus			Bigeye trevally	LC (13-12-18)
	Carangoides malabaricus			Malabar Trevally	LC (09-03-15)
	Carangoides chrysophrys			Longnose Trevally	LC (06-03-15)
	Carangoides equula			Whitefin trevally	NE (23-06-13)
	Scomberoides tala		***Ikan talang-talang***	Barred queenfish	NE
	Scomberoides commersonnianus		***Ikan ratu talang***	Talang queenfish	NE
Chanidae	*Chanos chanos*		*Bandeng*	Milkfish	LC (23-06-16)
Cynoglossidae	*Cynoglossus lingua*		*Ikan lidah*	Long Tonguesole	LC (12-08-19)
Dasyatidae	*Maculabatis gerrardi*	***Pari ketuk***		Whitespotted Whipray	**EN (06-05-20)**
	Neotrygon kuhlii.	***Pari pasir***	*Pari*	Kuhl's Maskray	LC (22-06-17)
	Taeniura lymma	***Pari***		Ribbontail stingray	LC (01-09-20)
Eleotridae	*Butis amboinensis*		*Gabus pasir*	Ambon gudgeon	LC (29-06-18)
	Butis gymnopomus		*Lontok*	Striped Crazy Fish	LC (23-08-18)
	Ophiocara porocephala		*Lontok*	Northern mud gudgeon	LC (30-06-16)
Engraulidae	*Stolephorus indicus*		*Ikan teri*	Indian Anchovy	LC (02-03-17)
Ephippidae	*Platax teira*			Longfin batfish	LC (12-10-18)
Fistulariidae	*Fistularia commersonii*			Bluespotted Cornetfish	LC (21-01-16)
Gerreidae	*Gerres erythrourus*			Deep-bodied mojarra	LC (02-03-15)
	Gerres filamentosus			Whipfin silver-biddy	LC (11-07-16)
	Gerres longirostris			Strongspine Silver-Biddy	LC (02-03-15)
Glaucosomatidae	*Glaucosoma buergeri*	*Ikan pintung*		Deepsea jewfish	NE
Gobiidae	*Pseudapocryptes elongatus*	*Tembakul, gelodok*	*Ikan Janjan*		LC (01-03-07)
Hemiramphidae	*Hyporhampus quoyi*		*Julung-julung*	Quoy's garfish	LC (10-08-20)
	Zenarchopterus beauforti			Hooghly halfbeak	LC (16-01-20)
Leiognathidae	*Aurigequula fasciata*			Striped ponyfish	LC (02-07-16)
	Eubleekeria splendens	*Paper, kempar, peperek*	*Ikan petek*	Splendid Ponyfish	LC (25-08-11)
Lethrinidae	*Lethrinus lentjan*			Pinkear Emperor	LC (09-03-15)
	Lethrinus nebulosus			Spangled Emperor	LC (09-03-15)
Lutjanidae	*Lutjanus argentimaculatus*		*Kakap*	Mangrove Red Snapper	LC (04-03-15)
	Lutjanus carponotatus			Spanish flag snapper	LC (28-06-18)
	Lutjanus russellii	*Gorara*	*Kakap berisisik besar*	Russell's Snapper	LC (05-03-15)
	Lutjanus xanthopinnis			Yellowfin snapper	DD (28-06-18)
	Lates calcarifer		*Kakap putih*	Barramundi	LC (15-02-19)

Megalopidae	*Megalops cyprinoides*	*Bulan-Bulan*	*Bulan-bulan*	Indo-Pacific Tarpon	DD (29-06-16)
Mugilidae	*Planiliza subviridis*		*Belanak*	Greenback Mullet	LC (21-08-20)
	Crenimugil seheli			Bluespot Mullet	LC (02-06-20)
Mullidae	*Upeneus vittatus*			Yellowstriped goatfish	LC (11-03-15)
Nemipteridae	*Nemipterus japonicus*			Japanese Threadfin Bream	LC (28-06-18)
	Nemipterus gracilis			raceful threadfin bream	LC (13-07-20)
Ostraciidae	*Lactoria cornuta*		*Ikan sapi tanduk panjang*	Longhorn cowfish	NE
Pomacanthidae	*Pomacanthus semicirculatus*			Semicircle Angelfish	LC (08-10-09)
Platycephalidae	*Grammoplites scaber*			Rough flathead	NE
Terapontidae	*Terapon jarbua*	*Kerong-kerong*	*Kerong-kerong*	Tiger Perch	LC (20-06-16)
	Terapon puta	*Pepisang*	*Kerong-kerong*	Small-scaled terapon,	NE
Tetrarogidae	*Chelonodon patoca*			Milkspotted Puffer	NE
	Tetraroge barbata			Bearded roguefish	LC (06-11-20)
Tetraodontidae	*Lagocephalus spadiceus*			Half-smooth golden pufferfish	LC (08-06-11)
Scatophagidae	*Scatophagus argus*		*Ketang*	Spotted Scat	NE
Sphyraenidae	*Sphyraena barracuda*		*Barracuda*	Great barracuda	LC (29-01-13)
	Sphyraena putnamae			Sawtooth barracuda	NE
Scombridae	*Scomberomorus commersoni*			Narrow-barred Spanish mackerel	NT (05-12-09)
	Rastrelliger kanagurta			Indian Mackerel	DD (05-12-09)
	Rastrelliger brachysoma			Short Mackerel	DD (10-12-09)
Serranidae	*Cephalopholis formosa*			Bluelined hind	LC (02-11-17)
	Epinephelus areolatus	*Kerapu*	*Kerapu*	Areolate Grouper	LC (25-11-16)
	Epinephelus bleekeri	*Kerapu*	*Kerapu*	Duskytail Grouper	DD (21-11-16)
Siganidae	*Siganus fuscescens*	*Baronang*	*Baronang susu*	Mottled Spinefoot	LC (10-03-15)
	Siganus canaliculatus	*Baronang lingkis*	*Baronang*	White-spotted spinefoot	LC (10-03-15)
Sillaginidae	*Sillago sihama*	*Ikan kapur sirih*	*Perak*	Silver Sillago	LC (05-03-15)
Syngnathidae	*Hippocampus comes*	*Kuda laut*	*Tangkur kuda*	Tiger tail seahorse	**VU (15-09-13)**
	Hippocampuskuda	*Kuda laut*	*Tangkur kuda*	Spotted seahorse	**VU (16-09-12)**
Kuhliidae	*Kuhlia marginata*			Dark-margined flagtail	LC (14-02-19)
Plotosidae	*Paraplotosus albilabris*	*Sembilang*	*Sembilang*	Whitelipped eel catfish	NE
Crustaceans					
Eriphiidae	*Menippe rumphii*	*Kepiting batu*	*Kepiting batu*	Maroon stone crab	NE
Ocypodidae	*Uca (Tubuca) coarctata*			Compressed fiddler crab	NE
Portunidae	*Charybdis feriatus*		*Rajungan karang*	The crucifix crab	NE
	Charybdis natator		*Rajungan batik*	Ridged swimming crab	NE
	Podophthalmus vigil		*rajungan angin*	Sentinel crab	NE
	Portunus pelagicus		*Rajungan*	Blue swimmer crab	NE
	Portunus sanguinolentus		*rajungan bintang*	Three-spot swimming crab	NE
	Thalamita crenata		*Rajungan hijau*	Mangrove swimming crab	NE
	Scylla olivacea			Orange mangrove crab	NE
	Scylla serrta			Mangrove crab	NE
Penaeidae	*Metapenaeus ensis*	*Udang batu*	*Udang batu*	Greasyback shrimp	NE
	Parapenaeopsis coromandelica			Indian ash tree	NE
	Penaeus merguiensis			Banana prawn	NE
Molluscs					
Arcidae	*Anadara antiquata*	*Kerang bulu*	*Kerang bulu*	Antique ark	NE
Buccinidae	*Babylonia spirata*				NE
Cerithiidae	*Cerithium coralium*			Coral cerith	LC
Corbiculidae	*Polymesoda erosa*	*Kerang bakau*	*Kerang totok*	Common geloina	NE
Cyrenidae	*Geloina expansa*				NE
Lasaeidae	*Kellia suborbicularis*				NE
Lucinidae	*Fimbria fimbriata*				NE
Pteriidae	*Pinctada maculata*	*Simping*	*Simping*	Spotted pearl oyster	NE
Melongenidae	*Pugilina cochlidium*				NE
Myidae	*Mya arenaria*				NE
Mytilidae	*Septifer bilocularis*				NE
Nassariidae	*Nassarius olivaceus*				NE
Neritidae	*Nerita balteata*			Violet nerite	NE
	Nerita violacea		*Keong merah*	Violet moon snail	NE
	Nerita planospira				NE
Pachychilidae	*Faunus ater*		*Siput air payau*	Black devil snail	LC (22-07-11)
Pinnidae	*Atrina pectinata*				NE
	Pinna muricata			Prickly pen shell	NE
Potamididae	*Teloscopium telescopium*	*Bla papaco*	*Keong bakau*	The telescope snail	NE
	Terebralia palustris				NE

Strombidae	*Strombus canarium*	*Siput gonggong*	*Siput gonggong*	The dog conch	NE
	Strombus triangulates				NE
	Strombus turturella	*Siput gonggong*	*Siput gonggong*	Pearl conch snail	NE
Veneridae	*Dosinia contusa*				NE
	Mactra grandis				NE
Other					
Balanidae	*Amphibalanus amphitrite*				NE
Clypeasteridae	*Arachnoides placenta*				NE
Holothuriidae	*Holothuria scabra*	*Kolong*	*Teripang pasir*	Sand fish	**EN (18-05-10)**
	Holothuria atra	*Kolong*	*Teripang keling*	Lollyfish	LC (18-05-10)
Stichopodidae	*Stichopus herrmanni*	*Kolong*	*Teripang emas*	Curryfish	**VU (18-05-10)**
Laganidae	*Laganum laganum*	*Dolar pasir, kue pasir*	*Dolar pasir*	Sand dollar	NE
Luidiidae	*Luidia quinaria*				NE
Limulidae	*Tachypleus gigas*		*Belangkas*	Horseshoe crab	DD (01-08-96)
	Carcinoscorpius rotundicauda			Mangrove horseshoe crab	DD (01-08-96)
Diadematidae	*Diadema setosum*		*Bulu babi*	Long-spined sea urchin	NE

Note: *IUCN (2023): NE: Not Evaluated, DD: Data Deficient, LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered

Table 2. Plankton species identified in Anak Laut Lake, Aceh Singkil District, Indonesia

Phytoplankton	**Zooplankton**
Bacillariophyceae	Protozoa
Amphiprora sp.	*Eutintinnus* sp.
Amphora sp.	*Tintinnopsis* sp.
Asterionella sp.	*Favella* sp.
Bacteriastrum sp.	Crustaceae
Chaetoceros sp.	*Calanus* sp.
Coscinodiscus sp.	Nauplius (stadia)
Ditylum sp.	Urochordata
Fragilaria sp.	*Oikopleura* sp.
Guinardia sp.	Catostylidae
Hemiaulus sp.	*Catostylus mosaicus*
Lauderia sp.	Penaedae
Leptocylindrus sp.	Mysis (post larvae)
Mostogloia sp.	Pelagiidae
Navicula sp.	*Chrysaora colorata*
Nitzschia sp.	*Chrysaora quinquecirrha*
Rhizosolenia sp.	
Skeletonema sp.	
Thalassionema sp.	
Thalassiothrix sp.	
Dinophyceae	
Ceratium sp.	
Dinophysis sp.	

In Anak Laut Lake, several species of aquatic biota face threats to their natural existence, including golden sea cucumber (*Stichopus herrmanni*) and seahorse (*Hippocampus comes* and *Hippocampus kuda*) with Vulnerable status (VU), and tap ray (*Maculabatis gerrardi*) and sand cucumber (*Holothuria scabra*) with Endangered species (EN) status (IUCN 2023). The presence of these four species makes Danau Anak Laut an essential habitat for marine organisms in Aceh Singkil and surrounding waters. The abundance of shrimp and fish larvae also confirms that the lake is essential as a nursery and feeding area. Previous research has shown coastal lakes as spawning and nursery areas for marine fishes. For example, El-Regal (2013), found 8 Red Sea fish species spawning in coastal lakes around the Red Sea. However, coastal lakes around the world mostly serve as nursery areas for larvae and juveniles of marine fish that spawn in the ocean (Verdiell-Cubedo et al. 2013; Le Luherne et al. 2017; Tournois et al. 2017; Baptista et al. 2020).

In the future, more detailed spatial and temporal research is recommended regarding the existence and dynamics of fish populations as well as other biota in Lake Anak Laut. Research on the relationship between tidal dynamics and the presence of fish species and populations is also needed for further lake management. Moreover, the Village Owned Business Entities (*Badan Usaha Milik Desa*/BUMDES) have launched Anak Laut Lake as a tourist destination for local and regional communities. The lake also serves as a vital fishing and crab area for the local community, necessitating spatial and temporal research of biota objects for further management.

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