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The Biological Aspects Monitoring in the Construction Stage of Tanjung Jati B, 5-6 Steam Power Plant, Jepara, Central Java Indonesia

Slamet Isworo[1*], Poerna Sri Oetari[1,2] and Tosan Adji[2]

[1]Departement of Environmental Health Program, Dian Nuswantoro University, Semarang, Indonesia

[2]PT Mitra Adi Pranata Company, Semarang, Indonesia

[*]**Corresponding author**: Slamet Isworo, Departement of Environmental Health Program, Dian Nuswantoro University, Semarang, Indonesia, E-Mail: slamet.isworo@dsn.dinus.ac.id

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Abstract

Background and Objectives: The environmental permit from the construction of the TanjungJati B 5-6 steam power plant has consequences for environmental responsibility, in the form of environmental monitoring activities. This research is a monitoring activity on aspects of marine aquatic biology and avifauna status, as a biocontrol of ecological balance. Materials and Methods: The research was conducted by laboratory experimental methods by calculating diversity index, uniformity index, and dominance index in plankton, benthos, and nekton, while avifauna analysis was carried out based on the results of inventory and observations of their encounters at the research location. Results: The status of the water in the study site is included in the medium polluted category. The status of the water in the study site is included in the medium polluted category. The results of the evaluation of diversity index parameters and the plankton-benthos dominance index showed a positive tendency, while the dominance index was negative. The nekton evaluation trends for all negative parameters. Status of the frequency of encounters for *Ardea alba*, *Egretta garzetta*, and *Ibis bubulcus* with a negative tendency. The avifauna is a type that is protected by the Government of the Republic of Indonesia. Conclusion: Action is needed to maintain the evaluation trend of modeling positive trends in all parameters so that the ecological balance in locations around the Tanjung Jati B steam power plant remains good.

***Keywords:* Monitoring activities; Trend evaluation models; Plankton; Benthos; Nekton; Avifauna; Environmental impact; Balance of ecologies**

Introduction

The need for electricity in the Republic of Indonesia is a challenge currently being faced, especially in providing adequate and inexpensive electricity supply guarantees for the people of Indonesia [1]. Based on data from the Ministry of Energy and Mineral

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Resources of the Republic of Indonesia in 2019, it states that the electricity demand for the Java-Bali region as the center of Indonesia's economic development has not yet been achieved. The construction of power generation capacity and the addition of power generation capacity in 2019 will only reach around +/- 5,000 megawatts or less than the demand of the break free coalition of 13,000 megawatts [2]. This happened because of the obstructed construction of coal-fired steam power plants which had been planned by the Government of Indonesia, which had not been carried out properly, as a result of the investment, licensing, land acquisition, availability of human resources and supporting equipment, as well as other factors [3].

The Tanjung Jati B 5-6 steam power plant is a steam power plant done by PT Bhumi Jati Power (BJP) which is a consortium of PT United Tractors Tbk through its subsidiary PT Unitra Persada Energia together with Sumitomo Corporation Group and The Kansai Electric Power Co., with 10,000 MW capacity of ultra/supercritical technology with high efficiency and low CO_2 emissions. This project is being built in Tabanan Village, Jepara District, which is a project to accelerate development that has been launched by the Indonesian Government. The development of Tanjung Jati B 5-6 steam power plant is expected to be able to meet the electricity needs of the Java-Bali-Madura region [4]. As the environmental responsibility of the establishment of the Tanjung Jati B steam power plant on the surrounding environment, it is required to conduct a study of the living environment in the form of management and environmental monitoring of the impact of steam power plant development activities. The monitoring study refers to the Environmental Impact Analysis document which has obtained an Environmental Permit through the Central Java Governor Decree Number 660.1/11 of 2016 [5,6].

The environmental protection program (ecological stabilizer) against various impacts that cause changes in the ecological balance needs serious attention from the technical ministries that handle it, the environment and forestry of the Republic of Indonesia and the whole community because ecological damage is at an alarming stage. Changes in biodiversity as a bioindicator and biocontrol from the occurrence of ecological changes and even ecological damage must be an important concern especially for endangered flora and fauna species, especially those threatened with extinction due to development activities regulated in Government Regulation No. 68 of 1998. The Government of Indonesia has ratified regulations regarding the protection of biodiversity of extinct flora and fauna based on PP no 7th 1999, The International Union for Conservation of Nature's (IUCN), dan The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) [7]. The ecological bioindicators and biocontrol of marine waters especially at the location of the construction of steam power plants need to be monitored during operations so that the ecological status of the environment is maintained well [8].

The environmental monitoring activities in the aquatic biology aspects and aspects of the presence and encounter of avifauna in the environment aim to determine changes in the ecological status of aquatic biota (plankton, benthos, and nekton) and avifauna (birds) which can be used as bioindicators of environmental changes due to the impact of development activities. The environmental monitoring study is inherent in nature, which is a comprehensive entity with environmental protection regulations in force in the Republic of Indonesian, which is the responsibility of the company in managing and monitoring the environment [9,10].

The management of the source of the impact of the Tanjung Jati steam power plant development activities that can affect the ecological status around the study site is in the dredging and dumping dredging construction phase. These activities can cause a decrease in the quality of sea water based on marine biota indicators and a decrease in avifauna encounter at the research location. The management of Tanjung Jati Steam Power Plant has made technical efforts to manage the source of the impact, to reduce the impact of activities, as follow:

1. Management of the primary impact of seawater quality and conduct a feasibility study for the determination of the installation of a fish apartment. The use of this fish apartment is expected to be able to give an idea of the impact of activities on the quality of marine waters [11] Fish apartment analysis includes fish species composition, fish abundance, diversity index and fish dominance index. **FIG. 1a**, shows the installation of a fish apartment
2. Management of the impact on the implementation of dredging is very dependent on the condition of the bottom sediment

waters that will be dredged. dredging uses cutter suction dredger for muddy material and grabdredger for rocky material. [12]. Dredge hauling equipment uses a bottom door hopper barge type (**FIG. 1b**). In case of oil spills from the equipment immediately add oil absorbent.

FIG. 1. **a: Fish apartement; b: Grabdredger dredging activities; c: Transport of bottom type hopper barge.**

3. Environmental management in the implementation of dumping using the installation of silt screens around the hopper barge vessels and oil spills in the waters is immediately handled by adding oil absorbent (**FIG. 1c**).
4. The construction of the jetty is carried out carefully by using precast elements or shuttering forms to minimize the spills of cement. Construction of the jetty in an open pile and when installing an open pile using a hammer pile, in **FIG. 2** [13-15].

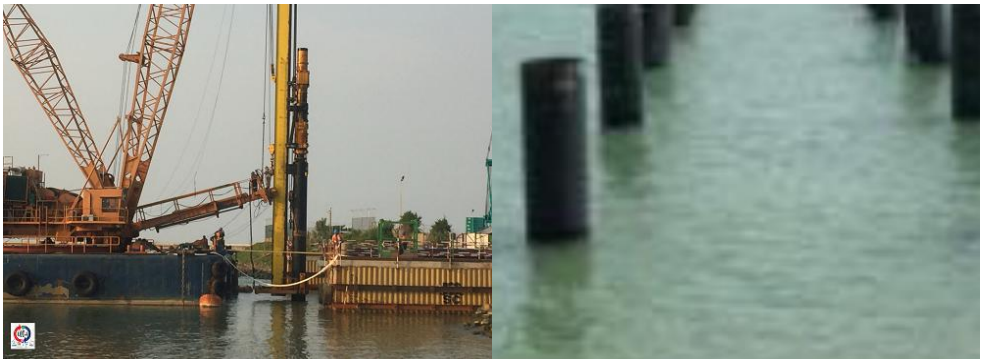

FIG. 2. **Open pile jetty construction using hammer pile**.

The management measures are expected to reduce the impacts that may arise and damage to marine ecosystems and disrupt the presence of avifauna due to the development activities of the Tanjung Jati steam power plant. Monitoring activity is carried out within the 6 (six) month time period and monitoring frequency during the construction phase. To conduct monitoring activities, it is necessary to do a study and analysis of marine biota and avifauna that live in the study site to get control of the description of the environmental status and predictions that may occur during development.

Research Methods

Aquatic biota: Plankton

The type of data collected is the composition and structure of the phytoplankton and zooplankton communities, while the location of sampling and collection of plankton and benthos data is in locations around fish apartments and dumping locations. **(TABLE 1**

and FIG. 3).

TABLE 1. **Plankton, benthos and nekton sampling locations**.

Code	East longitude	South latitude
PB-04	110° 43' 11,48”	06° 25' 59,69”
PB-05	110° 43' 48,40”	06° 26' 25,50”
PB-07	110° 44' 27,83”	06° 26' 17,13”
PB-08	110° 45' 05,96”	06° 26' 29,07”
PB-12	110° 43' 38,08”	06° 23' 55,82”
NEC05	110° 42’ 36,50”	06° 25’ 22,40”
NEC06	110° 42’ 14,30”	06° 24’ 35,10”
NEC07	110° 45’ 11,60”	06° 23’ 12,90”

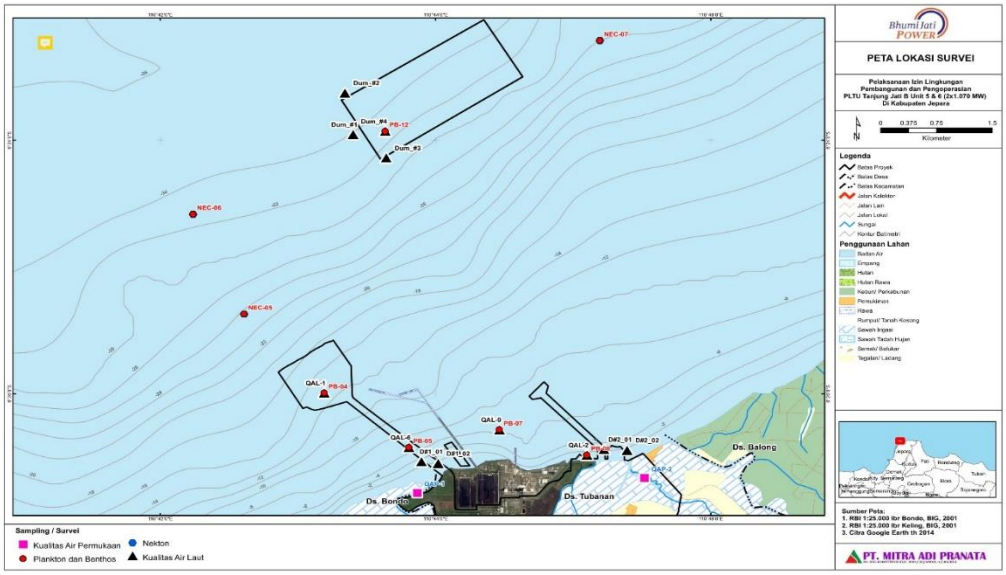

FIG. 3. **The sampling location of plankton, benthos, nekton.**

Phytoplankton sampling will be carried out using phytoplanton nets, while zooplankton sampling will be done using zooplanton nets. Plankton samples obtained will be preserved using 4-5% formalin buffer solution [16]. Plankton observations will be carried out under a microscope using the Sedgwick-Rafter cell counting chamber, then identification of the types of plankton is carried out using phytoplankton and zooplankton identification books. Data from the identification of plankton are then used to analyze the number of taxa and the types of plankton which are indicator species. Plankton identification (phytoplankton and zooplankton) is carried out using identification instructions, such as Bold and Wynne and Humm and Wicks [17]. The parameters calculated and analyzed are the following parameters:

1. Abundance

$$Ki = T/1 \times V_0 / V_a \times 1/W \times P/P$$

2. Species diversity index

$$H' = -\sum_{n=1}^{s} (n1/N) Ln\left(\frac{ni}{N}\right)$$

3. Species Uniformity Index

$$J = \frac{H'}{\ln S} = \frac{H'}{H \max}$$

4. Dominance Index

$$D = 1 - J$$

Aquatic biota: Benthos

Sampling of macrozoobenthos is done using grab sampler and macrozoobenthos filter. Sediment samples were sieved in water using a 5 mesh (2.54 mm) sieve [18].

The stone material and the remnants of the existing plants are separated then the obtained macrozoobenthos samples are put into a sample container and preserved using 10% formalin solution that has been added rose-bengal as a coloring solution that will be absorbed by macrozoobenthos making it easier for the identification process in the Laboratory. Benthos was found separated, cleaned, and put in bottles containing 70% alcohol preservatives or MAF (Methanol-Acetic Acid-Formalin). Identification is done in the laboratory using a binocular microscope and based on identification books. The data obtained were then analyzed to obtain the value of Relative Abundance Index (KR), Diversity Index (H'), Evenness Index (E), and Dominance Index (C) [19].

1. Abundance (Di)

$$Di = \frac{s \times 10.000}{a \times n}$$

2. Relative abundance (Kr)

Kr=(Abundance of type 1/Abundance of all types) × 100%

3. Diversity Index (H')

$$H' = -\sum_{l=1}^{s} (pi \log 2 pi)$$

4. Evenness index (e)

$$e = -\frac{H'}{LnS}$$

5. Dominance index (C)

$$C = -\sum \left(\frac{Ni}{N}\right)^2$$

Aquatic biota: Nekton

The type of data collected is nekton samples with sampling locations and data collection is at fish apartments and dumping locations. A sampling of nekton is done by netting. Additional data collection will be taken from the data of the types of fish landed at the Fish Auction Site. The quantitative data obtained were then analyzed based on parameters, as follows [20].

1. Relative abundance

$$Kr = \frac{ni}{N} \times 100\%$$

2. Diversity Index (H')

$$H' = \sum_{l=1}^{s} (Pi \log 2 Pi)$$

3. Dominance index (C)

$$C = \sum \left(\frac{Ni}{N} \right)^2$$

Diversity indexes are categorized in 3 categories namely: H'<1 Low diversity, 1<H'<3 moderate diversity, H'>3 High diversity. Plankton Uniformity Index (E<1). The smaller the value of E, the smaller the value of plankton uniformity. Dominance value (0<C<1) Dominance index ranges from 0 to 1, where the smaller the value of the dominance index shows that there is no species dominating otherwise the greater the dominance it indicates that there are certain species.

Avifauna (bird)

Data collected includes types of avifauna which are observed based on the track and sound, the number of individuals, the use of space, and the condition of the habitat where animals are found. The location of data collection is in the project site and surrounding area. Avifauna (bird) analysis is based on the inventory method, which is counting and identifying all avifauna (bird) species to get data on the number of species and individuals in the project site. In addition to primary data secondary data was also collected from interviews with the public. Qualitative data will be analyzed descriptively, to illustrate habitat conditions, avifauna (bird) threat due to various factors and the presence of avifauna (birds) entering the category protected by law and the status of rare and endangered species described on the IUCN Red List (International) Union for Conservation of Nature [21] and Government Regulation No. 7 of 1999 concerning preservation of plant and animal species in the form of a list of species [22]. **TABLE 2** shows the location of Avifauna monitoring points.

TABLE 2. **Avifauna monitoring points**.

Code	Bujur Timur	Lintang Selatan
AV-1	110° 45’ 45,96”	06° 26’ 37,81”
AV-2	110° 45’ 26,20”	06° 27’ 25,60”
AV-3	110° 44’ 00,30”	06° 27’ 05,92”
AV-4	110° 42’ 55,63”	06° 28’ 52,78”

Results

The results of the analysis of plankton, benthos and nekton are shown in **TABLES 3-7**.

TABLE 3. **Results of the plankton analysis**.

Location	Total species	Diversity index	Uniformity index	Dominance index
PB-04	38	1.95	0.54	0.2
PB-05	39	1.94	0.53	0.21
PB-07	42	2.04	0.55	0.18
PB-08	42	1.9	0.51	0.2
PB-12	35	1.83	0.52	0.2
NEC-05	30	1.81	0.53	0.22
NEC-06	34	1.88	0.53	0.21

NEC-07	39	1.83	0.5	0.21
Average	37.38	1.90	0.53	0.20

TABLE 4. **Types of plankton at the study site.**

Plankton type			
Amphisoleniaceae *Triposolenia sp.*	*Dictyochaceae* *Dictyoca sp.*	*Thalasiothrix sp.*	*Ceratideae* *Ceratium sp.*
Bacillariaceae *Nitzchia sp.*	*Dinophysiaceae* *Dinophysis sp.*	*Licmophoraceae* *Licmophora sp.*	*Codonellidae*
Biddulphiaceae *Biddulphia sp.*	*Orinthocercus sp.*	*Ditylium sp.*	*Tinntinopsis sp*
Chaetocerotaceae *Chaethoceros sp.*	*Diplopsaliaceae* *Diplopsalis sp.*	*Peridiniaceae* *Peridinium sp.*	*Codonellopsidae* *Codonellopsis sp.*
Coscinodiscaceae *Coscinodiscus sp.*	*Fragilariaceae*	*Pleurosigmataceae* *Pleurosigma sp.*	*Nauplius*
Rhizosolenia sp.	*Asterionella sp.*	*Rhopalodiaceae* *Rhopalodia sp.*	*Cyclopidae* *Cyclops sp.*

TABLE 5. **Results of benthos analysis.**

Location	**Total Species**	**Diversity Index**	**Uniformity Index**	**Dominance Index**
1. PB-04	6	1.61	0.9	0.24
2. PB-05	5	1.48	0.92	0.27
3. PB-07	2	0.64	0.92	0.56
4. PB-08	3	0.87	0.79	0.5
5. PB-12	6	1.79	1	0.17
6. NEC-05	1	-	-	1
7. NEC-06	1	-	-	1
8. NEC-07	4	1.33	0.96	0.28
Average	3.5	1.29	0.92	0.5

The type of benthos identified from the study location was *Macoma sp.* from the genus *Tellinidae*, *Nacula sp.* from the genus *Chrysophyceae*, species *Prothothaca sp.* from the genus *Veneridae* and *Tagelus sp.* from the genus *Solecurtidae.*

TABLE 6. **Results of nekton analysis.**

Local/scientific name	**NEC-05**	**NEC-06**	
1. Petek iler *(Leiognathus sp*)	4	9	-
2. Pepetek Brondol *(Eubleekeria splendens)*	3	1	-
3. Badong *(Caranx ignobilis)*	-	2	-
4. Pendek *(Anodentosm sp)*	-	6	-
5. Laosan *(Eleutheronema tetradactylum)*	-	1	-
6. Tengiri *(Scomberomorus commersoni)*	1	-	-

7. Kerong *(Terapon jarbua)*	1	-	-
Number of species	4.000	5.000	4.500
Number of individuals	13.000	24.000	18.500
Diversity index	1.095	1.186	1.141
Uniformity index	0.790	0.737	0.764
Dominance index	0.160	-	0.080

TABLE 7. **The level of encounter of avifauna.**

No	Species	Local Name	AV-1	AV-2	AV-3	AV-4	Total	UI	CI	UU
1	*Ardea alba*	Kuntul Besar	+++	-	+++	+++	+++	-	-	V
2	*Ardeola speciosa*	Belekok Sawah	+	-	++	+	+++	-	-	-
3	*Bubulcus ibis*	Kuntul Kerbau	+	-	++	-	++	-	-	V
4	*Centropus* sp.	Bubut	-	-	++	+	++	-	-	-
5	*Collocalia esculenta*	Walet Sapi	+++	++	+++	+++	+++	-	-	-
6	*Cypsiurus balasiensis*	Walet Palem Asia	+	+	++	+++	+++	-	-	-
7	*Egretta garzetta*	Kuntul Kecil	+++	-	+++	-	+++	-	-	V
8	*Hirundo rustica*	Layang-Layang Api	++	+	-	-	++	-	-	-
9	*Lonchura leucogastroides*	Bondol Jawa	++	+	+++	+++	+++	-	-	-
10	*Lonchura punctulata*	Bondol Peking	+++	-	-	++	+++	-	-	--
11	*Passer montanus*	Burung Gereja	+++	+++	+++	+++	+++	-	-	-
12	*Streptopelia chinensis*	Tekukur Jawa	+	+	++	+	+++	-	-	-
13	*Todirhamphus chloris*	Cekakak Sungai	-	+	+	-	+	-	-	-
14	*Butorides striatus*	Kokokan Laut	-	-	++	-	++	-	-	-
Rate of encounter: (-): none, (+): rarely, (++): medium, (+++): often encountered										

1) CI Trade status according to the Convention on International Trade in Endangered Species (CITES) [23]
2) IU Status of threat according to the International Union for Conservation of Nature (IUCN) Red List [21,24]
3) Status Act: The laws of the Republic of Indonesia:
   a) Law of the Republic of Indonesia Number 5 of 1990 concerning Conservation of Biological Resources and Their Ecosystems [25]
   b) Government Regulation Number 7 of 1999 concerning Preservation of Plant and Animal Species [26]

Discussion

Aquatic of biota

Sampling activities in the 3rd monitoring period were conducted in January-June 2019, based on the results of sampling plankton at 8 sampling points, then 30 to 42 species per sampling point were obtained. Diversity index at 8 location points ranged from 1.81 to 2.04 (Avg 1.90) which shows that the diversity of plankton is classified as moderate and the stability of the community is based on the diversity index of species (H') plankton and benthos in category 1<H'<3 (waters at the sampling location indicate a moderate polluted category) [17]. While the results of benthos analysis in the January-June 2019 period showed that the level of benthos

diversity was in the low-to-moderate to the moderate category of 0.64-1.79 (Avg 1.29) and the results of benthos uniformity analysis showed uniformity tended to be stable with values between 0.5-0.55 (Avg 0.53). This is in line with the low value of the benthos dominance index which indicates that no species dominates. The dominance index value ranges from 0 to 1, the smaller the dominance index value indicates that there are no species dominating otherwise the greater the dominance it indicates that there are certain species. The distribution of individuals between types is not evenly distributed/there are certain types that are dominant. [26].

Plankton and benthos are groups of organisms that play an important role in an aquatic ecosystem. The Tanjung Jati B-5 and 6 Steam Power Plant development area is directly related to the open sea. Water conditions can change at any time, both physical and chemical caused by human activities and natural factors. This will affect the survival of plankton and benthos namely abundance and diversity [27]. Therefore the role of plankton and benthos in the balance of an aquatic ecosystem can be an indicator of the current ecological conditions in the Tanjung Jati 5 and 6 Steam Power Plant development area. Based on the results of the identification of the types of plankton found in the waters around the Tanjung Jati B Steam Power Plant, there are 3 types of phytoplankton that have the potential to endanger fisheries is *Chaethoceros sp.* (*Chaetocerotaceae*) if it blooms it can cause the death of fish and invertebrates through the mechanism of oxygen depression and cause damage to abrasion in the gills, *Dictyoca sp.* (*Dictyochaceae*) There is a species known as the cause of fish death, *Dictyocha octonaria*. [28], and types of *Dinophysis sp.* (*Dinophysiaceae*) namely Dinophysis acuminate which causes diarrhea shellfish poisoning [29]. Another plankton species that is found in abundance is *Ditylium sp.* and *Ceratium sp.* type of *Ditylium sp.* and *Ceratium sp.* known as a type of phytoplankton in large quantities that can potentially become Harmful Algae Blooms (HABs). Harmful Algae Blooms (HABs) are a phenomenon of toxic phytoplankton blooming in waters that can cause the death of marine biota [30]. The existence of *Nauplius sp.* which belongs to the zooplankton group that is able to live in fresh or brackish water, is eurythermal. The existence of *Nauplius sp.* shows the location of activities adjacent to sea waters with brackish water characteristics [31].

Benthos including organisms that have a sensitivity to some pollutants, have low mobility, are easily captured, and have long survival, therefore benthos can be used as a bio-indicator of ecological disturbance or pollution [10]. Based on the identified benthos data, there are 4 types of benthos is *Macoma sp.*, *Nacula sp.*, *Prothothaca sp.*, and *Tagelus sp.* These four benthos species are found in all sampling locations and the benthos species has a sensitivity to polluted waters so that the four benthos species can be used as aquatic bioindicators in research locations with categorized medium polluted water [32].

The results of sampling nekton at four different points, only 2 points that received nekton (fish) namely at the locations of NEC-05 and NEC-06. Based on the results of the analysis show that the diversity index of 1.095-1186 (Avg 1.141) is included in the medium category and the index of uniformity is 0.737-0.790, including the category of the dominance of certain types [there are waters (E<1) The dominance index at the study location is between 0-0.160 (Avg=0.080) this shows that certain species dominate in the aquatic ecosystem around the study site so that the diversity of nekton in that location is low [17,26].

The sampling locations NEC05 and NEC06 are located west of the study site, nekton caught are Layur fish (*Trichiurus savala*) while in western waters are Pethek fish (*Leiognathus sp.*), Kerong (*Therapon theraps*) and Kurisi fish (*Holocentrum rubrum*). Some species that are only caught in the eastern waters of the Tanjung Jati B Steam Power Plant are Tengiri Kawang fish (*Scombromarus sp.*), Badong Fish (*Macrones sp.*) and Teri Gelagah fish (*Stolephorus indicus*). While in the western waters they are Kurisi fish (*Holocentrum rubrum*), Halibut fish (*Psettodes erumei*), Red Snapper fish (*Lutjanus argentimaculatus*) and Rajungan (*Portunus pellagicus*). Based on catches and interviews from fishermen, the presence of fish in the vicinity of the study site is rarely found with low diversity, this shows that there has been a disturbance in the ecological balance which causes the waters are not a good habitat for Nekton (fish).

Avifauna

Avifauna observations made in 4 monitoring points are AV-1 AV-2, AV-3, and AV-4. which was carried out in the January-June

2019 period. During this monitoring period, most of the observation locations were in the rice growing season, namely the AV-1 AV-3 and AV-4 locations. At AV-4 Location, even part of the land is still in the process of land management, at the beginning of the rice planting season. AV-2 observation location conditions are different from other locations, at the time of observation there were many corn plants that would soon be harvested.

The most common types of avifauna found in the four locations are the Ploceida and Apodidae tribes. Avifauna group from the Ploceida tribe is a small bird, short-tailed and thick and short beak that is useful for eating seeds and tend to group so that this species is most easily observed. While Avifauna from the Apodidea tribe are insectivorous birds that forage while flying. There are 4 types of Avifauna from the Ardeidae tribe found at the time of observation, namely Big Egret (*Ardea alba*), Blekok Sawah (*Ardeola speciosa*), Buffalo Egret (*Bubulcus ibis*), Small Egretta (*Egretta garzetta*) and Kokokan Laut (*Butorides striatus*). Of the four locations, only AV-2 was not found by Avifauna from this Ardeidae tribe. This is due to the condition of the land at the AV-2 location in the form of corn so that it does not support the Avifauna group from the Ardeidae tribe to land and do activities at that location. Avifauna's activities in the other three locations are foraging, flying, and sunbathing.

The Avifauna group of the genus *Ploceida* are small, short-tailed birds and thick short beaks that are useful for eating grains and tend to cluster so that this species that is most easily observed is in accordance with rice plant ecosystems. While Avifauna from the *Apodidea* tribe is insectivorous birds that forage while flying, the paddy ecosystem provides an environment suitable for insects as a place to live. The level of avifauna meeting at the time of complete observation is presented in **TABLE 8 and FIG. 4** shows the avifauna identified at the study site, as follows:

FIG. 4. **Big Egret (*Ardea alba*), Small Egret (*Egretta garzetta*), Paddy Blekok (*Ardeola speciosa*) and Erasia Sparrow (*Passer montanus*).**

The results of the study of the conservation status of wild fauna species that have been inventoried indicate that there are several types of fauna whose protection status has been determined through Law of the Republic of Indonesia Number 5 of 1990 concerning Conservation of Biological Resources and their Ecosystems and Government Regulation Number 7 of 1999 concerning Preservation of Types Plants and Animals, namely Big Cangak (*Ardea alba*), Little Egret (*Egretta garzetta*) and Buffalo Egret (*Bubulcus ibis*) which belong to the *Ardeidae* family. *Bubulcus ibis* Least Concern (LC) since 2004, 2008, 2009, and until now, and listed on the basis of the legal protection of the Unitary State of the Republic of Indonesia. *Egretta garzetta* Conservation Status of Birds protection was implemented under the criteria of the IUCN Red List [33]. *Ardea alba* protected under Indonesian Government Regulation [34,35].

Avifauna species are often found in paddy habitat in Hamlet Bayuran, Tubanan Village, Kembangan District (AV-1: S 06° 26'37.81"; E 110° 45'45.96", based on search results according to the IUCN Red List, the type birds of the *Ardeidae* family are threatened by Least Concern (low risk) but there is a tendency for an increase in the number of individuals in their natural habitat. The study of protected fauna is carried out by analyzing the fauna's living habitat. All protected fauna belongs to the *Ardeidae* family group. The three types of protected fauna have a common habitat in the form of rice fields, rivers, ponds, mangroves, and

swamps with types of food such as grasshoppers, small fish, crustaceans, dragonfly larvae, and frogs. Based on the status of bird encounters, the three types of birds have included species of birds that settled so it is very easy to find with very many and frequent frequencies. Based on these characteristics, an observation was made of several points at the study location that has the potential as habitat for the three protected fauna species, namely as follows:

1) Location 1 (AV-1) with coordinates S 06° 26'37.81"; E 110° 45'45.96", is a rice field habitat in Hamlet Bayuran, Tabanan Village, Kembangan District. The main crop in the form of rice, is the location of many protected birds found
2) Location 1 (AV-2) with coordinates S 06° 27'25.60"; E 110° 45'26,20", is a rice field in Tabanan Village. The main crop is rice. This location is ± 1.5 Km from the Hamlet Bayuran rice field which is the location of protected and commonly found birds
3) Location 2 (AV-3) with coordinates S 06° 27'05,92"; E 110° 44'00.30", is a rice field in Bondo Village around the Bondo River. The main crop is rice. The expanse of rice fields is quite extensive and close to Sunga Bondo. This provides potential support for living habits in the form of food sources for bird species from the *Ardeidae* family group. The distance between the project location and the location of protected fauna habitat is about ± 3.5 Km.
4) Location 3 (AV-4) with coordinates S 06° 28'52,78"; E 110° 42'55,63", is a rice field with the main crop in the form of rice. The distance from the project site to the protected fauna habitat is approximately ± 7 Km

The location has similarities with the location of habitats where species of protected fauna are often found, namely in the form of rice fields with a fairly wide expanse, rice as the main crop, and not far from waters in the form of rivers or irrigation channels. The three protected fauna species have a wide range of range so that the location can be made possible to become a roaming area for birds of the Ardeidae family. There are similarities in the habitat of the birds (avifauna) roaming area. The similarity of the three locations can be seen in the following **FIG 5.**

FIG. 5. **Comparison of locations encountered avifauna with all three potential habitat locations (Rice fields at 1, 2, 3 and 4).**

Observations made in the season where the rice plants have grown well show that at these three potential locations are also used by groups of birds from the *Ardeidae* family as living habitat. The results of interviews with farmers in Tubanan Village show that there is no hunting activity for these birds. This is possible to be one of the reasons the bird species from the *Ardeidae* group use rice fields in Tubanan Village and Bondo Village as living animals. The three bird species from the *Ardeidae* group also appear undisturbed by human activities around the rice fields. if the activity is considered too close, the bird only moves away from the location of human activity but is usually not far from the initial location when disturbed.

Trend evaluasi modeling

Plankton: Plankton modeling evaluation is calculated based on the analysis of plankton aquatic biota data since the start of the construction of the steam power plant. **TABLE 8** shows the average results of the Plankton Analysis, licensing analysis of Environmental Impacts Assesment (EIA), the Jan-June 2018 period, the June-December 2018 period and the Jan-June 2019 period,

as follows:

TABLE 8. **Average results of the plankton analysis.**

Location	EIA	Jan-June 2018	Jul-Dec 2018	Jan- June 2019
Plankton diversity index	2.09	3.89	2.83	3.04
Plankton uniformity index	0.94	1.44	0.84	0.84
Plankton dominance index	0.12	0.15	0.41	0.29
EIA: Environmetal Impact Assessment				

The results of the trend analysis of modeling plankton evaluation showed that the diversity index of the plankton had a tendency of positive values (y=0.1172x+2.519), the tendency value for the uniformity index was negative (y=-0.0886x+1,236) and the tendency for the index dominance is positive (Y=0.0773x+0.0.0463), as follows (**FIG. 6**).

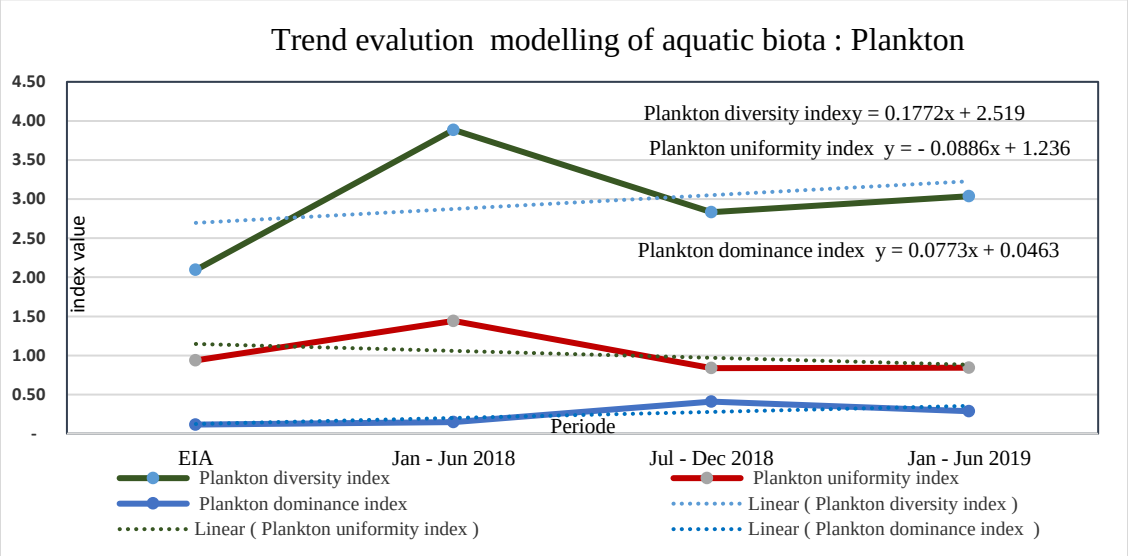

FIG. 6. **Evaluation trend of modeling plankton since EIA compilation period EIA c, January-June 2018, July-December 2018 and Jan-June 2019.**

This shows that the evaluation trend for diversity index and dominance index has a good tendency (+), while the value of the tendency for uniformity index needs to be considered for maintenance and be a concern in monitoring the aquatic environment.

Benthos

Benthos modeling evaluation trends, based on period data analysis: environmental impact analysis (2015), January-June 2018, June-December 2018 and Jan-June 2019, as follows: (**TABLE 9 and FIG. 7**)

TABLE 9. **Average results of benthos analysis.**

Parameter	**EIA**	**Jan-Jun 2018**	**Jul-Dec 2018**	**Jan-Jun 2019**
Benthos diversity index	1.36	1.3	1.75	1.26

Benthos uniformity index	0.98	0.79	0.74	0.92
Benthos dominance index	0.26	0.8	0.23	0.5
EIA: Environmetal Impact Assessment				

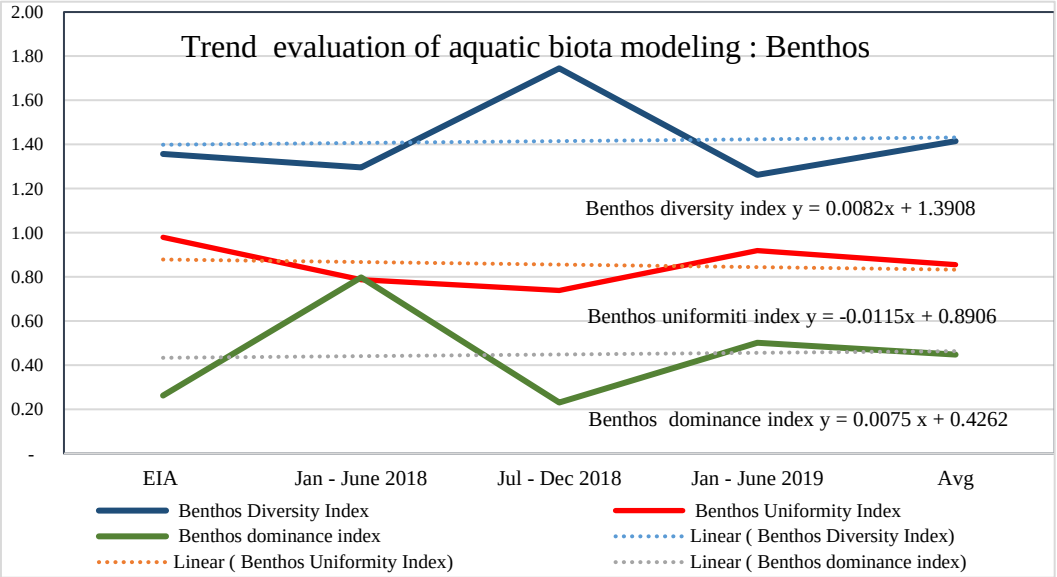

FIG. 7. **Evaluation trend of modeling benthos since EIA compilation period n period, January-June 2018, July-December 2018 and Jan-June 2019.**

The results of the trend analysis evaluation of benthos modeling are shown in **FIG.7.** The figure shows that the benthos diversity index has a tendency to have a positive value, it is shown that the graph modeling equation is positive (+), with a linear equation y=0.0082x+1.3908. Trend value evaluation modeling for benthos uniformity index with linear equation value y=-0.0115x+0.8906, this shows that the plankton uniformity index has a tendency of negative values (-), whereas for trend evaluation modeling for plankton dominance index has a positive value, with a linear equation y=0.0075x+0.4262. Benthos Uniformity Index monitoring is needed to increase the monitoring value to be positive, it is feared that the uniformity index in the periarians will become less diverse and the dominance of certain species increases, which shows that the ecological balance is disturbed.

Nekton

The trend of evaluating Nekton modeling based on the analysis of Nekton sampling data, in the period of: Environmental Impact Analysis preparation (pre-construction), Jan-June 2018, June-December 2018 and Jan-June 2019, as follows: (**TABLE 10 and FIG. 8**).

TABLE 10. **Average results of nekton analysis.**

Parameter	EIA	Jan-Jun 2018	Jul-Dec 2018	Jan-Jun 2019	Avg
Nekton diversity index	1.81	0.81	1.19	0.47	1.07
Nekton uniformity index	0.60	0.27	0.40	0.16	0.36

Nekton dominance index	0.80	0.36	0.53	0.21	0.48
EIA: Environmetal Impact Assessment					

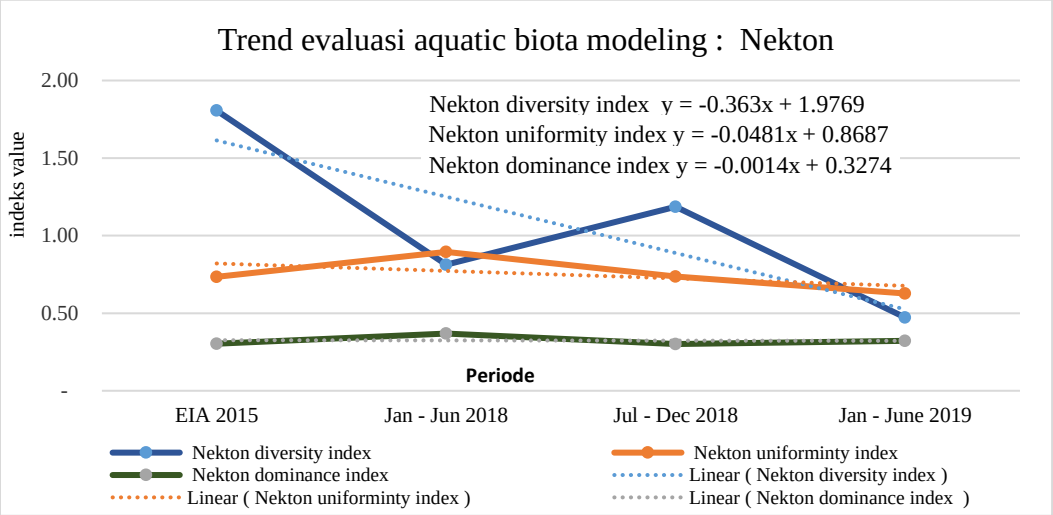

FIG. 8. **Trend evaluation average nekton since eia compilation period, Jan-June 2018, June-December 2018 and Jan-June 2019.**

The results of trend analysis of nekton biota modeling evaluation are shown in **FIG. 8.** The figure shows that the diversity index (y=-0.364x+1.9679), uniformity index (y=-0.0481x+0.8687) and dominance index (y=-0.0014x 0.3274), for all parameters having a negative value tendency, the value can be used as a base line for better environmental management.

Avifauna

The evaluation of the assessment of the presence and encounter trends of bird species protected by the Indonesian government. 5 of 1990 and Government Regulation No. 7 of 1999 was carried out on 3 protected avifauna species, was *Ardea alba*, *Bubulcus ibis* and *Egretta garzetta*, as follows: (**TABLE 11 and FIG. 9**).

TABLE 11. **Trend evaluation of the presence and encounter protected avifauna.**

		EIA-2015	**Q2-2016**	**Q1-2017**	**Q2-2017**	**Q1-2018**	**Q2-2018**	**Q1-2019**
Ardea alba		+++ (3)	+++ (3)	+++ (3)	++ (2.5)	++ (2)	++ (2)	+++ (3)
Bubulcus ibis		+++ (3)	+++ (3)	+++ (3)	++ (2)	++ (2)	+++ (3)	++ (2)
Egretta garzetta		+++ (3)	+++ (3)	+++ (3)	++ (2)	++ (2)	++ (2)	+++ (3)
+++ (3): High level of encounter; ++ (2): Medium level of encounter; + (1): low level of encounter								

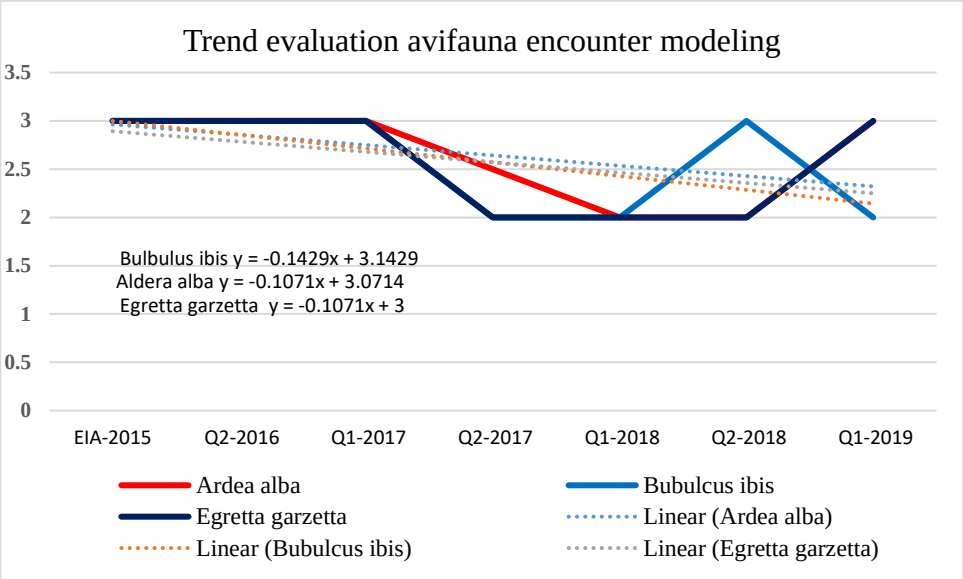

FIG. 9. **Trends in evaluating the availability of Avifauna species since EIA compilation period, Jan-June 2018, June-December 2018 and Jan-June 2019.**

Based on the diagram above, it can be concluded that the ongoing construction activities affect the existence of Avifauna which is a monitoring parameter. Types of meetings *Ardea alba*, *Egretta garzetta* and *Bubulcus ibis* tend to experience a decrease in meeting rates. Based on the evaluation trends of 3 types of avifauna that are often present at the study site are as follows: Bubulcus trend evaluation model ibis y=-0.0357x+2.8771, evaluation of Egretta garzetta modeling trends y=-0.1071x+3 and Ardea alba evaluation trend modeling y=-0.0357x+3, all showing a negative trend. This shows that avifauna protected by the Indonesian government is rarely found in future research sites, it is possible that all three types of avifauna are found to be smaller, even will become extinct

Conclusion

The assessment of the quality of aquatic biota based on bioindicators: plankton, benthos, and nekton, shows the status of moderately polluted waters, with a trend evaluation model on most parameters with negative trend values. Found in the research location avifauna protected by the Indonesian Government are *Ardea alba*, *Egretta garzetta*, and *Bubulcus ibis*, with the frequency of encounters showing negative trends. Therefore special attention needs to be paid to parameters that have negative trends, because the trend will indicate ecological imbalances over a long period of time, although at present it is still aimed at a good ecological balance

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Significance Statement

This research is a study of monitoring the biological aspects of waters as a biomonitoring the impact of construction activities of the Tanjung Jati-B Steam Power Plant 5-6 Jepara, Central Java Indonesia and the evaluation model of the tendency of aquatic biological parameters and avifauna parameters.

Author's Contribution

This research has been carried out in collaboration between three authors. The SI writer designed the study and the sample did statistical analysis and wrote the first draft of the manuscript. Authors of SI and PSO write the protocol and manage the analysis of this study. The Tosan Adji writer manages the literature search and has taken a sample. All authors have read and agreed to the final manuscript.

REFERENCES

1. Yoo SH, Kim Y. Electricity generation and economic growth in Indonesia. Energy. 2006;31(14):2890-9.
2. Cornot-Gandolphe S. Indonesia's electricity demand and the coal sector: export or meet domestic demand? Oxford Institute for Energy Studies. England. 2017:1-33.
3. Wijayanto HD, Sunitiyoso Y. Scenario planning of electricity needs in Indonesia for the next ten years. J Technol Manage. 2019;18(1):54-70.
4. Arsal T, Ambarwati NR. The impact of steam electricity power plant development on the economic and social activities of the community. Int J Bus Adm Stud. 2018;4(3):86-92.
5. Betara HC. Implementation of social and environmental responsibility PLTU Tanjung Jati B Jepara. Program Magister Ilmu Lingkungan. Diponegoro University Semarang, Indonesia. 2013:1-12.
6. Oetari PS, Hadi SP, Huboyo HS. Dispersion model of total suspended particulate from Tanjung Jati B Jepara coal-fired power plants Chimneys. E3S Web of Conferences. 2018;73(6):05024.
7. Lubis MI. Implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and Law No, 5 of 1990 on the Conservation of Biological Natural Resources and Its Ecosystems in Law Enforcement Efforts and Guarantees of Environmental rights in Gunning Leuser National Park, Indonesia. JILS. 2017;2:55-78.
8. Beumer C, Martens P. IUCN and perspectives on biodiversity conservation in a changing world. Biodivers Conserv. 2013;22:3105-20.
9. Koskimies P. Birds as a tool in environmental monitoring, in Annales Zoologici Fennici. JSTOR. 1989;153-66.
10. Hellawell JM. Biological indicators of freshwater pollution and environmental management. Springer Science and Business Media. 2012.
11. Harlyan LI, Sari SHJ, Yona D. Fish apartment as a solution for increasing fish catch in pacitan water, east Java. J Innov Appl Technol. 2017;3(1):376-80.
12. Hardya TP. Analysis of productivity in dredging project A case study in Port of Tanjung Perak Surabaya-Indonesia. 2016.
13. Allen SN, Moore GAC. Construction methodologies and challenges for marine concrete structures. Mar Concr Struct. 2016;115-33.
14. Sutherland WJ, Newton I, Green R. Bird ecology and conservation: a handbook of techniques. OUP Oxford. 2004.

15. Williams JD, Johnson C, Thavaraj T, et al. Timber compaction piles as part of seismic retrofit for a 110-year old railway bridge. 2019.
16. Goswami SC. Zooplankton methodology, collection and identyification-A field manual. National Institute of Oceanography. India. 2004.
17. Keylock CJ. Simpson diversity and the Shannon-Wiener index as special cases of a generalized entropy. Oikos. 2005;109(1):203-7.
18. Simboura N, Zenetos A. Benthic indicators to use in ecological quality classification of Mediterranean soft bottom marine ecosystems, including a new biotic index. Mediterr Mar Sci. 2002;3(2):77-111.
19. Morin S, Gómez N, Tornés E, et al. Benthic diatom monitoring and assessment of freshwater environments: standard methods and future challenges. Aquat Biofilms Eco Water Qual Wastewater Treat. 2016;15:111-24.
20. Salmo SG, Tibbetts IR, Duke NC. Nekton communities as indicators of habitat functionality in Philippine mangrove plantations, Marine and Freshwater Research. CSIRO. 2018;69(3):477-85.
21. International Union for Conservation of Nature, Iucn Species Survival Commission, International Union for Conservation of Nature, et al. IUCN Red List categories and criteria. IUCN; 2001.
22. Rodrigues ASL, Pilgrim JD, Lamoreux JF, et al. The value of the IUCN Red List for conservation. Trends Ecol Evol. 2006;21(2):71-6.
23. Raymakers C. CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora: its role in the conservation of Acipenseriformes. J Appl Ichthyol. 2006;22:53-65.
24. Indonesia PR, Indonesia PR. Undang Undang No. 5 Tahun 1990 Tentang: Konservasi Sumberdaya Alam Hayati Dan Ekosistemnya, Jakarta: Dephut. 1990.
25. Indonesia R. Peraturan Pemerintah No. 7 Tahun 1999 Tentang: Pengawetan Jenis Tumbuhan Dan Satwa, Menteri Negara Sekretaris Negara Republik Indonesia, Jakarta. 1999.
26. Odum HT. Environmental accounting: emergy and environmental decision making. Wiley. 1996.
27. Kennedy AD, Jacoby CA. Biological indicators of marine environmental health: meiofauna-a neglected benthic component? Environ Monit Assess. 1999;54(1):47-68.
28. Hallegraeff GM. A review of harmful algal blooms and their apparent global increase. Phycologia. 1993;32(2):79-99.
29. Lelong A, Hégaret H, Soudant P, et al. *Pseudo-nitzschia* (*Bacillariophyceae*) species, domoic acid and amnesic shellfish poisoning: revisiting previous paradigms. Phycologia. 2012;51(2):168-216.
30. Syakti AD, Idris F, Koenawan CJ, et al. Biological pollution potential in the water of Bintan-Riau Islands Province, Indonesia: First appearance of harmful algal bloom species. Egypt J Aquat Res. 2019;45(2):117-22.
31. Pratiwi NTM, Ardhito WDY, Iswantari A. Horizontal distribution of zooplankton in Tangerang coastal waters, Indonesia. Procedia Environ Sci. 2016;33:470-477.
32. Zuloaga, Prieto A, Usobiaga A, et al. Polycyclic aromatic hydrocarbons in intertidal marine bivalves of Sunderban mangrove wetland, India: an approach to bioindicator species. Water Air Soil Poll. 2009;201(1-4):305.
33. Fadila MI, Hidayat JW Hadi M. Community structure and conservation status of birds in tapak mangrove tugurejo Semarang, Indonesia to support mangrove ecotourism. Adv Sci Lett. 2017;23(7):6450-4.
34. Ralph CJ, Droege S, Sauer JR. Managing and monitoring birds using point counts: standards and applications, In: Ralph, C. John; Sauer, John R.; Droege, Sam, technical editors. 1995. Monitoring bird populations by point counts. Gen. Tech. Rep. PSW-GTR-149. Albany, CA: US Department of Agriculture, Forest Service, Pacific Southwest Research Station. 1995;149:161-8.
35. Tirtaningtyas FN, Yordan, K. Updating the seabird fauna of Jakarta Bay, Indonesia. Mar Ornithol. 2017;45:11-16.