Dolphins sighting throughout the pile-putting process in Makassar Bay, East Kalimantan, Indonesia

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Abstract. This survey is part of the installation of Tripod Jackets in Makassar Bay, targeting the North Side, North Nubi and Jumelai, PT Pertamina Hulu Mahakam in East Kalimantan waters. This study aims to provide marine mammal observation to the JSN project. Expert help is essential because it complies with the International Maritime Organization MEPC.1/circ.833 rules. From 13th April to 2nd June 2021, observations were made using visual and passive acoustic methods (SQ26: H1 recorder). The visual observation focus was from 500 meters to 1000 meters. The team found that the dolphins that appeared were bottlenose, long-beaked, and dolphins were not identified. The highest prevalence was during the piling of 12 dolphins at JML 1 site (after the GTS installation and adjustment). Long-beaked and unidentified dolphins were found in WPN 4 location. The dolphins seen were Tursiops species, while the turtles seen were green turtles. When watching dolphins, sightings occurred mainly at night. In the next task, the collection process, we want to discuss the process that produces a high sound on the water's surface. We recommend using "early warning". The warning will be done after the routine inventory, and we hope the staff can do it three times.

1 Introduction

An oil and gas shell structure is a fixed offshore building or facility constructed on a site to support the exploitation of offshore oil and gas deposits, including facilities and operational safety while in the water of conditions and storms [1]. The main activity in offshore oil exploitation is drilling, while offshore platforms must be positioned in a suitable place. Information about conditions below and above the seabed is indispensable for platform laying. Sampling data information becomes an important part that could not be gathering activities in the pre-process-after series Offshore Jacket Platform Development [2].

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According to [3], the installation of a drift pile in coastal and marine areas without mitigation is likely to result in noise levels that cause injury and disturbance to cetaceans. Although the impact is related to the approved activity, it may conflict with the habitats and marine biota organism on the protection regulations in 2010, which apply to UK and Welsh waters within 12 nautical miles, and the Marine Protected Area Regulations’ offshore of 2007 year under the International Maritime Organisation, as amended in 2009 and 2010.

The construction of the Offshore Jacket Platform can socially and economically take on a large workforce. A variety of scientific expertise is required in the Offshore Jacket Platform Development process. One of the most important activities as the first step for installing the Offshore Jacket Platform is installing and modifying GTS. The method of installing and adjusting the GTS can produce a sound wave that affects the biota. One affected aquatic and estuarine organisms are the marine biotas that use sound sonar to communicate. These biotas are cetaceans (dolphins, porpoises and whales) [4]. It is feared the highest voice from the installation and modification project would damage the cetaceans’ communication organs, so the JSN project must be required by the MMO (Marine Mammals Observers) team during the installation and modification of the GTS (Gathering System) process. Influence on the activity of cetaceans. Besides the existence of cetaceans, the biota with their behaviour and distribution in the whale toad is turtles, so the team observes the safety and emergence of marine mammals migration and sighting around the project’s area. Installation and modification of GTS in WPS 3 continuity work from WPN 4 and JML 1 PHM (PT. Pertamina Hulu Mahakam) offshore, EPSCC for JSN Project. In addition, collecting the data on cetaceans uses visual sighting and detecting hydrophone cetacean research. The MMO team also used hydrophone cetacean research to collect their sound sample around 500 to 1000 meters.

East Kalimantan waters are the potential area for dolphin migration and feeding area that most highly. Accompaniment by the MMO and PAM teams is a natural step by business actors towards mitigating efforts to save and preserve cetacean resources. This was followed by [5] reporting that the dolphin sightings around East Kalimantan waters recorded by video camera by 8-12 individuals. According to [6], sighting dolphins for the “pesut mahakam (Indonesian common name)” around Mahakam estuarine, Indonesia, passively moved in the morning to noon (between 5.30 to 11.30) and between 4.30 p.m. to 8.00 p.m. in the evening. Dolphin sightings are associated with the availability of food and migration routes. According to [7,8] and [9], dolphin sightings on surface waters allegedly related to eating habits as a daily activity, which is usually carried out in the morning to evening. Referring to several research results in the East Kalimantan region, expert assistance is needed in the pilling process.

This study was part of the installation and modification process of GTS and aimed to make observations (species dataset and number of estimates) of the presence of marine mammals within a radius of ≤ 500 meters from the installation and modification site of GTS and try to use equipment that produces low noise equipment. Developing this research is to save the cetacean around the project area during the pilling project.

2 Materials and methods of research

Based on the internal discussions of the MMO (Marine Mammals Observers) team and comparing the project manager schedule, the group conducted visual recording to look for cetacean sightings at the location in JML 1, WPN 4 and WPS 3 (Fig. 1). The observation was done from 13th April to 2nd June 2021. The area during the observation was on the Barge Eka Nusantara (EN) 3000. The observation time above Barge EN 3000 was divided into three times, namely: I) Morning to noon (7.00 a.m. - 1.59 p.m.), II) Noon to evening (2.00 p.m. - 09.59 p.m.), and III) Evening to morning (10.00 p.m. - 6.59 p.m.).
Fig. 1. Research observation station during pilling project processing

Sampling area observations were between 500 and 1000 meters at Barge EN 3000. The focus location for visual observation is 500 meters (Fig. 2), while the detection is up to 1000 meters using the Hydrophone Cetacean Research, including the SQ26: H1 recorder. Before stacking, a "safe zone" with a pre-agreed radius should be established around the stacking site. The Marine Mammal Observer (MMO) and the Passive Acoustic Monitor (PAM) operators monitor mammals visually or acoustically before stockpiling begins. The area of this zone must be considered in the eco-impact assessment and coordinated with the authorities.

Observation shows the trajectory area where marine mammals may be exposed to lint noises. A place of observation area represents the trajectory area where marine mammals can be exposed to pilling sounds. The mitigation zone radius should be no fewer to 500 metres, measured from the location of the piles (Fig. 2). The operators (MMO and PAM) must be stationed on the most appropriate observation platform (e.g. ship or boat) to ensure adequate coverage of the area of mitigation zone. They would also require a platform that provides an excellent view of the sea. The working equipment used for surface monitoring of cetacean sightings, both visually and by underwater sound detection, is shown in Table 1.
Fig 2. Line area towards visual sightings of cetaceans and mitigation zone representatives. This is calculated from the piles site to be deployed out to a range of 500 metres (Developed from [3]).

Table 1. Equipment of cetacean visual sighting and passive acoustic

<table>
<thead>
<tr>
<th>No</th>
<th>Types of equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hydrophone cetacean research + recorder; SQ26:H1</td>
<td>1 unit</td>
</tr>
<tr>
<td>2</td>
<td>Binoculars military zoom day</td>
<td>1 unit</td>
</tr>
<tr>
<td>3</td>
<td>Monocular distance (± 1000 meter); Bushnell Elite 1600</td>
<td>1 unit</td>
</tr>
<tr>
<td>4</td>
<td>Binoculars Telescope night vision waterproof</td>
<td>1 unit</td>
</tr>
<tr>
<td>5</td>
<td>GPS (Garmin 62s)</td>
<td>1 unit</td>
</tr>
<tr>
<td>6</td>
<td>Camera Canon EOS 60 D + lens telephoto</td>
<td>1 unit</td>
</tr>
<tr>
<td>7</td>
<td>HT (Handy Talky) UV 5R walkie-talkie radio communication</td>
<td>2 units</td>
</tr>
<tr>
<td>8</td>
<td>Compass (white waterproof slate with mounted glow)</td>
<td>1 unit</td>
</tr>
<tr>
<td>9</td>
<td>Whistle U2 ultrasonic</td>
<td>2 units</td>
</tr>
<tr>
<td>10</td>
<td>Datasheet of cetacean sighting</td>
<td>100 sheets</td>
</tr>
</tbody>
</table>

Emergence of marine mammals observation was conducted for 24 hours, including access to rest and replacement. It was according to: a) Environment Minister Decision No. KEP. 48/MENLH/11/1996, b) ISO 1996-1:2003 (E) International standard, c) Manual Guide for reducing underwater noise of cetacean from Barge EN 3000 from the International Maritime Organization (IMO), and d) SNI 8427:2017 about Measurement of ambient noise levels. Doc.: ICS 13.140.

Detection of sound intensity data in the seawater column uses hydrophone cetacean research. Data collected was done around ± 24 hours. It included detecting sound on Deck B port side every 1 hour with a detection time of about 15 minutes. Besides Deck B, detecting the sound of cetaceans is also on Main Deck. Variation in the data collection time aims at obtaining sound intensity during the biological time for living things.
Event data during pre-post processing were statistically descriptively analysed to describe the time-based variables and the number of events. The surface appearance is shown in numerical digits while writing the presence detected by the hydrophone as "2 (two)". The digit used for cetaceans that saw was the number "2" for cetaceans whose sound is detected by a hydrophone because the nature of cetaceans is like social creatures.

Data and information obtained during observations at Barge EN 3000 are sighting data and sighting predictions based on sound detection results using hydrophone research for cetaceans. The recorded data from the observations were statistically descriptively analysed. [12] Explained that descriptive statistics is a statistical analysis that describes or shows several common characteristics of all samples. Descriptive statistics summarise data on a single variable (for example, number of individuals, mean, median, mode, and standard deviation) [13]. Further analysis to see the distribution of dolphin sightings divided into five periods, namely: a) Early morning, at 00.01–05.59 a.m., b) Morning at 06.00–11.59 a.m., c) Afternoon at 00.01–04.59 p.m., d) Evening at 05.00–07.59 p.m., and e) In the night with the time at 08.00–11.59 p.m.) used PCA analysis. According to [14] PCA analysis can be reduction of the data and information. It used XL-Stat 2016 software. As described by [15,16], The PCA advantage is that it allows data to be simplified and classified more quickly.

3 Results

The observation result of cetacean sightings in the JLM 1 area was that dolphin sightings were in the early morning. Found the dolphin species was *Tursiops aduncus* and unidentified dolphin species. Dolphin behaviours observed during observation were avoidance, spy-hopping, and hunting. The distance of dolphins observed ranged from 10 metres to 110 metres. Dolphins in the water area of JML 1 was found at 01.20 a.m. five dolphins (4 = adult; 1 = brood) of *Tursiops aduncus* species, at 02.34 a.m. three dolphins, adult of unidentified Dolphin species, at 03. 00 - 04.00 two dolphins, Adult of Dolphin un-identified. In comparison, at 04.30 a.m., dolphin species were classified as unidentified, with six dolphins (5 = adult and 1 = brood). The occurrences are detailed in Figure 3 and Appendix 1.

The results of sightings in the JML 1 area of the sighted cetaceans did not differ from the location in the mouth of Balikpapan Bay, where the dolphin species that appeared during the sighting were the *Tursiops aduncus* and some dolphins that enter in unidentified category. It did not find the dolphin's appearance during sightings at JML 1 until around 9–10 a.m. The recorded occurrence distance is focused on an area of 500 meters as the perimeter of the mitigation zone. The appearance of the dolphin during the primary and guide pilling process is different, so the boom of the pilling and guide process does not significantly affect the appearance of the dolphin.
The appearance dominance of dolphins in the JML 1 area before the lint installation process, the supremacy of their arrival was around 9.00 to 10.00 a.m. Sightings at night on 25th April 2021, into the early hours of 26th April 2021, found five Bottlenose dolphins. The night of 25th April 2021 until the early hours of 26th April 2021 will be when there will be no activities and announcements due to the pilling process. Based on the appearance pattern seen at the JML 1 site from April 18-26 (early morning), the team found a way of appearance dominated by the emergence period between 9.00 and 10.00 p.m. Apart from that time, as in Figure 3, on 1st May, it occurred for around one hour at 0.45-1.35 hours. Dolphin’s behaviour five dolphins were shown as their health description (the pilling process was not affected) in the JML 1 area pilling project. The dolphin’s behaviour was feeding, avoidance, and spy hopping.

The sighting dominance of the *Tursiops aduncus* in JML 1 and WPS 3 areas was in line with the study by [17] that recorded sightings between April 2013 and September 2014 in Balikpapan Bay waters found ten species of dolphins. The results also explained that an MMO made the other four sightings from the Haibao during seismic operation, with a *Tursiops aduncus* recorded after the shooting was completed. Research by [18] describes some dolphines detected in Kilauni Bay waters were *Tursiops truncatus* and *Stenella longirostris*. The bottlenose dolphin is a relatively high-frequency species in November and April-March. Distribution it is usually found within 500 meters of the coast, sometimes offshore near rocks (edges) where prey can be more abundant [19]. Bottlenose dolphins (*Tursiops truncatus*), which comprise the larger group, are part of the hunting strategy because their food source breaks up into fish in the open water. The feeding habits consist various sizes and cephalopods like octopuses and squid [21,21].

**Fig. 3. Dolphin sighting around Barge EN 3000 in JML 1 area**
Cetacean visual sightings result in the Barge EN 3000 moving from JML 1 to WPN 4. Visual sighting started on 1 May 2021 when the Barge EN 3000 moved out. The team visualised Deck D and Deck E to get a good position and viewpoint—visual sighting during the WPN 4 site used from 2nd to 14th May 2021. The result during observation explains two types, such as *Stenella longirostris* and dolphin unidentified. The *Stenella longirostris* was found from 10.06 to 11.00 in the morning and from 09.30 to 10.00 in the evening; therefore, the dolphin was unidentified at 4.16 p.m. and 5.07 p.m. The behaviour during the sighting was avoidance, spy hopping, and feeding. Another behaviour found was going somewhere. They dive together and then sight and obtain on surface waters. They looked like they were tracking down the fish schooling, and the behaviour activities were looking for fish because fish were schooling around their location.

During visual sighting from JML 1 to WPN 4, found 3 (three) dolphins with the dolphin un-identified at 5.07 p.m. Their behaviour of them was avoidance and spy hopping. The sighting run away from Barge EN 3000 was ± 305 meters. Temporal distribution of cetaceans on 2nd until 14th May 2021 at WPN 4 on Barge EN 3000 area found two species of dolphins: *Stenella longirostris* and dolphin un-identified. During the visual sighting, WPN 4 is not a migration area of dolphins because the dolphins were sighting due to the outboard and fish schooling during the migrations from Balikpapan to Makassar Strait. The result of visual sighting is that installation and modification of GTS in WPN 4 developed can be a new food chain that presents fish schooling. The fish schooling can give an aggregate of cetaceans in the WPN 4 area. The condition benefits fish resources, but if the piling process loses ground of its time, it can affect sighting the cetacean. Sighting of cetaceans during WPN 4 is described in temporal distribution as long as 24 hours, as explained in Figure 4.

**Fig. 4.** Dolphin sighting around the Barge EN 3000 in the WPN 4 area

*WPS 3 Area*
The result of cetacean and turtle visual sightings since the Barge EN 3000 moves from WPN 4 to WPS 3. Whereas starting visual sighting was on 18th to 29th May 2021 since the Barge EN 3000 moved out, the team visualised Deck D and Deck E to get a good position and viewpoint. The cetacean voice was recorded on Deck B every 1 or 2 hours with a sample of 15 minutes. It worked to a visual sighting during the WPS 3 area on 19th - 29th May 2021. The dolphin species found during the WPS 3 area was *Tursiops truncates*. Domination of their behaviour was feeding. The result during observation is explained as follows in Fig. 5.

Found the result observation of cetacean sighting two times dolphin sighting in the WPS 3. The dolphin sighting was *Tursiops truncatus*. The cetacean sightings dominated the night day. During cetacean, the sighting was different with piling process time. All sightings of a cetacean from dolphins can be seen on the sheet data collected above.

The *Tursiops aduncus* species dominated the occurrence in the WPN 4 region, and *Stenella longirostris* was also found with a time dominance. The research results of Kreb & Budiono (2015) in the waters of the Derawan Islands in the waters of East Kalimantan showed that *Stenella longirostris* was generally found more often (1.4 to 2.2 fish/km) because of the relatively large group size and more commonly found. The research results by [22] explained that the appearance distribution of *Stenella longirostris* was the highest species found around Savu Sea, East Nusa Tenggara. Thus has an extensive circulation which covers almost all tropical and subtropical waters, as well as the tropical Atlantic ocean, Pacific and Indian Oceans. Found the location of the spinner dolphin in the end of year especially in November month in the Sumba Southeast waters, Kupang Regency, around Rote Ndao Regency. He added that he found the November apparition in the waters of East Sumba waters region, West Sumba waters, Sumba especially on southwest side and around Central Sumba Regency waters. It was a specific location near mainland Sumba region.

![Dolphin sighting around the Barge EN 3000 in WPS 3](image)

Fig. 5. Dolphin sighting around the Barge EN 3000 in WPS 3

The composition of the behaviour found during the observation was dominated by the feeding, hanging and species types. According to [23], the appearance of dolphins was believed to be related to eating activities generally performed in the morning to noon. This was evidenced by the feeding activity of the dolphin's appearance, which was generally
carried out in the morning and evening. Research by [24] showed that aerial action establishes boundaries before hunting. Dolphins use antennae to jump directly to groups of prey on the water's surface for easy capture and to attract attention and communication [25].

The dolphins sighted in different areas, both JML 1, WPN 4 and WPS 3, were not found on average when Barge EN 3000 arrived at the site, but when Barge EN 3000 was inactive for more than three days. It was probably because, during the work preparation, the lamps at night affected fish schooling. It was suspected that dolphins in the Barge EN 3000 area, both JML 1, WPN 4 and WPS 3, is due to food for the dolphins. These conditions were thought to be the nature of animals, where they will come when there is food. One species of dolphin with a close relationship with the fish resources in coastal areas is the *Tursiops truncatus* species. According to [26,27] and [31], bottlenose dolphins were the primary species that interact with the fisheries. Bottlenose dolphin shrinkage mainly affects gillnets and trammel nets, with associated general economy impacts which if closely evaluated may be modest even in areas of intense local conflict [29,30]. But with a few exceptions [31].

**Dolphin sighting distribution**

The distribution of dolphin appearance at three project sites resulted in a diverse pattern of appearance times. In the JML area, the distribution of dolphin occurrence in the number of the same species, such as *Stenella longirostris* and Dolphin un-identified category, is at the time of Evening - Morning and early morning - afternoon. The occurrence of *Tursiops truncates* in the WPS 3 area forms 2-time groups, namely morning and afternoon and the next group with similar dolphin occurrence. Dolphin occurrence in the WPN 4 area was only found by 2-time groups, namely evening and early morning. Each group site area is shown in Figure 6.

Sighting distribution each time that produces 5 group distributions of dolphin occurrence can summarize dolphin time fluctuations that will be approached in the pilling process area. Based on Figure 6 in the JML 1 area, the time range allowed to carry out the pipe piling process is at night, with a specific time able to be seen in the time series for 24 hours of the appearance of dolphins. While in the WPN 4 area, the time that may not carry out the offshore pipe pilling process is evening and early morning. In the WPS 3 area, the time of concern, if the pipe pilling process will be carried out, is in the evening.

The dolphin distribution grouped into five groups based on the division of time for 24 hours is one effort to avoid risks if, during the pipe-pilling process, dolphins are found passing or in the depths of the waters around the project site. The known emergence time series can mitigate the implementation of offshore piling projects for the safety of marine mammal resources. In Indonesian waters, marine mammals, especially dolphin species, often appear in coastal. [22]. This makes them particularly susceptible to harmful conditions influenced by a variety of contributing factors such as sudden and startling noises such as blows during pipeline placement and or oil and gas pipeline stacking, noxious materials, food supply lack, and either direct or indirect natural exploitation of resources such as shipping traffic and wildlife commercial activities. These contributing factors may be responsible for dolphin presence and fisheries issues.
Fig. 6. Distribution of dolphin sightings based on four groups of times (early morning, morning, afternoon, evening and night)

4 Conclusion

Cetacean compositions of sighting in sites (JML 1, WPN 4 and WPS 3) were *Tursiops aduncus*, *Stenella longirostris* and unidentified dolphin. The highest appearance was 12 dolphins, namely *Stenella longirostris*, in the JML 1 area. In the WPN 4 area, the *Stenella longirostris* sighting and dolphins were unidentified twice. WPN 4 area is not a migration area of dolphins because the dolphins were sighted due to the outboard and fish schooling during the migrations from Balikpapan to Makassar Strait. They expected the sighting at WPS 3 from the Barge EN 3000, which was passive for more than five days. Statically, Barge EN 3000 for more than five days can become FADs for fish communities and fish schooling. It can be dolphins and turtles around the EN 3000 Barge. In these activities of the piling process, we would like to suggest the piling process, which produces a high voice on surface waters. It is pleasing to use “early warning”. The early warning is before the usual process of trashing the pile, and we hope the worker could do three times trashing, namely: 1st: Low thrashing and that “pause 60 seconds”; 2nd: Medium trashing and that “pause 60 seconds”; and 3rd: Maximum trashing, continued pilling process.

This research is part of the team's work as MMO and PAM experts in Project Engineering, Procurement, Supply, Construction and Commissioning Contracts for North Sisi, North Nubi and Jumelai Project activities. The authors want to thank PT Pertamina Hulu Mahakam, PT MEINDO Elong Indah, PT Krotogeo, and PT Eka Nusantara 3000. The authors also thank...
the crew of Barge EN 3000 for all their hospitality and good cooperation while the team worked as cetacean experts.

References

3. JNCC [Joint Nature Conservation Committee ]. Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise. 2010. (Marine Advice, Inverdee House: United Kingdom), 13
12. Donna M M. Research in educational evaluation and psychology; integrating diversity with quantitative, qualitative, and mixed methods. 2010. Publisher: Sage. (UK), 405

Appendix 1. The dominance of dolphin sighting, which was caught on camera.
**Tursiops aduncus**

Un-identified dolphin

**Tursiops aduncus**

**Tursiops aduncus**