Waterbirds roosting on gas drilling platforms in Mahakam Delta, East Kalimantan: the Unexpected Impact of Landscape Transformation

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Abstract. Since 2014 some offshore gas platforms operated by Pertamina Hulu Mahakam near Mahakam Delta has been used by hundreds of egrets as roosting sites, causing nuisance to the platform and hampering the duty of workers/operator. The objective of this paper was to analyse the situation of the waterbirds’ nuisance, analyse the possible causes, and provide some recommendations. Field visits were conducted in August 2019 and February 2020 to three unmanned platforms (Ax, D, C) that suffered the most from the bird roost. Birds that infested the platforms were identified as great egret and intermediate egret, both are very similar in appearance and ecological requirements. The maximum number of egrets visiting C-Platform (the worst platforms) was 671 birds. These birds roost at night in the platform and leave the platform in the morning to forage for fish, eel, and shrimps in the wetlands of Mahakam Delta, about 2-4 km from the platform. The root cause of the infestation was believed to be the landscape transformation in the Mahakam Delta. Mangrove forest has been diminished and heavily converted into shrimp-ponds. The egrets’ foraging areas became ubiquitous, while the roosting/nesting site greatly decreased, forcing the egrets to roost on gas platforms. In the short-medium term, platforms need to be managed as bird tolerated-zone and bird-free zone (using deterrent), while in the long term, land-use in Delta Mahakam need to be restored.

Keywords: egrets, mangrove, Nypa, Pertamina Hulu Mahakam, wetlands

1. Introduction

Seabirds that used offshore rigs for roosting has been reported in some sites outside Indonesia, for example in Bering Sea \cite{1}, North Sea \cite{2} and North-west Atlantic \cite{3}. However, published report on non-marine birds roosting on rigs could not be found. In Indonesia there has been no scientific report related to birds (both seabirds or non-seabirds) that use offshore rigs as part of their habitat.

Offshore rigs (or categorized as ‘swamp rigs’) managed by Pertamina Hulu Mahakam (PHM) in the eastern side of Mahakam Delta in West Kalimantan (Indonesia) has been reported being used by many birds - suspected to be egrets - for roosting. PHM is a subsidiary of Pertamina, a state-owned oil and gas company. PHM operates several gas and oil platforms in the Mahakam Delta areas.

Egrets that have been roosting on the gas platform was noted by the PHM Management since early 2014. The birds were considered nuisance to the PHM Management due to various reasons. The accumulation of egrets’ faeces on the platform could cause damage to the sensitive apparatus. Fallen feathers and regurgitated food (shrimp, fishes, eels, other macroinvertebrates) might clogged the sewer. For the workers (operators) who occasionally...
need to inspect the platform, the faeces would be slippery when raining and might impacted the safety of the workers. There was also a health concern that might linked to the decomposition of faeces and regurgitated food, although there has been no previous report about human disease due to microorganism in bird’s faeces.

There has been no scientific report on birds that use gas or oil rigs in Indonesia. The phenomena of egrets roost on human-made gas platform is quite unique and need to be observed on a scientific basis. The objective of this study was to document the occurrence of the birds nesting on gas drilling platform, to analyse the situation, and discovered the possible causes.

2. Methods
The study area was located in the Mahakam Delta in East Kalimantan, Indonesia, specifically on and surrounding offshore gas platforms (Ax, D, and C), managed by PHM, located about 1.7km from the nearest mainland (Figure 1). Population and the daily habit of egrets as nuisance were examined on or near the gas platforms. Bird species that have been roosting in the gas platforms were directly observed. Counting was conducted only to C-Platform, which has been suffered the most from bird nuisance. C-Platform was an unmanned small platform, consisted of a two-deck main platform and two trunklines that branched out from the main platform.

Bird population was estimated by counting all birds (i.e. census) when the birds flying from the mainland to the gas platforms in the evening (5:30-7pm, 5-min interval). The three-day counting was conducted by four observers (two pairs), taken from a boat or the tip of the gas platforms without disturbing the birds’ flight behavior and flight path. Each pair of observers counted birds in different directions, avoiding sight overlap. Bird species was identified during flight, based on morphological character and size. Binoculars (Nikon Action EX; 8x40) were used to improve sighting of bird flight and when roosting on the platform. Visit during the night when birds were roosting was prohibited, following standard operational procedure and due to security reason. Morning count when the birds leave the Platform was not conducted due to technical reason.

Habitat components were also analyzed, both for feeding sites in the mainland of Mahakam Delta and roosting sites on the gas platforms. For birds’ feeding sites, the habitat components were analyzed based on several boat trips to the Mahakam Delta to overview the condition of the nearby feeding sites. The available land-use map was also studied to aid interpretation about landscape transformation that has been going on in the Mahakam Delta.

Habitat components of the gas platforms were analyzed based on visits to three gas platforms that suffered the most from bird nuisance, during the day when the birds were not present on the gas platforms. The analysis included identification of specific sites and constructions used for bird roosting. Land-use type surrounding the C-Platform was analyzed from Google Earth map, within 5-km radius, as the main potential foraging sites. A larger foraging areas in the mainland was analyzed based on the available maps and published papers related to the land use system in the terrestrial areas of Mahakam Delta. Interviews with PHM Management Team, mainly to the Health, Safety & Environment Division, were also conducted to provide a clearer understanding about the situation. Some necessary recommendations were generated from the analysis.
Figure 1  Google Earth map of the gas platforms as the study sites at the east side of the Mahakam Delta, East Kalimantan (left; circle denoted 5-km radius from C-Platform), and C-Platform as the main focus of the study (right).

3. Results

3.1. Daily habit and population of egrets roosting on C-Platform
The birds arrived from the mainland to the C-Platform in late evening, spent the night on the platform, and leave the platform very early in the morning, before the sun rise. The peak of arrival time occurred on 6:45pm during the observation days. The bird species were most probably consisted of two species, namely great egret (Egretta/Areda alba) and intermediate egret (Egretta intermedia). During the flight, these species mixed together and difficult to distinguished one and another.

The maximum number of bird count was 671 individuals, occurred in day two (Figure 2). Underestimated bias might still happen due the poor lighting during the end of the census period (7pm). There was a dim light at the top of the platform, which could navigate some late comers, if any. However, the number of uncounted birds was considered low, judging based on the trend of the timing of the birds’ arrival. Birds selected the central part of the platform first (mainly the top part of the large piping), or trunk lines. Hand railings (on the main decks and along walkways) as well as small piping also were used intensively. They seemed to keep distance to each other on their perched spot, and some fighting over a specific perch site might happen.
Figure 2 Estimation of the number of egrets that use C-Platform as roosting site during the night, presented in 5-min interval; average egret population was 603 birds

3.2. Analysis of habitat components in the mainland and gas platforms
Observation during bird arrival in the evening showed that the C-Platform (as well as other platforms in the nearby area) were able to provide a roosting site for the birds, due to the abundant availability of piping, railing, and other human-made construction for perching. Other factors might also contributed, including short distance to the mainland and the lack of roosting site on the mainland of Mahakam Delta (Table 1).

Land-use type within the 5-km radius from the C-Platform was confirmed to be dominated by shrimp ponds (Table 2). Visit to the surrounding areas in the Mahakam Delta by a boat showed that there was almost no mangrove tree left due to the intensive clearing for the shrimp pond. Nypa palm (Nypa fruticans) was still can be found in a narrow strip along the water periphery. The shrimp pond was managed in a non-intensive operation and almost all shrimp ponds were unattended. Land-use map in the larger area of the Mahakam Delta confirmed that most of the delta region has already converted into vast areas of shrimp ponds (Figure 3).
### Table 1  Habitat component analysis of the mainland and C-Platform

| Sites                                      | Advantages for Birds                                                                 | Limiting Factor for Birds                                                                 |
|--------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| **Mainland** as feeding sites for birds during the day | • Vast feeding/foraging areas  
• Abundant of food from shrimp/fish ponds (shrimps, eels, fishes, other invertebrates)  
• Relatively safe from anthropogenic disturbances  
• Sufficient cover from climatic factors (heat, rain) during the day | • Lack of perching/roosting site for resting during the nights (i.e. trees to perch)  
• Lack of breeding sites during breeding season (i.e. trees to lay nests and eggs) |
| **Gas platforms** as perching/roosting sites for birds during the night | • Availability of the various constructions (e.g. hand-railing, piping, trunk lines) that resembled perching sites  
• The occurrence of the deck construction that resembled tree canopy layers  
• Short distance from the mainland to the offshore gas platforms  
• Warm temperature during the night  
• Provide protection from the strong sea wind and rain  
• Safe from anthropogenic disturbance | • Un-natural; human-made; (could be not a limiting factor because egrets apparently were able to adapt to this condition)  
• Lack of breeding sites during breeding season (i.e. construction resembled trees to lay nests and eggs) |

### Table 2  Land-use type within the radius of 5km from C-Platform

| Landscape type | Land-use type | Area (ha) | Percentage To the total area | Percentage To land area |
|----------------|---------------|-----------|------------------------------|-------------------------|
| **Marine area** | Sea           | 4886.14   | 62.02                        | -                       |
|                | Estuary       | 0.00      | 0.00                         | -                       |
|                | Tidal area    | 1850.55   | 23.58                        | -                       |
| **Land area**  | Shrimp pond   | 751.03    | 9.57                         | 66.48                   |
|                | Vegetated area| 357.74    | 4.56                         | 31.66                   |
|                | Housing       | 21.00     | 0.27                         | 1.86                    |
4. Discussion

Food, water and cover are known to be habitat components for wildlife [4]. For egrets, cover consists of sheltered area during the day (trees are the best), trees to roost during the night, as well as trees for breeding (i.e. to lay eggs and to care of chicks). In Pulau Rambut Wildlife Reserve, a small island in the Jakarta Bay area, about 3 km off the coast [5], egrets also behave similar to birds that roosting on the PHM’s gas platform. In the late afternoon, the egrets flew back to the island to roost, and then leave the island to the mainland of Java early morning to forage for food. The wildlife reserve is a natural island, and mangroves as roosting and nesting habitat was available.

Landscape transformation in the Mahakam Delta surely has a major impact on wildlife that inhabit and depend on the landscape. The landscape of Mahakam Delta that used to be covered by mangrove has been transformed into shrimp ponds. Analysis of mangrove deforestation in the Mahakam Delta by using high fidelity images [6] suggested that a total of 21,000 ha of mangrove land had been converted to shrimp ponds during 2000-2010. The deforested lands increased sharply, from 47% in 200 to 75% in 2010.

Shrimp ponds are excellent for egrets as feeding or foraging areas. A study on South Kalimantan [7] suggested that the food of egrets were fish, frogs, crabs, molluscs, mud worms, and other shallow-water vertebrates and invertebrates. With the vast expansion of the shrimp pond in the Mahakam Delta to replace mangroves, food for the egrets were abundant. In addition, visit to the surrounding areas has confirmed that the shrimp-ponds
were mostly unattended by the fishermen during the day, creating a more convenient condition for the egrets to forage for food.

Mangroves are needed by egrets for roosting and breeding. This bird species, however, has been known to be very adaptive and even able to roost and breed successfully on non-mangrove trees, for example Melaleuca leucadenron and Acacia mangium, as reported occurred in the industrial area in West Java [8]. Nypa palm that was still scattered in the study area was not appropriate for roosting sites due to the absence of perching sites. Unfortunately, there has been no report on the breeding sites of the egrets or other waterbirds nearby.

The lack (and almost absent) of mangroves eventually drove the egrets to discover alternative roosting sites near the foraging areas. The alternative sites that was the gas platforms, located offshore, within a flight distance from the land. Study on egret’s flight in the USA [9] had showed that the round-trip flight distances of egrets averaged 16.1±3.2 km (range 6-49 km). Furthermore, the optimum foraging distance were less than 1 km distance [10]. As the closest distance from C-Platform to the nearest mainland was 1.7km, basically most of the foraging areas in the Delta Mahakam were within the reach to the egrets, although not within the optimum flight range.

Flight velocities of the egrets in the USA was known to be 10.8-14.1 m/sec (Maccarone et al. 2012), and thus it will take about 5min for the egrets to fly from the C-Platform to the nearest shore. Under strong sea wind, the flight trip might take longer, but still manageable by the egrets.

5. Conclusion and Recommendation
Wildlife species can easily react when landscape was transformed or has been transforming into other land-use types. Although bio-ecological knowledge has been greatly gathered and expanded, some impact of the landscape transformation on a certain species is less predictable and could be unexpected. The fact that the platform has been used by egrets was unexpected and was not foreseen beforehand. The case of egrets roosting on gas platforms could happened because the birds’ natural habitat was not able to provide necessary components for their survival due to landscape transformation. The ultimate cause of this unfortunate event was the landscape change in the egrets’ foraging habitat.

Restoring the current habitat into its original mangrove-dominated habitat is the best solution. However, this solution is very difficult to be implemented, due to the already complicated land ownerships of various stakeholders and local communities, and thus require a long-plan collaboration of multi-stakeholders. While waiting to implement the long-term plan, platforms need to be managed as a bird friendly roosting sites. Some less-sensitive parts of the platform can be manage as a ‘bird tolerated-zone’, while other are managed as a ‘bird-free zone’ by using appropriate deterrent.

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