Rapid Biophysical Socio-economic and Health Impact Assessment of Oil Spill Incident in Pola and Calapan, Oriental Mindoro, Philippines

Biophysical Assessment Report

Introduction

The MT Princess Empress sank off the coast of Naujan, Oriental Mindoro Province of the Philippines last February 28, 2023. It carried 900,000 liters [L] of industrial fuel oil (Rita, 2023), which is strongly toxic to the environment (de Leon, 2023). This resulted in the massive oil spill affecting Oriental Mindoro and neighboring provinces such as Palawan (UP Marine Science Institute, 2023), Antique (Ramirez and Rendon, 2023), and Batangas. Since the sinking, the oil spill has impacted the marine ecology, livelihood, and even the health of the inhabitants. As of April 21, early 200,000 individuals (41,000 families) have been affected, 75% of which are from MIMAROPA Region (political region composed of provinces of Mindoro, Marinduque, Romblon, and Palawan) (NDRRMC, 2023 cited from Mangaluz, 2023b).

The recent oil spill is considered as one of the worst oil spills in the country. This is to consider its extent, which includes the biodiversity hotspot Verde Island Passage, considered as the center of the center of marine shore fish biodiversity (Carpenter & Springer, 2005). It has been reported that the oil spill affected seaweed farming in Antique (Lena, 2023) and 21 locally-managed marine protected areas (MPAs) in Oriental Mindoro (Mangaluz, 2023a). Earlier photos of oil spill-impacted areas showed mangroves and marine animals covered with oil. Chemical analysis by BFAR showed low levels of polycyclic aromatic hydrocarbons (PAHs) in fish and water samples collected last March 9 and 10, 2023. These environmental damages caused by the oil spill based on the combined extent of mangroves, seagrasses, and corals in the area may cost up to least 7 billion Philippine Pesos [PHP] (125.6 million USD) as of April

27 (DENR, 2023, cited from Cabico, 2023). With the potential health hazards posed by the inhalation and ingestion of oil spill (Aguilera et al., 2010), the Bureau of Fisheries and Aquatic Resources (BFAR) thus implemented a fishing ban on the affected municipalities in Oriental Mindoro (BFAR, 2023a, 2023b).

Despite initial reports from BFAR and the Department of Environment and Natural Resources (DENR), a comprehensive study on the impacts of the oil spill on marine ecosystems and communities is still lacking. Since diving is still not allowed, assessment of seagrass and coral reef ecosystems is not possible. Additionally, not much is known about the experiences of affected residents when the oil spill happened. Therefore, this study aims to provide an immediate qualitative assessment in impacted areas of Oriental Mindoro. The results of this preliminary assessment can be used to promote awareness of the severity of the problem to the local government units (LGUs). It can also provide policymakers with valuable and timely insight for them to tailor their solutions to the situation, including continuous monitoring. Lastly, it can provide future researchers with baseline data to further investigate the effects of the oil spill and assess the effectiveness of the interventions implemented in the future.

Methodology

This study was conducted last April 1 to 3, 2023 using a mixed methods approach in gathering data which include an ocular inspection of coastal ecosystems, key informant interviews (KIIs), focused group discussions (FGDs), and other secondary data obtained from the LGUs. Ocular inspection includes taking photos of affected and unaffected water bodies, mangrove parts, fish, marine invertebrates, sand, rocks, and artificial surfaces such as boats.

Two municipalities in Oriental Mindoro were considered as the study sites: Pola and Calapan (Figure 1). Due to logistical limitations, only two municipalities were chosen as study sites based on the time it took for the oil spill to reach their shores. Pola is a 3rd class municipality with 23 barangays (smallest local government unit, abbreviated as Brgy.), two of which were selected study sites: Brgy. Misong and Brgy. Tagumpay. It was one of the first municipalities to be hit by the oil spill, with oil slicks arriving a few days after the oil tanker sank. A total of 170 responses were gathered in Pola: 83 from Brgy. Misong and 87 Brgy. Tagumpay. Calapan City is a 3rd class component city and the capital of the province. Oil slicks started to appear about two weeks after the oil tanker sank (Virola, 2023). Four barangays were investigated in Calapan: Brgy. Navotas, Brgy. Silonay, Brgy. Lazareto, and Brgy. Madiang. A total of 176 responses across the coastal barangays were obtained: 53 from Navotas, 23 from Maidlang, 51 from Silonay, and 49 Lazareto were obtained.

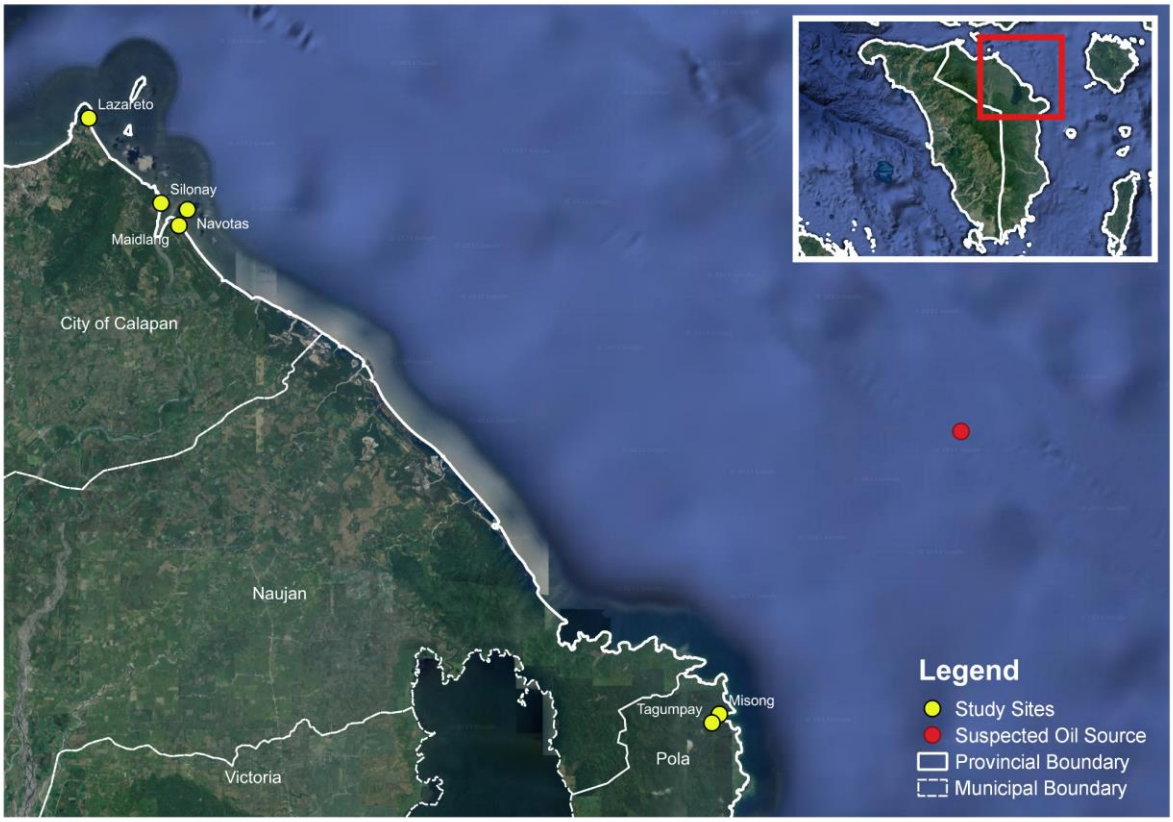


Figure 1. Study sites showing relative distance from the site where the MT Princes Empress sank off the coast of Naujan, Oriental Mindoro.

Results and Discussion

Before the Oil Spill

Prior to the oil spill, fisherfolk in Brgy. Misong and Tagumpay in the town of Pola, and in Brgy. Lazareto, Silonay, Navotas and Maidlang in Calapan City engage in finfish and invertebrate fisheries. Based on data from the PSA, the top five fishery commodities in the municipal fisheries sector in Oriental Mindoro include *tulingan*, *alumahan*, *gulyasan*, *tamban* and *galunggong*. Other commercially important fishes commonly caught in Oriental Mindoro based on the interviews are listed in Table 1. These are caught using various types of fishing gears such as gill nets, troll lines, traps and spears. Meanwhile, invertebrate fisheries include capture of invertebrates using nets and traps or invertebrate gleaning (*paninihi*) in the intertidal zone during low tide. Among the common invertebrates captured include *banagan, lukan, sikad, liswek, sahang, alimasag, pusit, pugita, hipon,* and *balatan*.

Table 1. List of commonly caught fishes and invertebrates in Calapan and Pola, Oriental Mindoro.

Fish		Invertebrates	
Local Name	**English Name**	**Local Name**	**English Name**
Tulingan	Mackerel tuna	*Banagan*	Lobster
Alumahan	Indian mackerel	*Sikad*	Black-lipped conch
Gulyasan	Skipjack tuna	*Liswek*	Strawberry conch
Tamban	Sardines	*Sahang*	Spider conch
Galunggong	Round scad	*Alimasag*	Blue swimming crab
Tambakol	Yellowfin tuna	*Pusit*	Squid
Maya-may	Red snapper	*Pugita*	Octopus
Tanigue	Spanish mackerel	*Hipon*	Shrimp
Lapu-lapu	Grouper	*Balatan*	Sea cucumber
Samaral	Rabbitfish	*Lukan*	Mud clam
Banak	Sea mullet		
Bisugo	Threadfish bream		
Parrotfish	Parrotfish		
Matambaka	Bigeye scad		
Hasa-hasa	Short mackerel		
Dalagang bukid	Fusilier		
Talakitok	Trevally		
Dorado	Dolphinfish		
Dumpilas	Goatfish		
Tingin	Bigeye fish		

The high fisheries productivity in Oriental Mindoro can be attributed to the existence of several marine protected areas (MPA) that serve as fish nursery grounds across the province. In total, there are 34 MPAs in the entire province, with a total area of 3,105.45 hectares. Among the two study sites, Calapan City has two MPAs, one each in Brgy. Lazareto and Silonay, while Pola has seven MPAs as shown in the map below (Figure 2). Prior to the oil spill, fisherfolk and coastal residents in both Calapan and Pola have been instrumental in maintaining and managing the said MPAs.

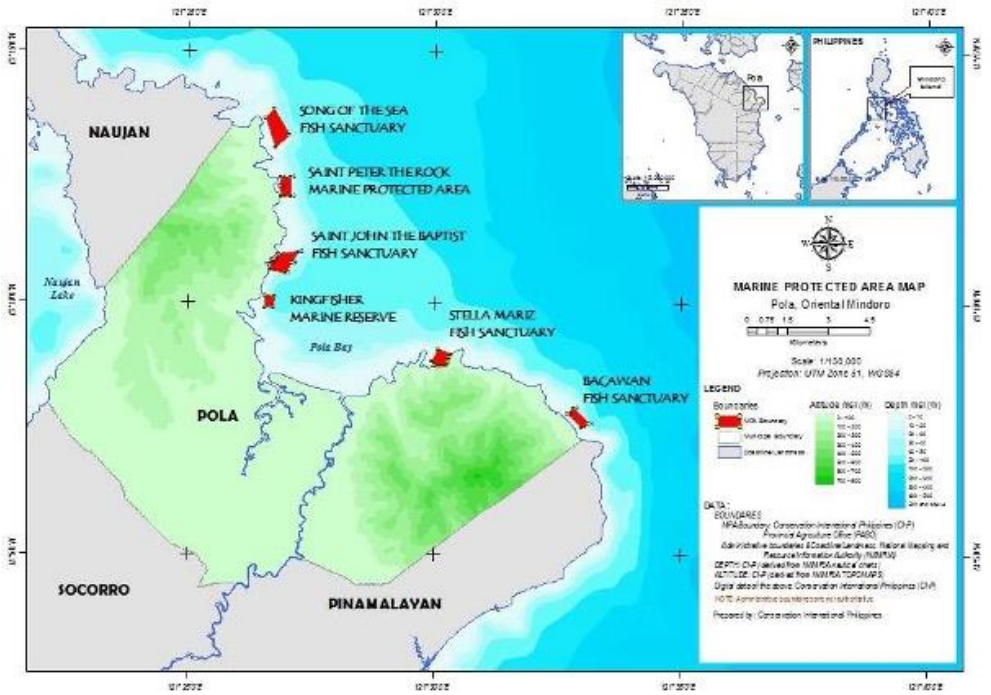
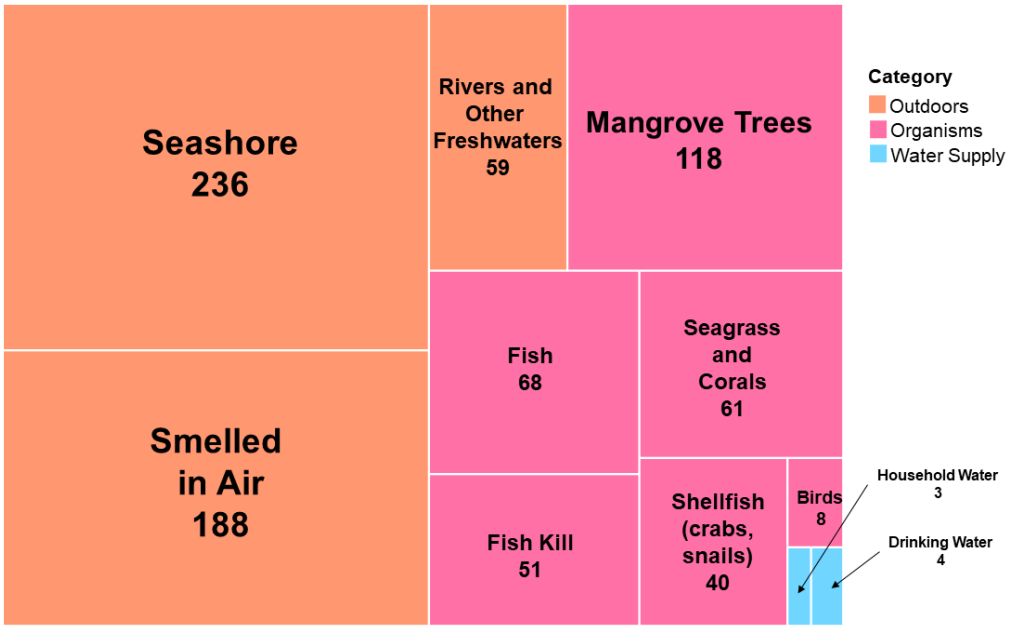


Figure 2. Map showing the location of marine protected areas (MPAs) in Pola, Oriental Mindoro. Source: [Oriental Mindoro (adoptmpa.ph)]

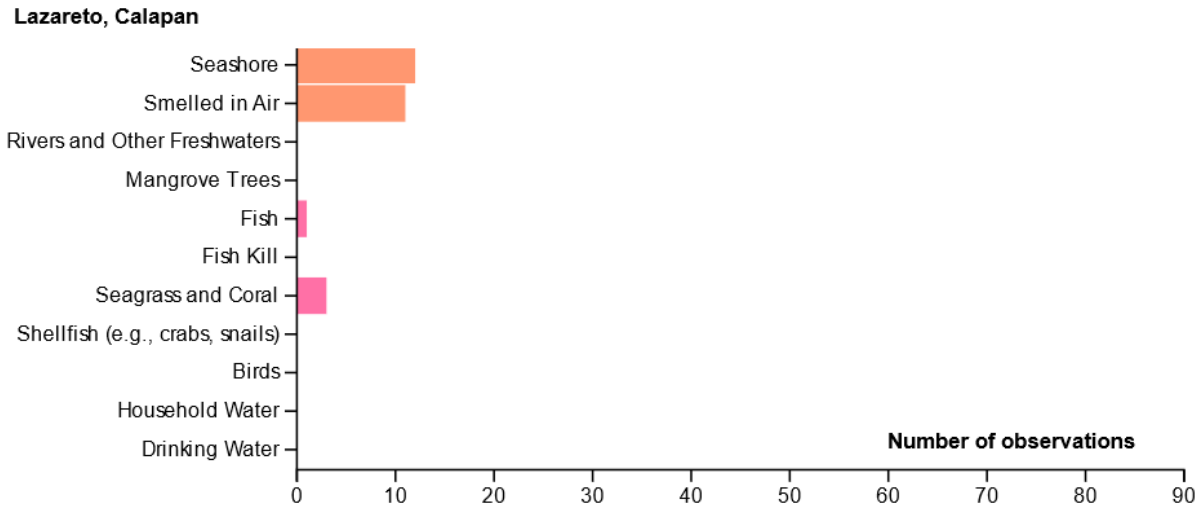
After the Oil Spill

After the MT Princess Empress sank on February 28, it took three days before the oil reached Pola, and two weeks before it reached Calapan. Figure 3 shows the number of respondents who reported fish kills, oil in various locations including the air, coasts, freshwater, mangroves, birds, fishes, seagrasses, corals, shellfish, tap water, and drinking water, as well as instances of fish kill and oil odor. Across all barangays, the majority of residents observed oil along the shore (236 out of 346). More than half smelled evaporating oil in the air (n=188). A considerable number of residents also observed oil in mangroves (n=118), fish (n=68), seagrass and corals (n=61), freshwater bodies (n=59), fish kill (n=51), shellfish (n=40), birds (n=8), drinking water (n=4), and household water (n=3). Between the towns, a higher number of residents observed oil affecting marine ecosystems and organisms in Pola than in Calapan.

(a)

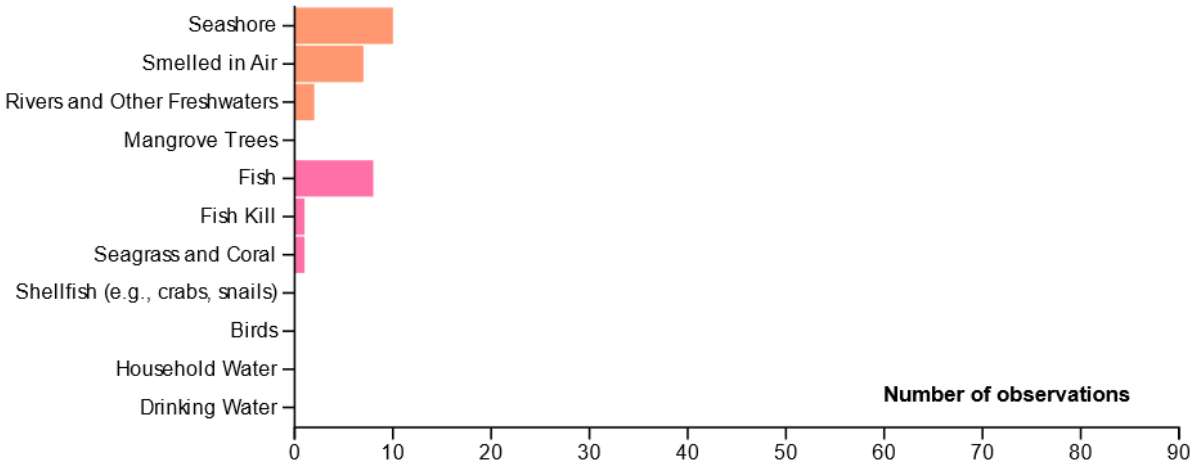

Seashore
236
Rivers and Other Freshwaters
59
Mangrove Trees
118
Fish
68
Seagrass and Corals
61
Smelled in Air
188
Fish Kill
51
Shellfish (crabs, snails)
40
Birds
8
Household Water
3
Drinking Water
4
Category
Outdoors
Organisms
Water Supply

(b)


Lazareto, Calapan
Seashore
Smelled in Air
Rivers and Other Freshwaters
Mangrove Trees
Fish
Fish Kill
Seagrass and Coral
Shellfish (e.g., crabs, snails)
Birds
Household Water
Drinking Water
Number of observations
0
10
20
30
40
50
60
70
80
90

(c)

Silonay, Calapan



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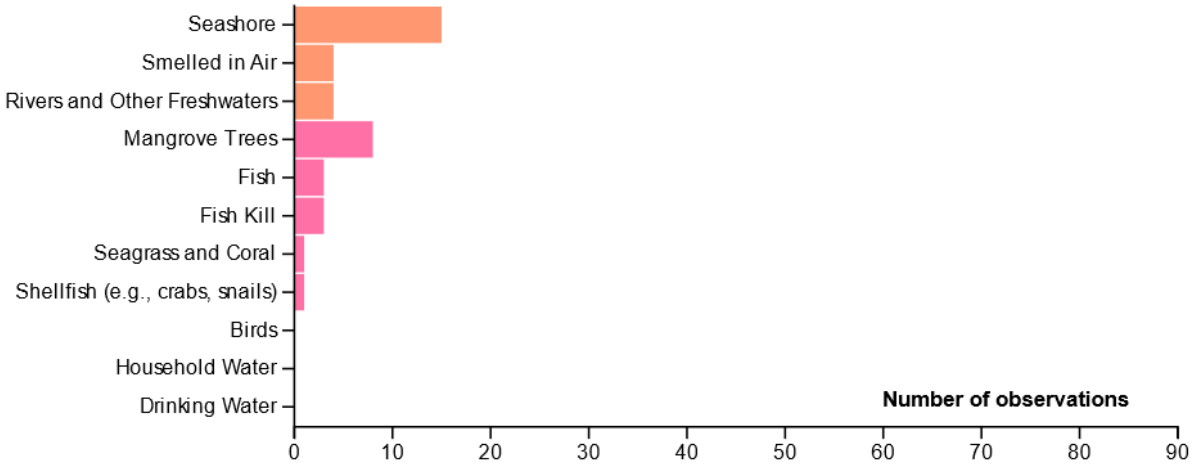
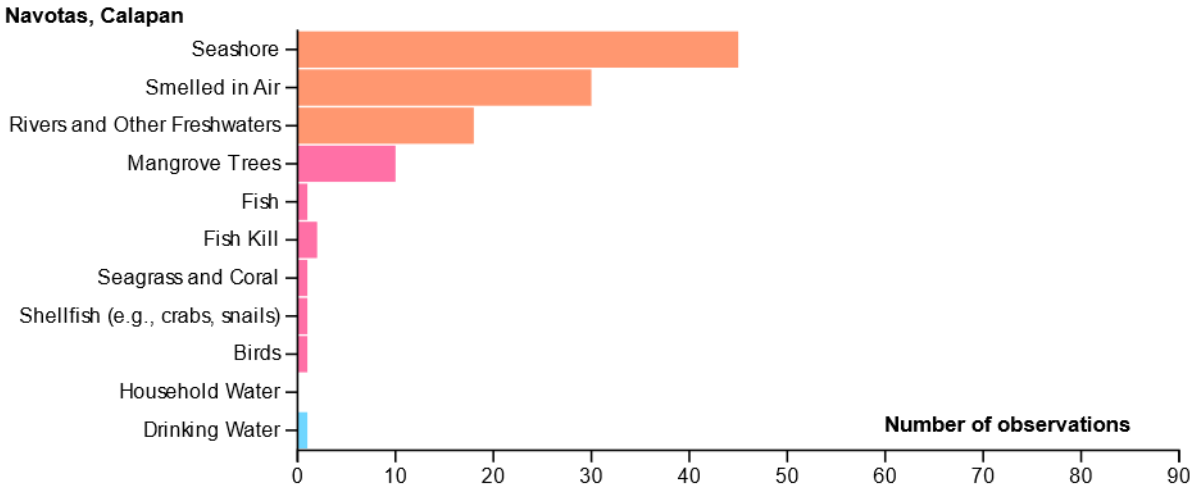
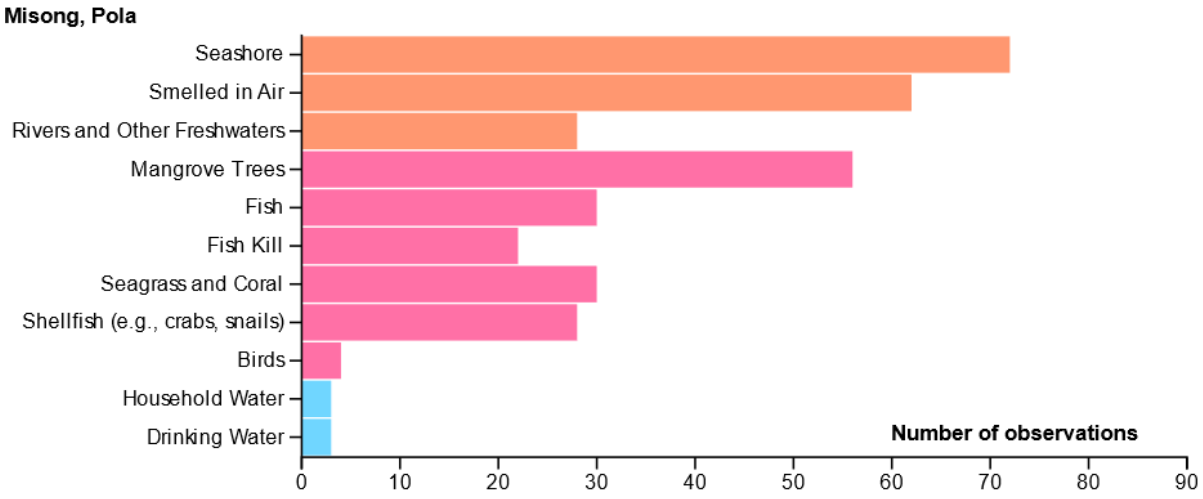
Maidlang, Calapan



(e)


Navotas, Calapan
Seashore
Smelled in Air
Rivers and Other Freshwaters
Mangrove Trees
Fish
Fish Kill
Seagrass and Coral
Shellfish (e.g., crabs, snails)
Birds
Household Water
Drinking Water
Number of observations
0
10
20
30
40
50
60
70
80
90

(f)


Misong, Pola
Seashore
Smelled in Air
Rivers and Other Freshwaters
Mangrove Trees
Fish
Fish Kill
Seagrass and Coral
Shellfish (e.g., crabs, snails)
Birds
Household Water
Drinking Water
Number of observations
0
10
20
30
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60
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80
90

(g)

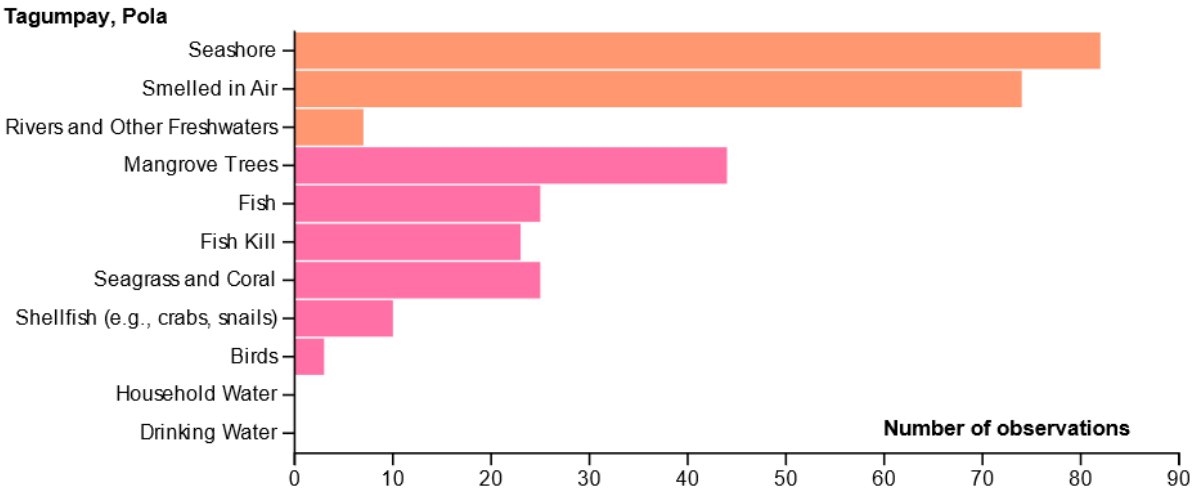

Figure 3. Total number of observations of occurrence of oil from respondents for *(a)* all visited sites shown in the tree map, and; *(b-g)* each visited barangay in Calapan and Pola, Oriental Mindoro shown in bar graphs. The tree map *(a)* and bar graphs *(b-g)* were generated using RAWGraphs (Mauri et al., 2017). "Fish kill" refers to observations involving *widespread* death of fish.

Pola

When the oil spill hit Brgy. Misong and Tagumpay on around March 1, residents immediately observed oil along the coast (Figure 4), at the mouth of the river, in mangroves, seagrass, corals, fish, shellfish and birds. They also smelled evaporating oil. Very few (three in Misong, none in Tagumpay) reported oil contamination in households and drinking water. Freshwater is typically obtained from the mountain, with pipes running throughout the community (Figure 5).

Figure 4. Initial oil spill response by residents of Brgy. Misong, Pola, Oriental Mindoro, with red arrows indicating oil slicks. Yellow arrows show residents holding pails used in the collection of oil. Photo credits to Mr. Dominador Conde, fisherfolk leader in Brgy. Misong.

Figure 5. There was no oil contamination in the freshwater used in the households since water comes directly from the mountain, with pipes (blue arrow) found throughout the community.

After a month since the oil spill happened, traces of oil can still be found in some areas of the coast of Pola, including mangrove ecosystems. Figures 6 and 7 show images of mangroves with traces of oil in their leaves and roots (prop roots and pneumatophores). Despite the presence of traces of oil on their leaves and roots, there was no observed mortality among mangroves in Brgy. Misong. Based on interviews, residents immediately responded as soon as oil arrived at their shores. They immediately conducted cleanup drives by collecting oil using pails and other vessels (Figure 4), even without personal protective equipment (PPEs). This immediate response prevented worse negative effects on coastal ecosystems. Figure 4 shows the actual response of the residents of Brgy. Misong, Pola on the day when the oil spill arrived. In Brgy. Tagumpay, several dead juvenile mangrove trees were found, although the cause of mortality is not certain. Traces of oil were also observed around these mangroves (Figure 8).

Figure 6. Oil-blackened mangrove leaves and roots (red arrows) in Brgy. Misong, Pola, Oriental Mindoro (N 13.21387°, E 121.43871°).

Figure 7. Oil-blackened mangrove leaves and pneumatophores (red arrows) in Brgy. Tagumpay, Pola, Oriental Mindoro (N 13.21070°, E 121.4359°).

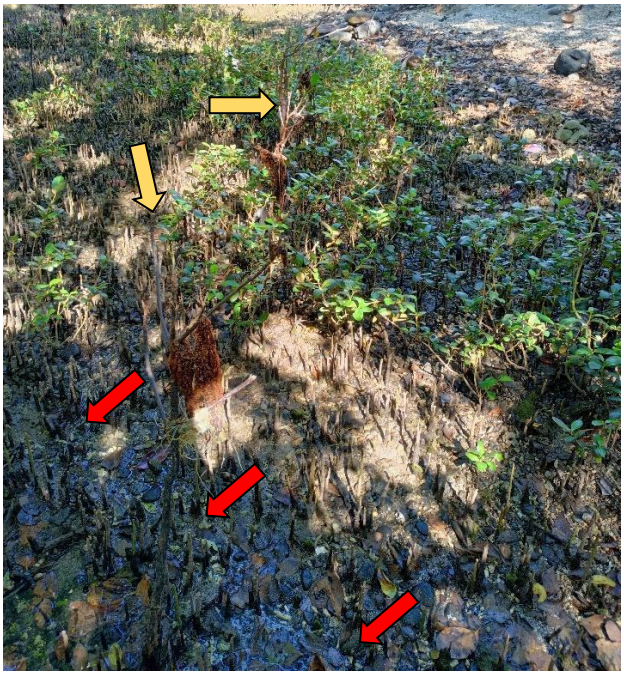

Figure 8. Dead mangrove trees (yellow arrows) in Brgy. Tagumpay (N 13.21070°, E 121.43593°). Traces of oil (red arrows) were observed around these mangroves.

Oil traces and tar balls (hardened oil) have also been observed to seep into the sand (Figure 9). Some benthic invertebrates (Figure 10) observed during the ocular visit include sea cucumbers, a polychaete, limpets, hermit crabs, nerite snails, and other unidentified mollusks.

Figure 9. Traces of oil and tar balls on sand and rocks (red arrows) in Brgy. Tagumpay (N 13.21070°, E 121.43593°).

Figure 10. Some benthic macroinvertebrates found during the ocular inspection include hermit crabs (Misong), sea cucumbers, a polychaete (marine worm) and a nerite snail (Tagumpay). Red arrows indicate traces of oil.

Calapan

Residents have varying anecdotes on when the oil spill arrived in Calapan, with oil first observed in coastal ecosystems as early as March 5 and 6 up to March 16. Oil was not observed in the freshwater used in the household for all barangays, except for one resident in Brgy. Navotas, although the source of the oil is unconfirmed.

During the ocular inspection across four coastal barangays in Calapan City, the research team found traces of oil in the water, sediment and animals. For example, traces of oil were observed surrounding some mangrove pneumatophores in the Silonay Mangrove Eco-Park, Brgy. Silonay (Figure 11). In Harka Piloto Island, a fish sanctuary in Brgy. Lazareto, traces of oil and tar balls were also observed in rocks along the shore (Figure 12). In mainland Lazareto, the presence of oil depots operated by Shell & Phoenix Petroleum in the area was noted. Local residents reported that Shell has an on-going construction of petroleum pipes coming from the yellow concrete structures located meters away from the shore to the Shell depot, thus it is also possible that this facility could be another potential source of oil spill in the area.

Figure 11. Mangrove pneumatophores with traces of oil in the surrounding water. Found in Brgy. Silonay, Calapan City (13’24’6’’ N 121’13’29’’E).

Figure 12. Tar balls (hardened oil) in rocks along the shores of Harko Piloto, Brgy. Lazareto, Calapan City. Red arrows indicate traces of oil.

In Brgy. Maidlang and Navotas, traces of oil were found in the water and sand (Figure 13), ranging from small to large sized tar balls. Particularly in Brgy. Maidlang, an ocular inspection was made on a nearby coast, where mangrove forests, benthic macroinvertebrates and some species of birds and fishes were found. According to the residents and key personnel from the Philippine Coast Guard (PCG), the installation of spill booms in Brgy. Maidlang and Navotas did not completely prevent the presence of oil spill along their coasts, but were helpful in minimizing adverse effects to local flora and fauna.

Figure 13. Traces of oil in the water and sand were also observed in the boundary of Brgy. Maidlang and Navotas, Calapan City. Tar balls found (indicated by red arrows) ranged from less than a centimeter to ~15 cm (N 13.3897°, E 121.2383).

Five species of mangrove were initially identified on the coast of Maidlang (Figure 14). Pagatpat (*Sonneratia sp.*) comprises the majority of the mangrove population in the area. Other mangrove species include two species of *Avicennia*, bakhaw babae (*Rhizophora sp.*) and Sasa (*Nypa fruticans*). Other tree species growing along the coast of Maidlang include *malabago, talisay, ipil-ipil* and *coconut*. Common grass species such as *talahib* were seen in the area. The extent of effects of the oil spill was minimal, as patches of oil sludge were rarely observed, with some found on its roots and pneumatophores at most. Presence of fishes (tilapia, mudskipper) and invertebrates (gastropods, crablets) was also observed however few (Figure 15). In both Brgy. Maidlang and Navotas, no species showed apparent signs of erratic movement or behavior, thus possibly indicating minimal negative effects to the fauna observed.

Figure 14. Oil traces found on roots and pneumatophores of mangroves along the coast of Brgy. Maidlang (N 13.3929°, E 121.2351°). Red arrows indicate traces of oil.

Figure 15. Some benthic species found along the coasts of Brgy. Maidlang, including crablets, mudskippers, snails and hermit crabs (N 13.3916°, E 121.2364°).

Implications of the Oil Spill

Based on the reports of the Bureau of Fisheries and Aquatic Resources, low levels of PAHs have been detected in water and fish samples in municipalities affected by the oil spill (BFAR, 2023a, 2023b). This indicates that the oil spill has contaminated many ecosystems. Oil contamination poses health hazards to humans, especially when fish and invertebrates are consumed (Aguilera et al., 2010).

Marine organisms may have ingested water and sediments contaminated with oil, which could also affect the food chain. Figure 16 shows a sample food chain in a coastal community, indicating the potential pathways by which an oil spill can contaminate and pose potentially harm to human health. For example, sea cucumbers and other deposit-feeders may ingest sand and other types of sediments that could have possibly been contaminated by oil. Other benthic (sea bottom) species such as goatfish (*dumpilas*) prey upon polychaetes and small crabs found in benthic ecosystems. This could possibly become a health hazard as fisherfolk reported that they collect *balatan, dumpilas* and other marine species for food. This could also be the case in pelagic (open water) food webs. The consumption of primary producers (e.g., phytoplankton, seaweed) and prey (e.g., zooplankton, small fish and invertebrates) may transfer oil to higher trophic levels. Prolonged exposure of small organisms to oil can result in their mortality, which can lead to a cascading effect throughout the food chain as their loss would mean less food for larger organisms (Incardona et al., 2011).

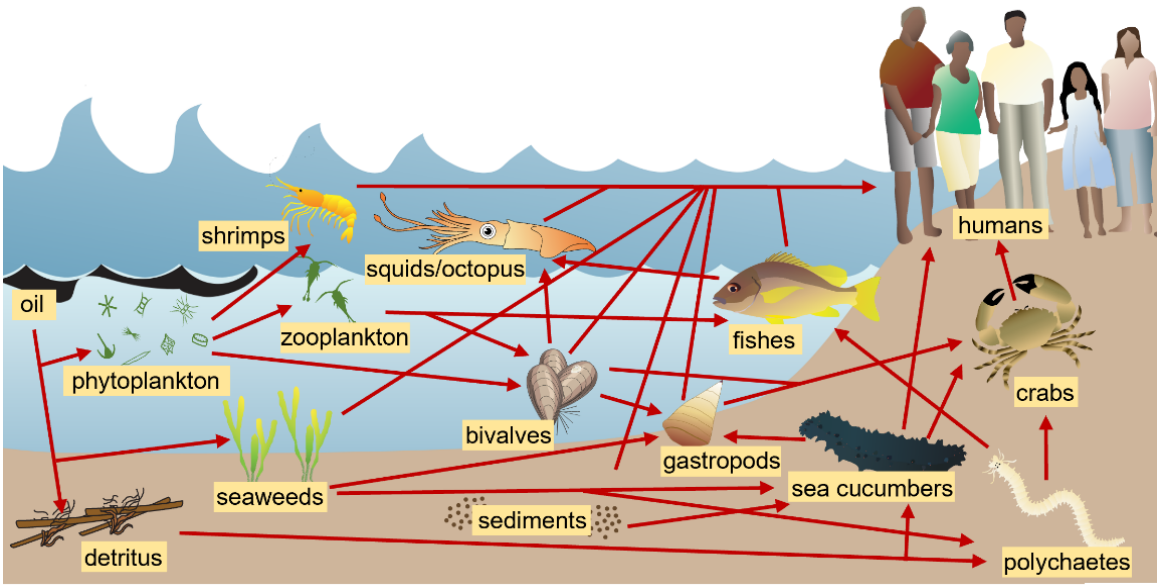

Figure 16. Food chain in a coastal community affected by oil spill. Red arrows indicate the direction from the prey (food) to predator (consumer). Vector graphics from Integration and Application Network (ian.umces.edu/media-library).

The presence of oil on mangrove leaves could affect primary production, especially on juvenile mangroves that only have few leaves, which could affect their growth and survival (Sadaba and Barnuevo, 2010). Oil presence in prop roots and pneumatophores could also hinder gas exchange among mangroves (Yender and Stanzel, 2011). Other immediate effects on the ecosystem include death of mangrove seedlings and to its associated fauna (Lewis, 1983 in NOAA, 2014). If left untreated and depending on the severity, chronic exposure to oil could lead to weakened trees, reduced seedling survival, and eventual deforestation (NOAA, 2014). Degradation of this ecosystem could lead to loss of the services they provide such as water filtering, coastal protection, carbon sequestration, and source of food and livelihood to locals (Salmo, 2015).

Responses to Oil Spill

Due to regular cleanup for the past month, oil found along the coast and mangroves in both Pola and Calapan have become minimal. There was one incident during the research mission (April 2, 5–6 pm) when a patch of oil slick drifted into the coast of Tagumpay, but this was immediately cleaned up by the residents, although some were not able to wear PPEs due to limited supply (Figure 17). Spill booms were also deployed in both areas, thus preventing further spread of oil slicks in coastal ecosystems (Figure 18).

Figure 17. Actual oil spill response in Brgy. Tagumpay on April 2, around 5 – 6 pm. Residents regularly monitor the coast for drifting oil slicks. Once detected, responders would surround the slick with spill booms, and then bring them to the shore to collect using a sieve.

Figure 18. Spill booms in Calapan City.

Summary and Recommendations

The quantitative assessment of the impact of the recent oil spill was conducted using ocular inspection, and interviews, KIIs and FGDs with the locals in the two municipalities of Oriental Mindoro. Between the two sites, Pola was impacted more than Calapan City. This might be due to the proximity of the area to the sunken vessel. Prior to the oil spill, fisherfolk engaged in finfish and invertebrate fisheries using various types of fishing gears. The high fisheries productivity in the area is due to the existence of several locally-managed marine protected areas that serve as nursery grounds for fish and invertebrates. However, due to the oil spill, fishing bans were implemented due to the potential risk of ingestion of oil and other toxic substances that can be bioaccumulated (or incorporated into the tissues) by marine organisms living in the area. There are still traces of oil observed along the coast and adjacent waters as well as mangrove roots and leaves. The immediate response and regular cleanup may have lessened the surfaces covered in oil from those areas.

This rapid biophysical assessment is only limited to ocular inspection in the coast and cannot fully conclude the status of marine ecosystems affected by the oil spill. It is highly suggested to conduct a comprehensive monitoring of the marine ecosystems in the area. While the ocular suggests minimal impact on mangroves due to few mortalities, the oil may have seeped through the sediments that can still cause chronic damages to mangroves. While in-person water activities (such as snorkeling and scuba diving) necessary for assessing seagrasses and corals are still prohibited, the use of available technology, such as remote sensing or deploying platform-based equipment, may provide assistance in their status as soon as possible. Government agencies such as BFAR and DENR must also conduct extensive analysis of fish, invertebrate, sediment and water samples (marine, brackish- and freshwater) for possible oil contamination. Previously, BFAR (2023a, 2023b) only released reports on oil contamination in water and fish, but not in sediments. We suggest that they include sediments in their monitoring as benthic fish and invertebrates, especially deposit-feeders, may have also been contaminated with oil. Regular monitoring of these parameters and timely release of reports are needed as fisherfolk already want to return to fishing, and they want to know exactly when they would be allowed to return to their livelihood.

Acknowledgement

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