Deployment of Electronic Monitoring Cameras on Fish Trawlers in Sabah

Annual Report
2020 –2021

Project Title:

Conservation of Large Marine Megafauna in Malaysia

Implementing Agency:

Marine Research Foundation

Funded by:

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1.0 INTRODUCTION

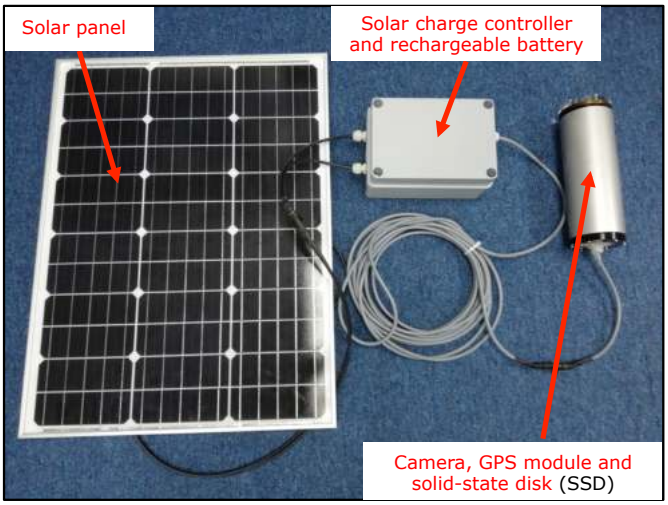
Bycatch of sharks, rays, and wedgefishes is among the greatest threats faced by these species. In Sabah, sharks, rays and wedgefishes are not high value catches, but they are still retained and sold in markets. This has led to changes in their species composition and abundance, and in some cases, drastic population declines. Hampering fisheries management, there is no information on where and when these bycatch events occur, the fishery gears responsible, and on captures that are not landed at the major markets. To fill this knowledge gap, this project aims to identify precise occurrences of shark, ray, and wedgefish captures in trawl fisheries. Where it occurs, bycatch of other endangered species is also recorded.

This report describes the progress of MRF's role in the Sabah Shark and Rays Initiative. The current report covers between March 2020 and March 2021. Since March 2020, we have constructed our self-built electronic monitoring cameras, installed the cameras on fishing trawlers, and then collected and analysed the images captured by the cameras. We have also developed preliminary monthly bycatch maps and hotspot analyses to indicate the manner in which we envision the final results being presented. We envision that these grap[hic outputs will assest the Department of Fisheries Sabah in designing targeted management measures that protect these species.

2.0 METHODOLOGY

2.1 Construction of Electronic Monitoring Cameras

We have built 32 electronic monitoring cameras (see **Figure 1**) with the help of local programmers and a solar power specialist. The cameras are powered by 12V rechargeable batteries, and the batteries are charged by 50W/60W solar panels. The cameras take photos every five seconds continuously, and the images are time- and GPS-stamped, and this provides us with accurate location data for each capture of shark, ray or wedgefish.



The complete set of the electronic monitoring camera

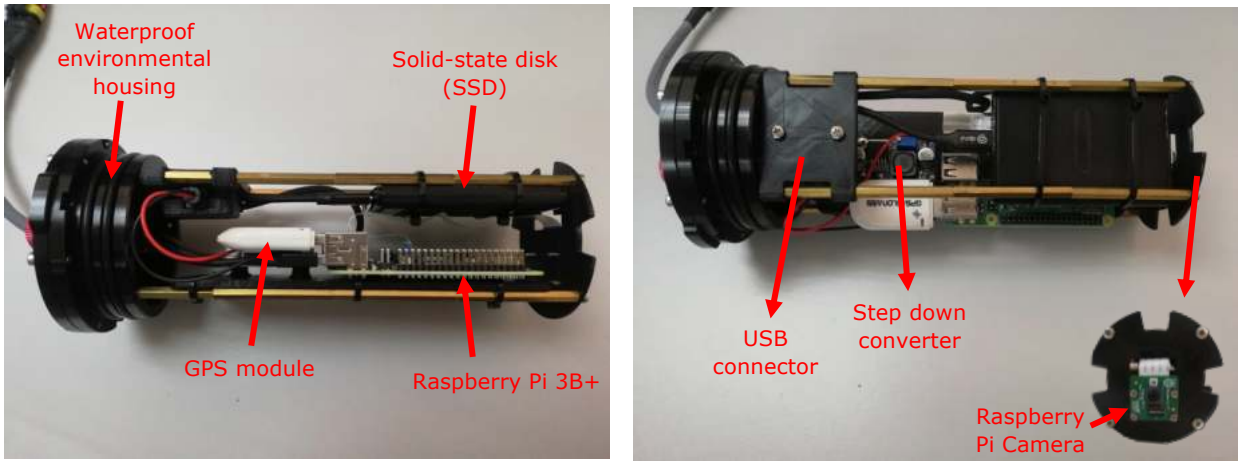


Figure 1. Internal parts of the electronic monitoring camera.

A full 12V battery can power the camera for around one to two weeks, dependent on weather conditions. On the first night after installation, the camera consumes some 50% of the battery capacity while capturing images every five seconds. Then, the battery is charged by the solar panel during the following days and it might be charged up till 90% in good weather conditions. The reasons why the battery may not reach full power after this recharge is because the camera is still drawing power from the battery when it is charged by the solar panel, and because solar irradiation is not always optimal. Therefore, the power of the battery decreases gradually day by day (see a graphic illustration in **Figure 2**). However, the power issue is not our greatest limitation, but rather the storage space of the memory disk. This is because a 1TB solid-state disk (SSD) sufficiently compact to fit in the camera housing can only store images for maximum of two weeks. Our cameras capture 17,280 images every day which occupies 54GB of memory space. Thus, the camera is limited to store images for no longer than two weeks.

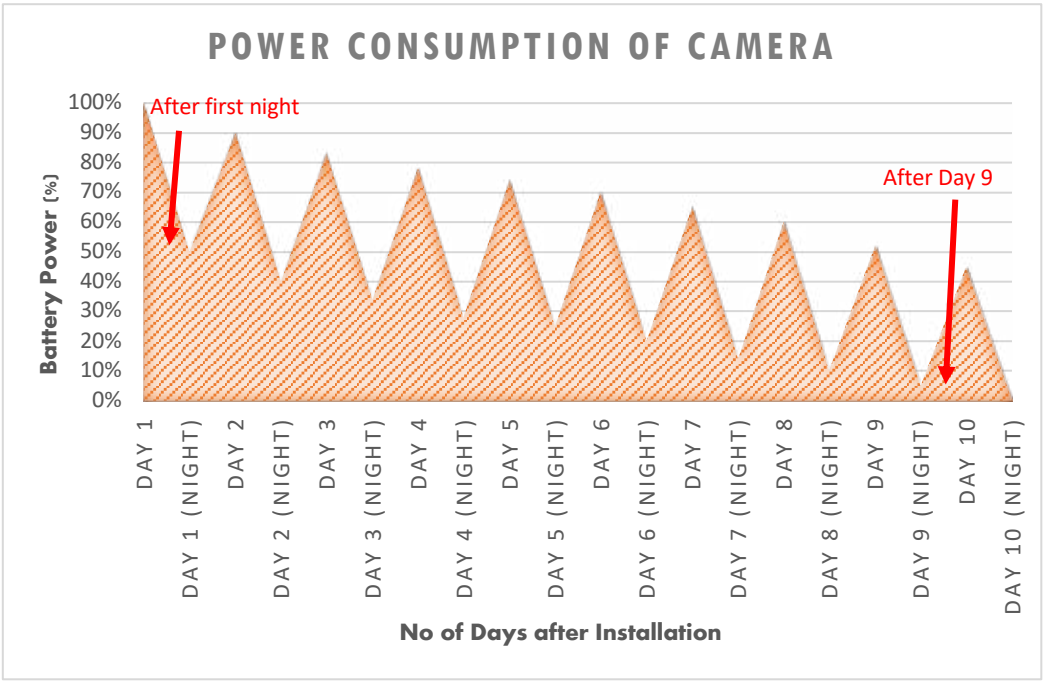


Figure 2: Illustration of battery power consumption of the camera.

2.2 Installation of Electronic Monitoring Cameras

The cameras are installed on one of the beams on a fishing trawler which enables the camera to capture the whole rear deck where catches are landed. The solar panel and battery are installed on another beam on top of the vessel (**Figures 2-7**). The installation of the camera takes around 2 to 3 hours and it requires 2 to 3 team members.

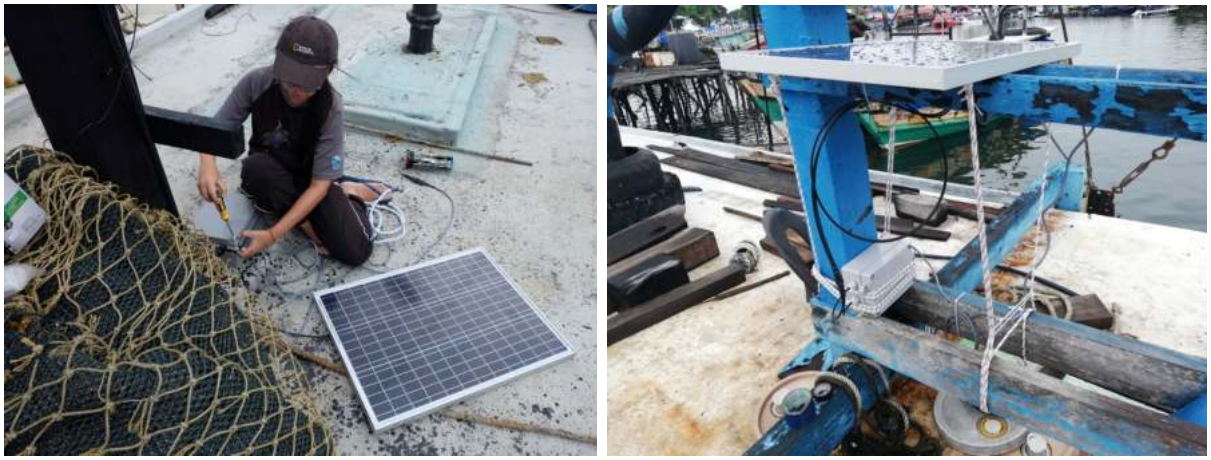


Figure 3. KC (MRF) installing the solar panel and the battery on a trawler.

Figure 4. Jonathan (MRF) installing the round bracket on a fishing trawler.

Figure 5. The electronic monitoring camera is attached to the round bracket using a ball mount joint.

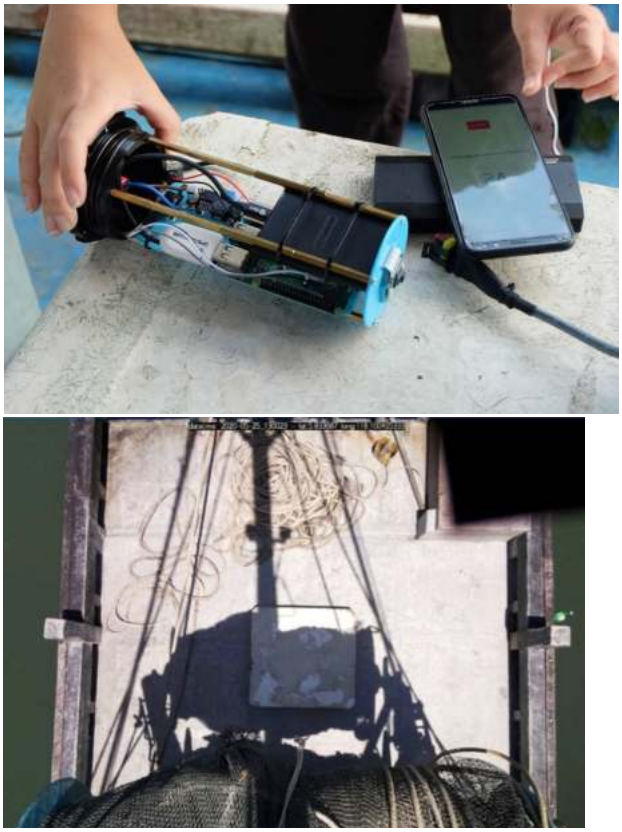


Figure 6. Camera is connected to custom software to view and adjust the angle of the camera. The angle of the camera is adjusted until the greatest view of the deck is visible. The camera then captures images of the deck every five seconds.

Figure 7. The complete installed electronic monitoring camera on a fish trawler. Images are downloaded when the trawler comes back from the sea.

2.3 Data Analysis

After we downloaded the images from the cameras, we visually scanned all the images and only stored those relevant images where fishermen emptied their net and sorted out their catches (the balance of the time, while the net was deployed, the camera just took photos of an empty deck). The vessel usually trawled for 4 to 5 hours, and images captured between trawls where the deck was empty were

deleted. After saving the relevant images, we reviewed the images carefully and have been able to identify sharks, rays, wedgefishes and turtles caught by the trawlers. When we identified a bycatch event, we kept those images in another folder and recorded the details of the bycatch event in an Excel spreadsheet (please refer to the attached Excel spreadsheet for the complete database). We identified shark and ray species using field guides, occasionally checking with specialists, and with the help of MRF staff and interns. We plotted locations of all bycatch events by months and developed hotspot maps for each group using QGIS. For public viewing, we have also developed a 'live' map for all the bycatch events and updated it regularly by using Google Maps.

3.0 RESULTS AND DISCUSSION

3.1 Field trips to Different Ports

We started to deploy our self-built cameras in March 2020. We made 25 trips to Sandakan between March 2020 and March 2021, to install cameras on trawlers and/or to retrieve data from the cameras. We also made seven trips to Tawau, and nine trips to Semporna to install cameras between July and March 2021. In Kota Kinabalu, we installed three cameras between August and December 2020. There are currently 13 cameras installed on 13 different trawlers in Sandakan, three in Kota Kinabalu, six cameras installed on three trawlers in Tawau and another three trawlers in Semporna. Therefore, there are currently 22 fully working cameras across Sandakan, Tawau, Semporna and Kota Kinabalu.

We have faced several challenges in deploying, retrieving and accessing cameras, which include vessel availability, covid-19 and the simple act of convincing fishermen to allow us to deploy cameras on their boats. Sometimes, vessels from different ports such as Sandakan and Tawau came back at the same time, and that meant that one of those cameras could not be serviced. For instance, we might have been collecting data from cameras in Sandakan and by the time we flew to Tawau, the vessel had gone out to the sea again. Other cameras occasionally encountered hardware or software issues after coming back from fishing, and we would have to bring the camera back to the office for servicing and maintenance. During covid-19 travel-restriction days, we were not allowed to cross district borders for field trips and this hindered installation of cameras and collecting data from the cameras. Moreover, it has taken us substantial time to convince boat owners and fishermen to allow us to deploy these cameras. Notwithstanding the good relationships MRF has built up over the years, there continues to be a worry that the data will impact individual boats, companies and fishers, and the early days of this work were spent in countless discussions over coffee and lunch to persuade boat owners to come on board. As of late, however, the more boats we deploy with cameras works in MRF's favor, as other fishers are less reluctant to participate. Another aspect was that the fishermen on board always misunderstood that their owners were placing CCTVs to monitor their daily activity. Therefore, we have had to explain several times how the data are processed and utilised, until they came to understand the purpose of the project.

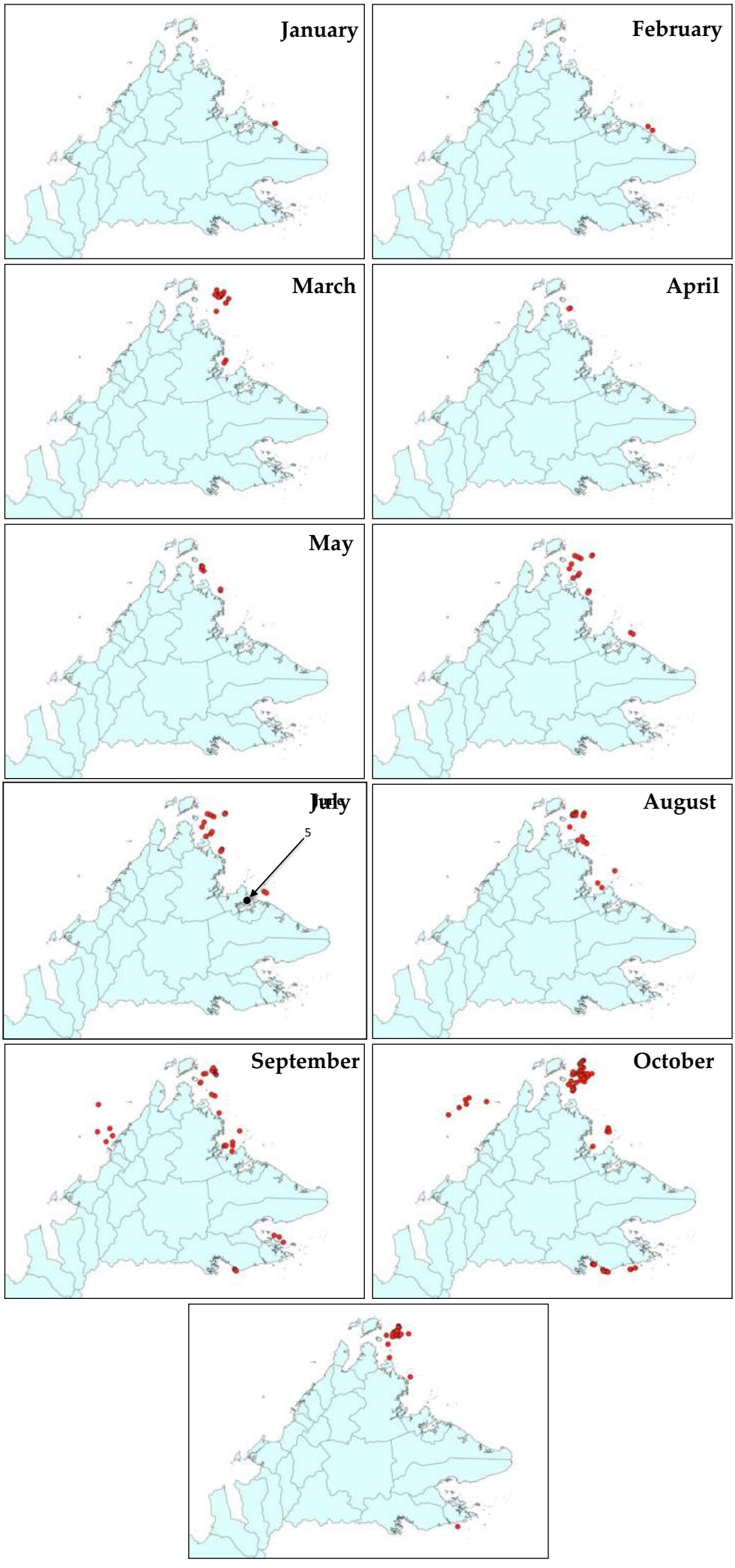
3.2 Database of Sharks, Rays and Wedgefishes Bycatch

As of 9th April 2020, we have collected 106 weeks' worth of data and images from 22 cameras in Sandakan, Kota Kinabalu, Tawau, and Semporna. We have scanned 65 weeks of images, which is 61.3% of the total number of images collected, from which we have spotted 1,635 incidences of shark, ray, wedgefish and turtle bycatch. To date we have managed to identify the 1,450 individuals to species, which is 88.7% of the total number of bycatch events. Please see **Annex A** for samples of processed images captured by the cameras.

3.3 Data Analysis for Shark, Ray and Wedgefish Bycatch

3.3.1 Monthly Comparison of Bycatch Between Each Group

The locations of bycatch events for each group were plotted across months and presented graphically for each group of species. Given the current limited data we are unable to process these by species, but what we have accrued so far is revealing some interesting bycatch patterns (**Figures 8-10**).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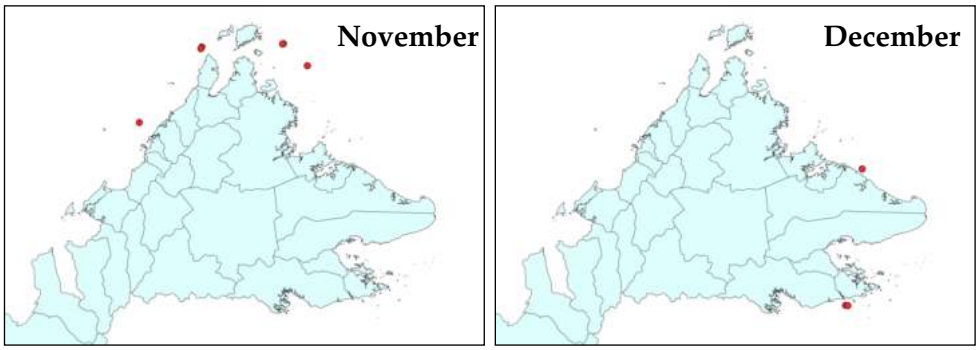
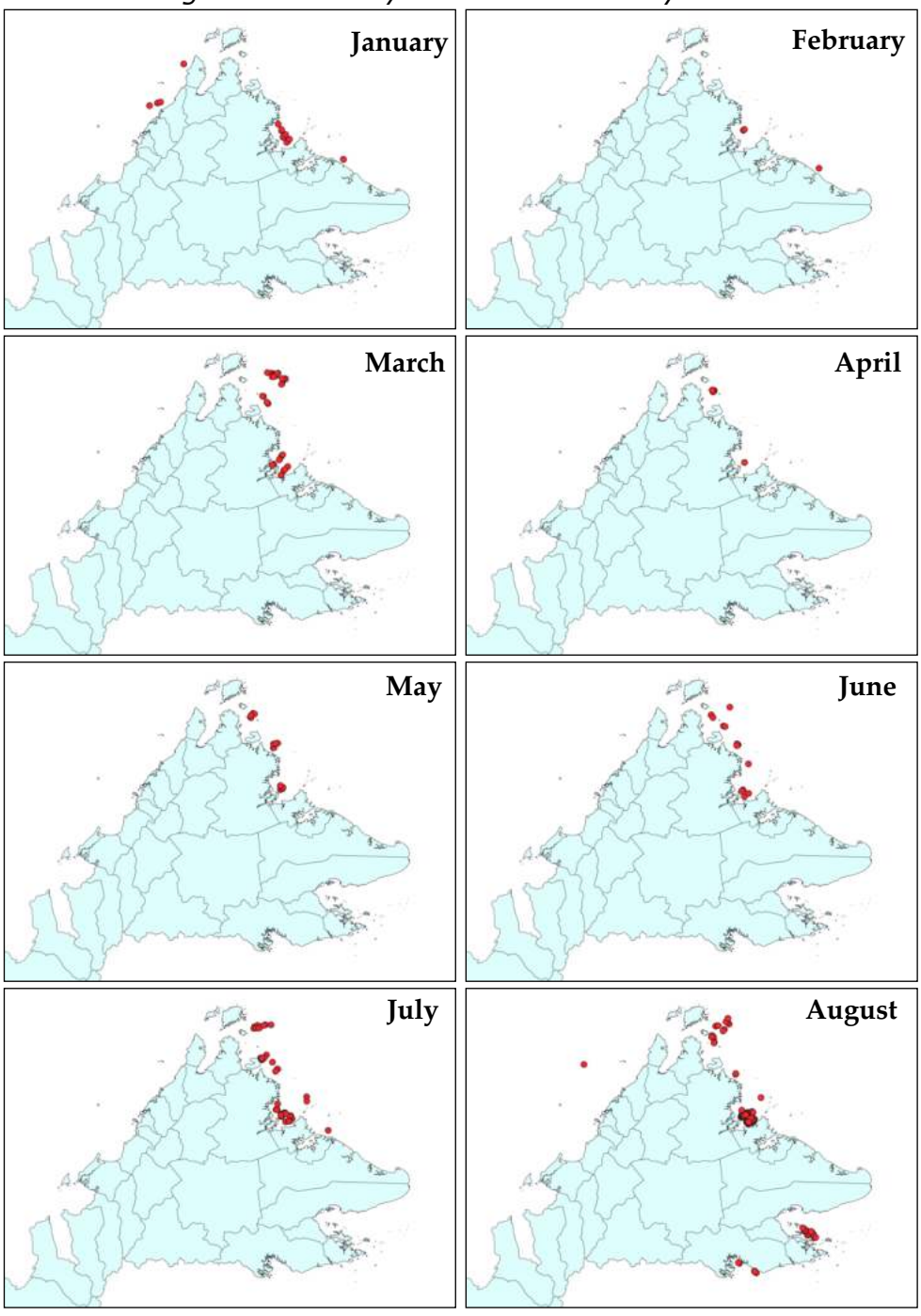


Figure 8. Monthly records of shark bycatch.



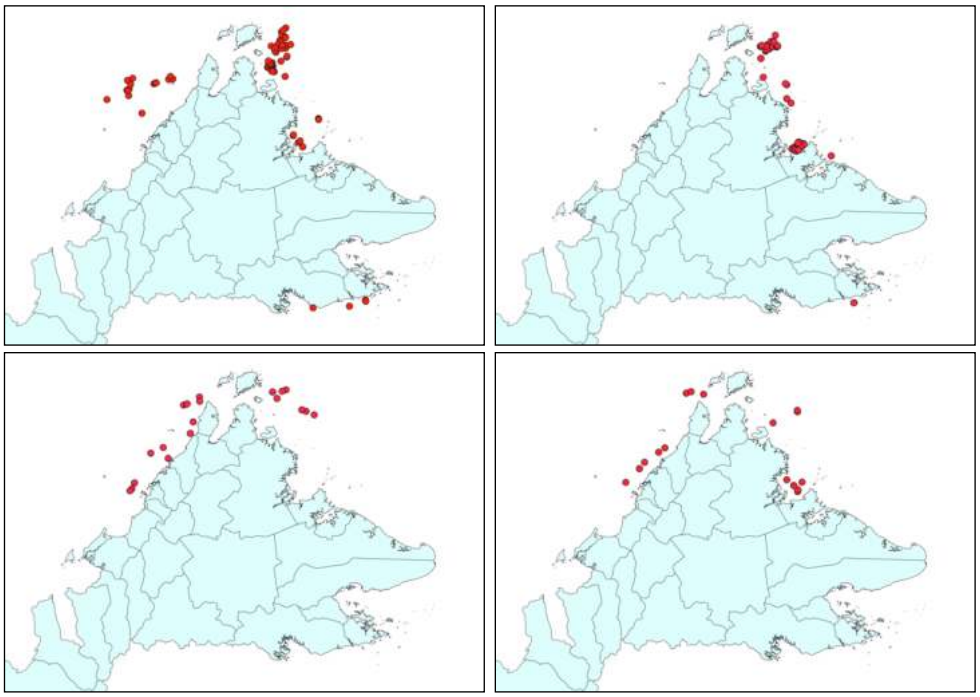
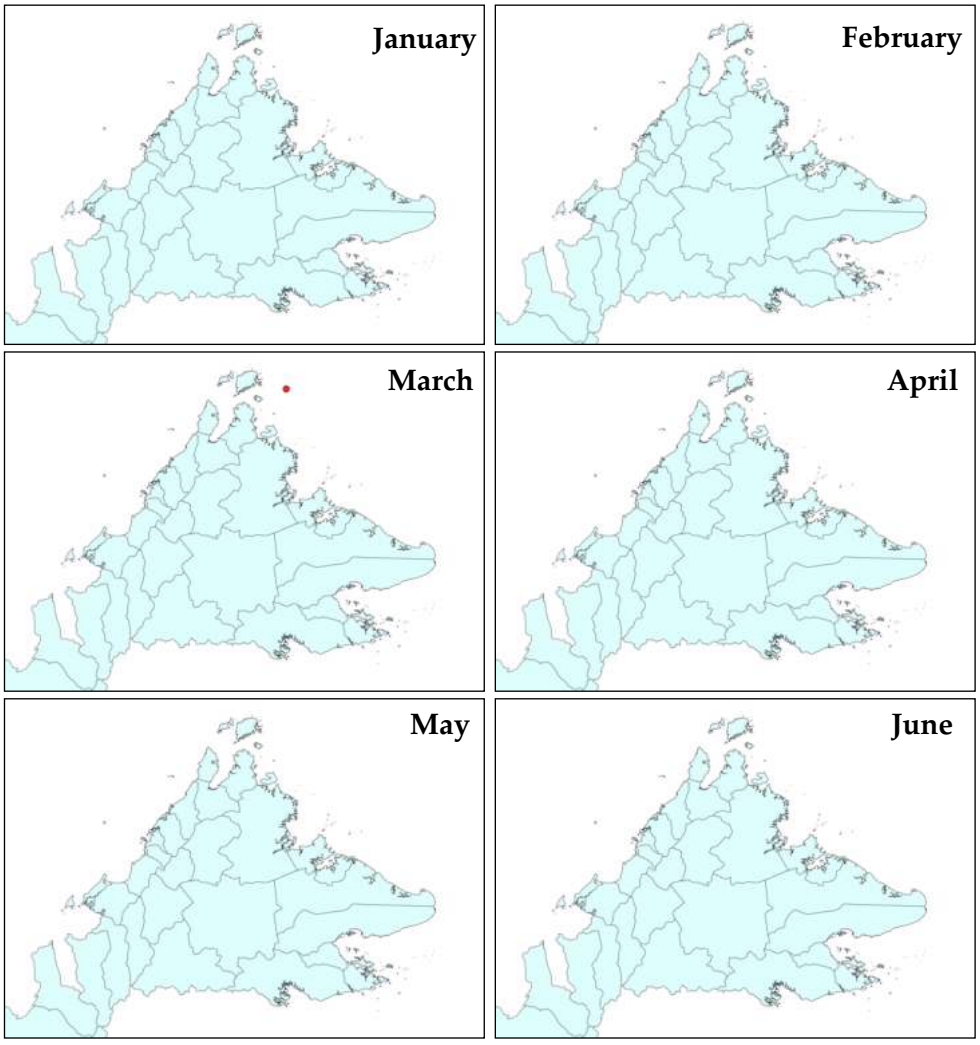


Figure 9. Monthly records of ray bycatch.



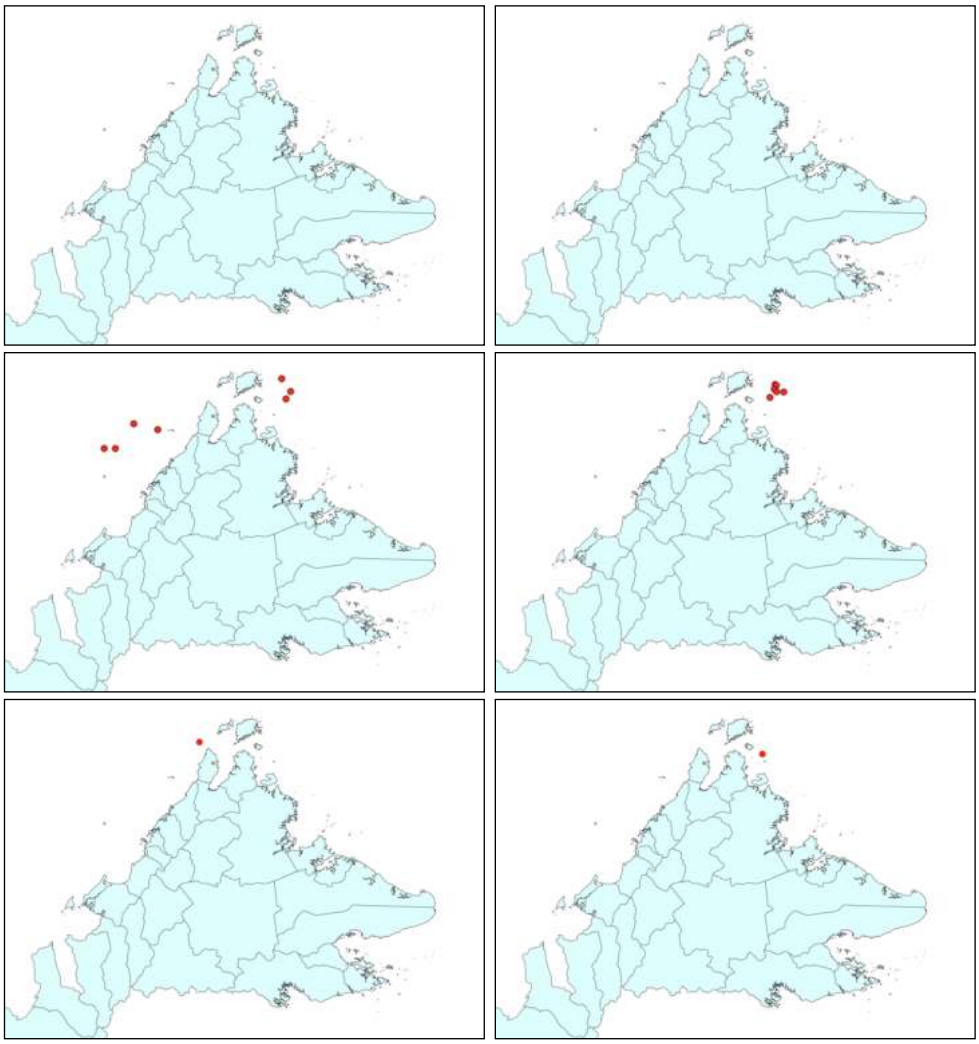


Figure 10. Monthly records of wedgefish bycatch.

There are 20 species of shark that were caught by trawlers, and the most common shark species were the Coral Catshark *(Atelomycterus marmoratus)*, Brownbanded Bamboosharks *(Chiloscyllium punctatum),* and the Milk Shark *(Rhizoprionodon acutus).* Other shark species were Scalloped Hammerhead Sharks *(Sphyrna lewini)*, Spottail Shark *(Carcharhinus sorrah)*, and the Borneo Shark *(Carcharhinus borneensis)*.

For rays, 24 species were caught by trawlers and the most common species were Whitespotted Whiprays *(Maculabatis gerradi)*, Sharpnose Stingrays *(Telatrygon zugei),* and *the* Bluespotted Maskray *(Neotrygon kuhlii)*. Other ray species were the Eastern Cowtail Stingray *(Pastinachus atrus)*, Whitespotted Eagle Ray *(Aetobatus ocellatus)*, and the Longtail Butterfly Ray *(Gymnura poecilura)*.

Other than sharks and rays, four species of Wedgefish/Guitarfish were caught accidentally and all four species are listed on the IUCN Red List as **Critically Endangered**. They are Brown Guitarfish *(Rhinobatos schlegelii)*, Giant Guitarfish *(Glaucostegus typus)*, Bowmouth Guitarfish *(Rhina ancylostoma)* and Bottlenose Wedgefish *(Rhynchobatus australiae).* Most of the wedgefish bycatch were Bottlenose Wedgefish, consisting of nine individuals that were **caught in the same area**.

3.3.2 Hotspot Maps for Each Group

For months which in which we have more than 30 bycatch events (about the minimum needed for good GIS analysis), we have developed heatmaps to illustrate the hotspot areas (**Figures 11-12**). Most of the sharks were caught near Banggi island and Malawali island, and an area nearby Tawau. While for rays, most of them were caught near Tetabun island and Kanawi island, area near Banggi island and Malawali island, and area near Gaya island. Data collection is still on-going and these data will be analysed to derive more refined hotspot area maps in the future.

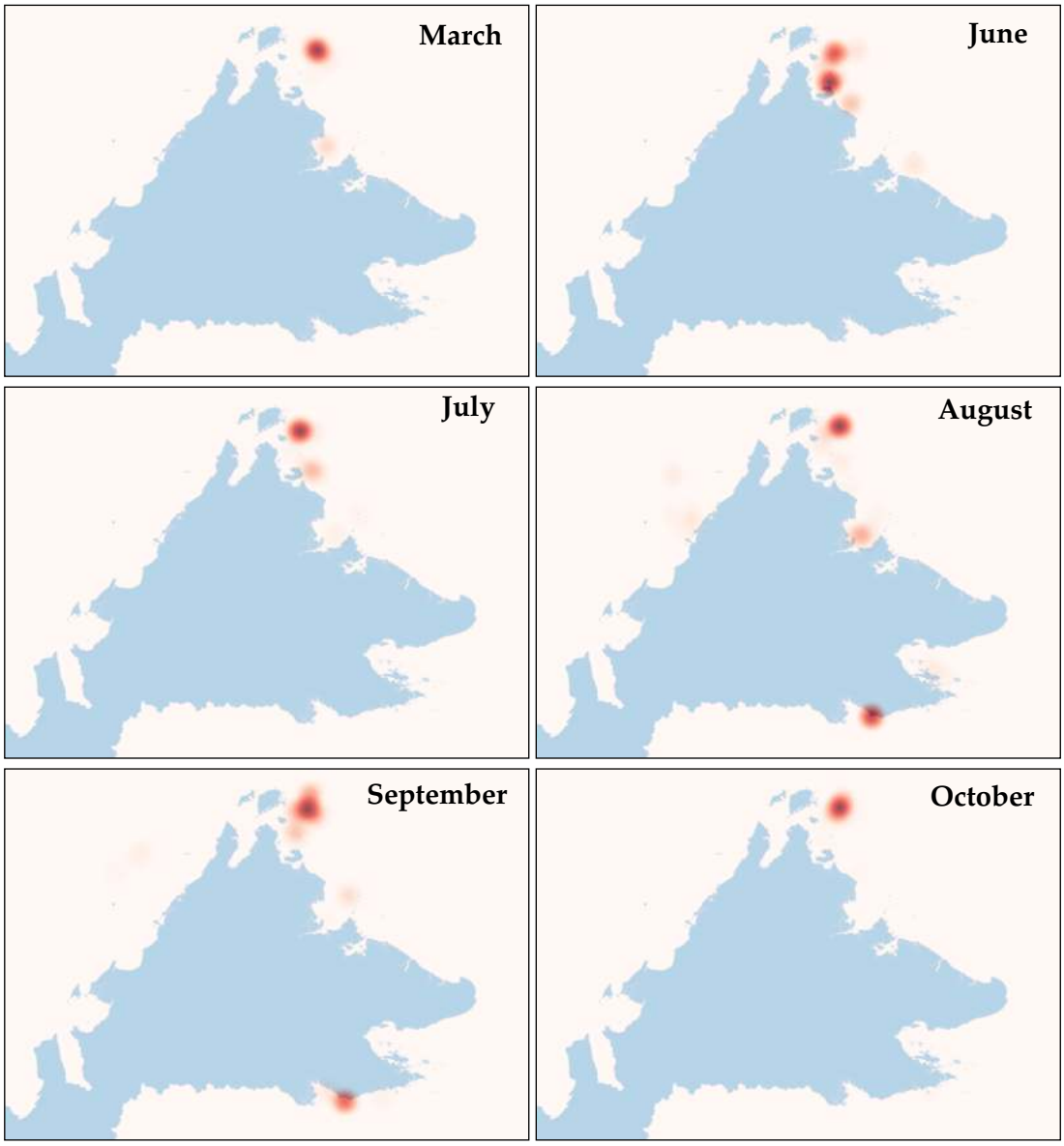
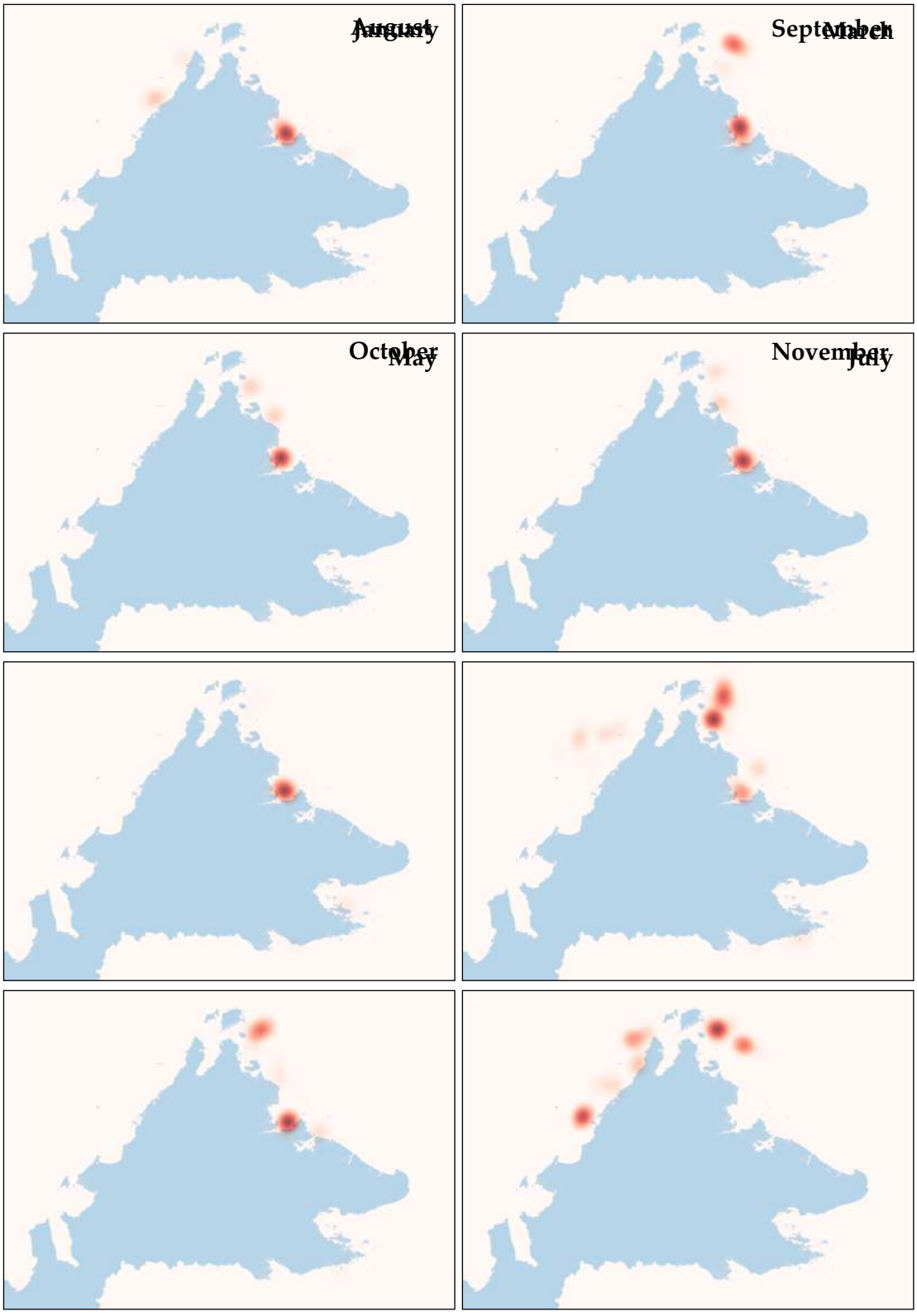


Figure 11. Hotspot maps for shark bycatch.

Note: there were fewer images collected between April-May 2020 due to a Movement Control Order (MCO) that restricted our ability to cross districts for fieldwork. We have yet to compare the locations of bycatch events for individual species or species group as these are under identification, and as data collection is ongoing.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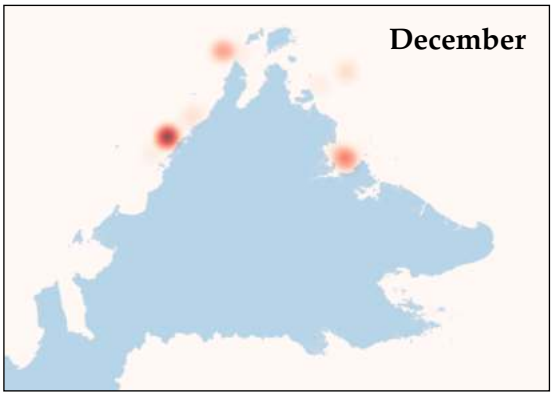


Figure 12. Hotspot maps for ray bycatch.

3.3.3 Overall Findings

Figures 13-15 show the locations of all bycatch events between each group alongside hotspot analyses of the findings. Note these include all bycatch events, and are not broken down temporally.

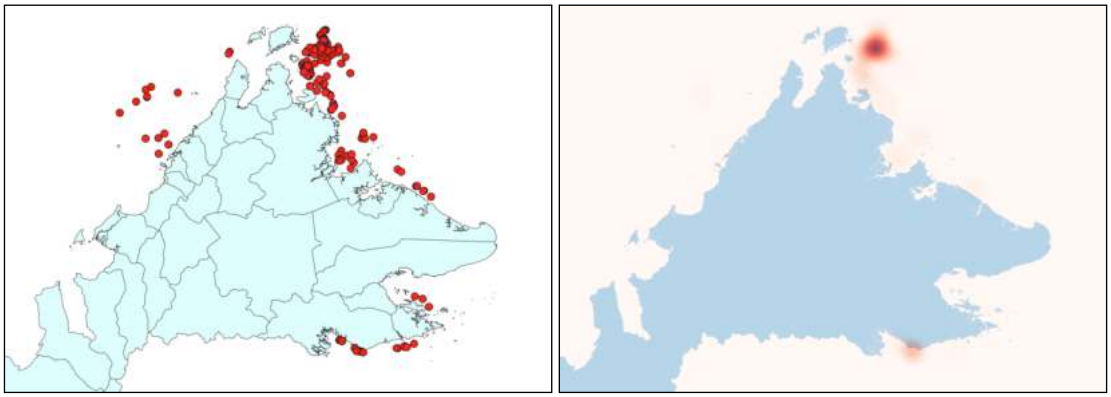


Figure 13. Locations of sharks' bycatch across the state.

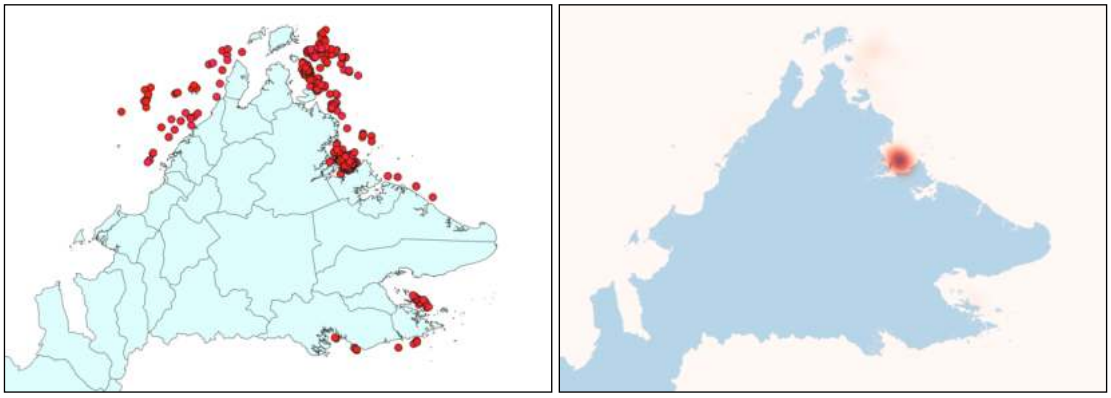


Figure 14. Locations of rays' bycatch across the state.

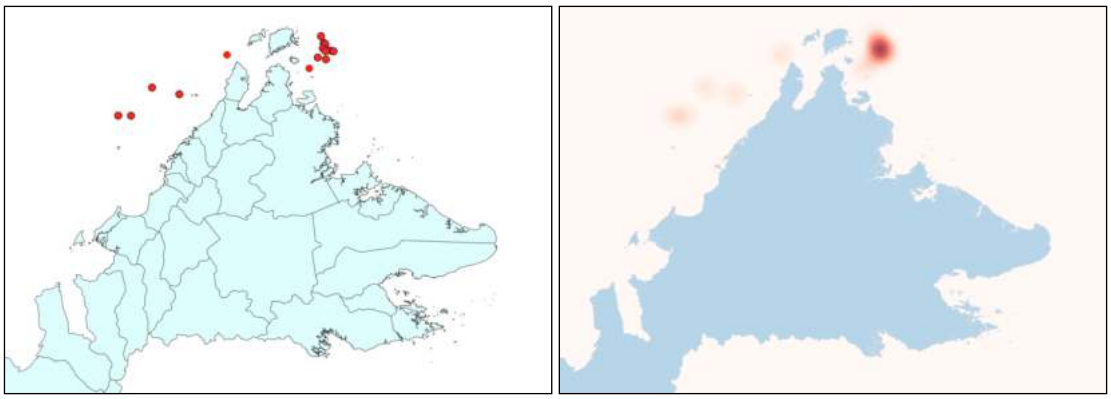


Figure 15. Locations of wedgefishes' bycatch across the state.

3.3.4 Distribution of Hammerhead Sharks

There were 45 individuals of hammerhead shark caught by trawlers and most of these were juveniles (**Figure 16**). Based on our analysis, hammerhead sharks such as the Great Hammerhead *(Sphyrna mokarran)* and Scalloped Hammerhead *(Sphyrna lewini)* were also **caught in the same area**, which is nearby Banggi and Malawali islands. Both species of hammerhead shark are listed on the IUCN Red List as **Critically Endangered**. This area might be a potential pupping ground for hammerhead sharks; however, this is a preliminary result and more bycatch data will be needed for further investigation.

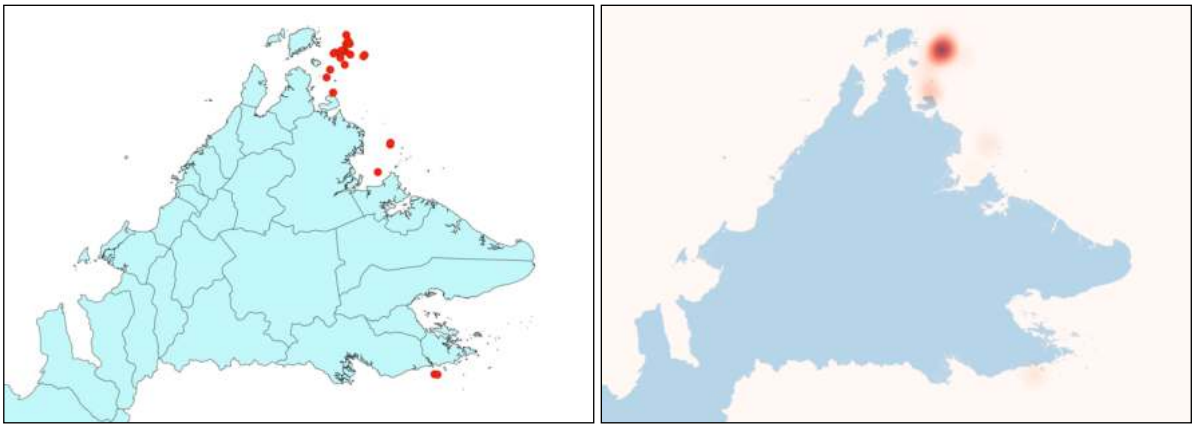


Figure 16. Locations of Hammerhead Sharks' bycatch.

3.3.5 Distribution of Bottlenose Wedgefish

There were nine individuals of bottlenose wedgefish caught by trawlers and six of these were juveniles (**Figure 17**). They were also **caught in the same area,** which is nearby Banggi and Malawali islands, in the same area as hammerhead sharks. This area might be a potential pupping ground for Bottlenose Wedgefish also.

Figure 17. Locations of Bottlenose Wedgefishes' bycatch.

3.3.6 Distribution of Turtle

There are 2 species of sea turtles that have been caught by trawlers, the green turtle (*Chelonia mydas*) and the Olive Ridley turtle (*Lepidochelys olivacea*). There were 16 turtle bycatch incidences (**Figure 18**) and most of them were caught nearby Banggi island, Malawali island and Jambongan islands. Green sea turtles are listed on the IUCN Red List as **Endangered** and Olive Ridley sea turtles are listed as **Vulnerable**.

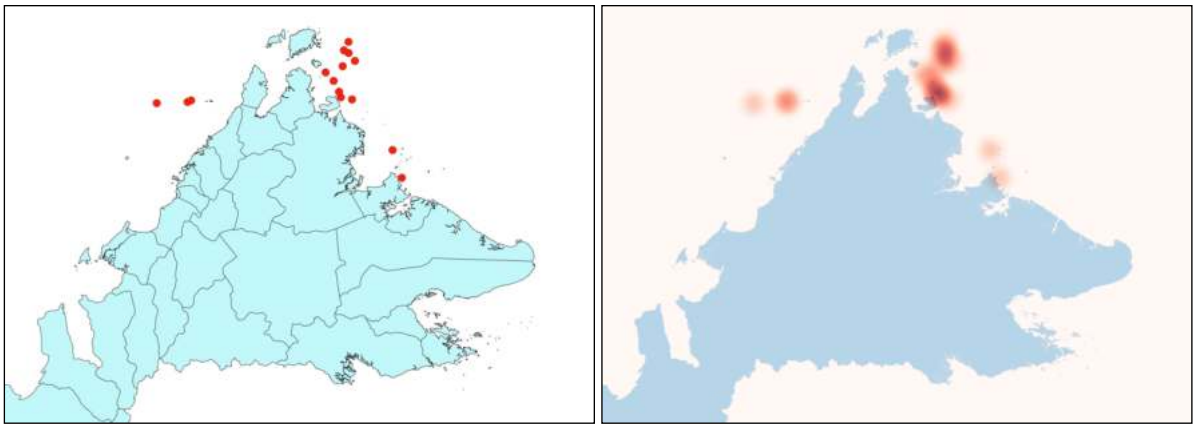
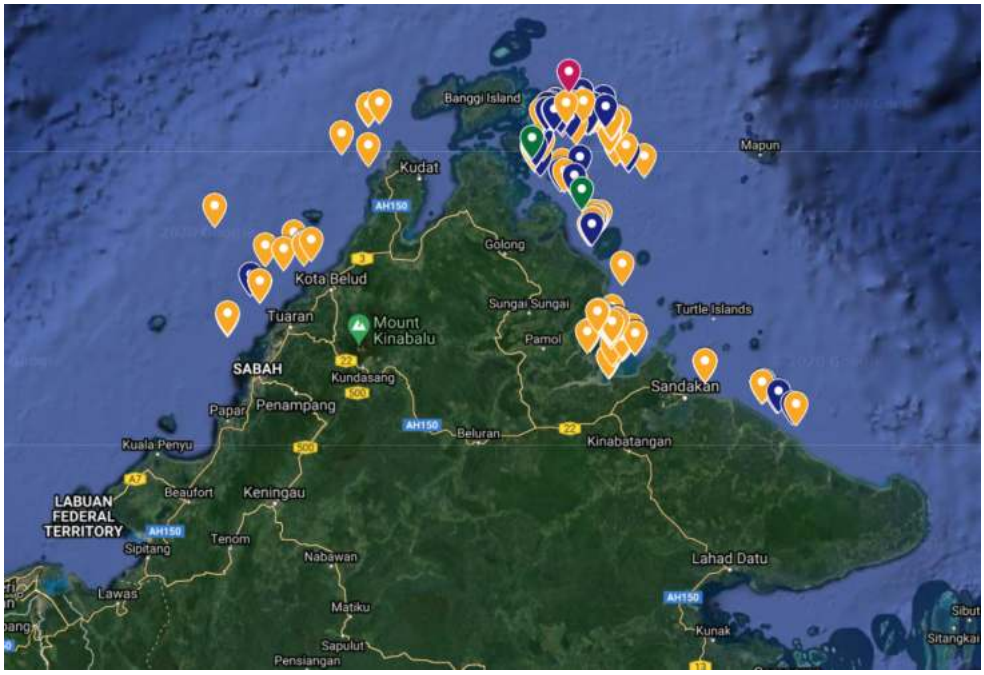


Figure 18. Locations of turtle bycatch.

3.3.7 Live Interactive Map

To communicate the results of our work we have also developed a map of bycatch events and the map is updated regularly with known incidences of sharks and rays bycatch. Once we download the images from the cameras and process them, we upload incidences of bycatch onto the map. Keep in mind that we do not get to every camera every week especially during covid-19 days. However, this is as 'live' as we can make things under current circumstances.



Link: www.mrf-asia.org/project/live-interactive-map-for-sharks-and-rays-bycatch-in-sabah-malaysia/

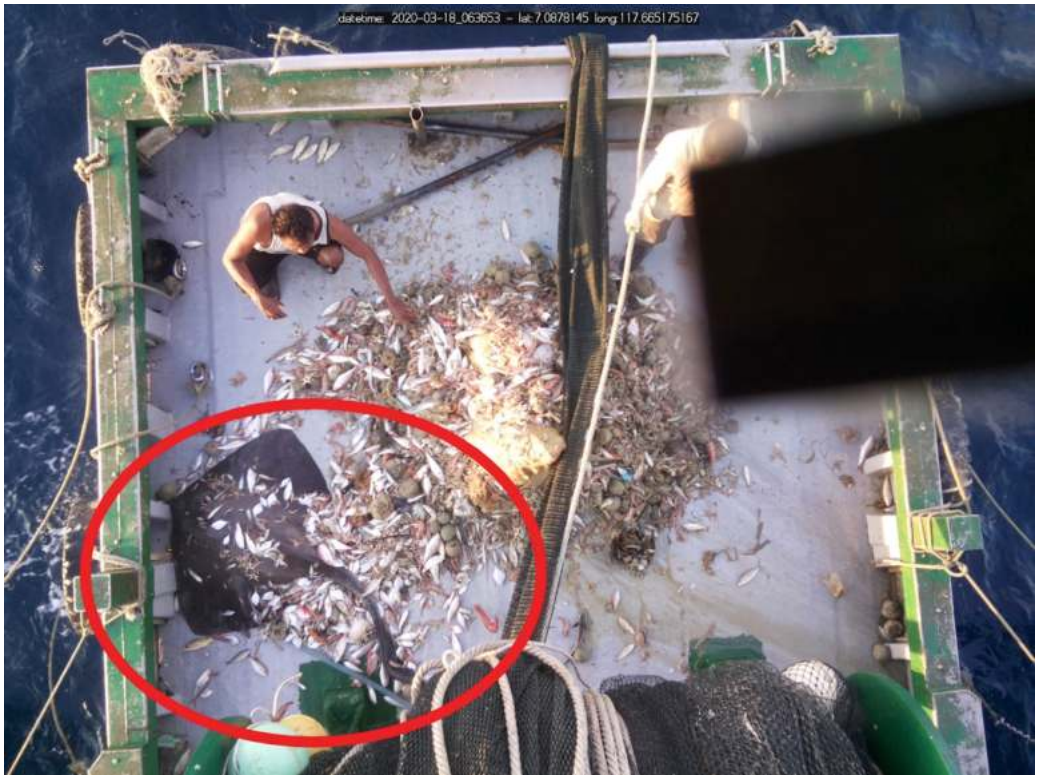
4.0 FUTURE PLANNING AND NEXT STEPS

We plan to install an additional 10 cameras, and expand our coverage to Kudat and Lahad Datu, and continue to collect data from the cameras in Sandakan, Kota Kinabalu, Tawau and Semporna. In the meantime, we are making every effort and trying to solve issues of vessel availability, travel logistics and fishery buy-in. Data collection will be continued until at least October 2021 and more images will be collected for further analysis to produce more robust kernel density analyses of species distributions, and comparisons of seasonal bycatch between different species.

Species distribution maps and hotspot bycatch maps for each species or species group will be developed to support a white paper to be presented to the Department of Fisheries Sabah for consideration of shark and ray bycatch mitigation options. Further management solutions will be discussed with the Fisheries Department based on these results, and we plan on continued engagement with the Department in the development of suitable management options.

ANNEX A

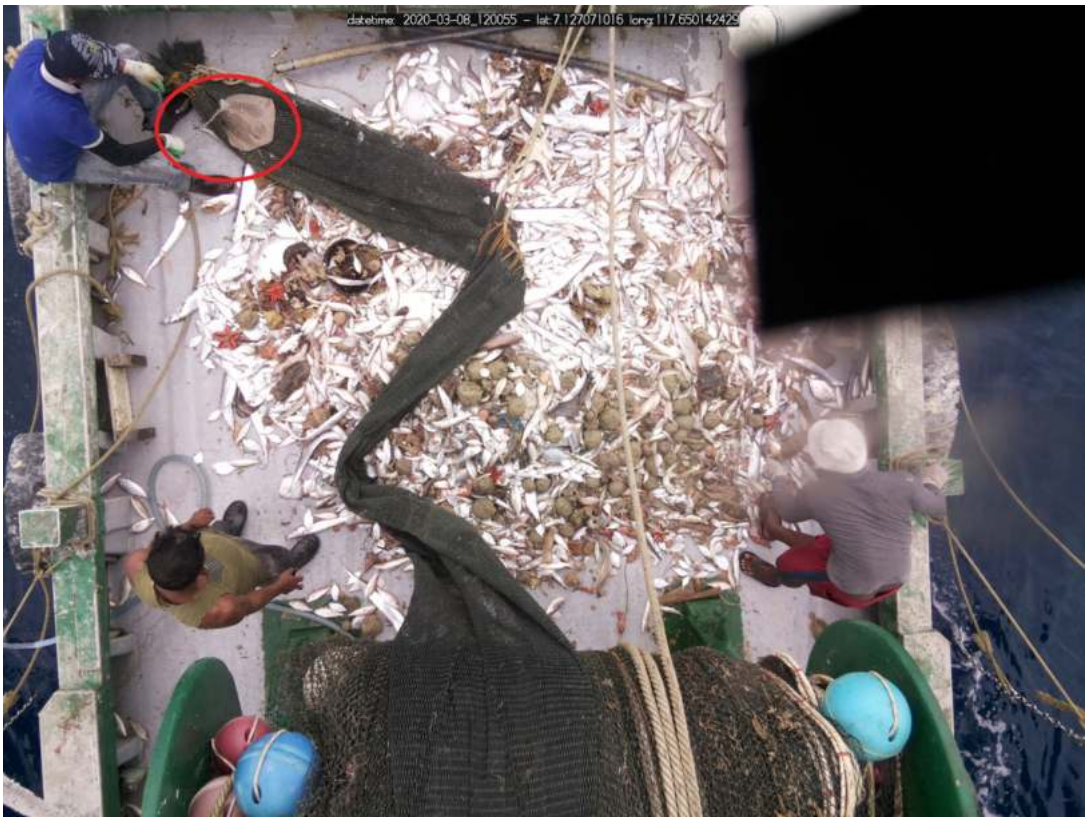
Samples of processed images captured by the cameras



Eastern Cowtail Stingray

Brownbanded Bambooshark

Bottlenose Wedgefish (juvenile)



Whitespotted Whipray

Olive Ridley Sea Turtle

Scalloped Hammerhead Shark (juvenile)

Bluespotted Maskray

Coral Catshark

Spot-tail Shark

Whitespotted Eagle Ray

Giant Freshwater Whipray

Giant Guitarfish