Greenpeace Research Laboratories Analytical Results Report 2022-04

Final report on research conducted from MY Arctic Sunrise in Saya de Malha Bank region, Indian Ocean, 2021

Field expedition date: 2nd – 30th March 2021

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Summary

During early 2021, Greenpeace International conducted a research and investigation cruise on the vessel MY *Arctic Sunrise* in the Indian Ocean as part of the Protect the Oceans campaign. As part of this campaign, on March 2nd 2021, a research expedition departed from Victoria, Mahe Island, Seychelles to the Saya de Malha Bank region of the Mascarene Plateau. A total of four transits between Seychelles and Saya de Malha Bank took place in the course of the expedition, which ended on the 30th March 2021. The primary aim of the research was to contribute much needed data on marine megafauna distributions within the Western Indian Ocean region, and specifically to build knowledge on sperm whale populations (*Physeter macrocephalus*).

The research team on board was led by marine scientist Dr Kirsten Thompson, Greenpeace Research Laboratories and University of Exeter, and assisted by Dr Tim Lewis, independent research scientist. The participation of Sheena Talma from Seychelles and Shaama Sandooyea from Mauritius was essential in providing insights into the region's biodiversity and environment as well as research networks. Dr Thompson and Dr Lewis designed the visual survey with support from GLOBICE and the Indian Ocean Cetacean Research Network and additional guidance from Seychelles Bird Records Committee on seabird observations.

The initial findings from the Greenpeace International expedition to the Saya de Malha Bank in March 2021 have revealed a diverse array of wildlife[1]. The research team used a combination of systematic (and opportunistic) visual surveys, passive acoustic monitoring, underwater video and photographic imaging as well as water sampling for subsequent environmental DNA (eDNA) monitoring. We recorded 16 species of birds and six species of marine mammal (one baleen whale and five toothed whales) through the visual survey, eight species of toothed whales using passive acoustic monitoring and 144 through eDNA-based methods (at high confidence, eight cetaceans, eight elasmobranchs, 72 teleost fish and 56 vertebrates). Overlap was evident between these complementary methods providing consistent evidence that this region of the Indian Ocean is highly biologically diverse, and that integration of multiple methods is a powerful technique in assessing biodiversity.

[1] Preliminary report on research conducted from MY Arctic Sunrise in Saya de Malha Bank region, Indian Ocean, 2021. Greenpeace Research Laboratories Analytical Results Report 2021-04: 15 pp. https://www.greenpeace.to/greenpeace/wp-content/uploads/2021/07/Preliminary_Research_Report_SayadeMalhaBank_March2021.pdf

The visual survey of marine megafauna, defined as birds, whales and dolphins, turtles and large fish, such as sharks or billfish, demonstrates the diversity of wildlife living on and around the Saya de Malha Bank region. Our survey included transits across the Saya de Malha Bank and Ritchie Bank, and regions of the shelf edge, particularly between the two.

The water samples collected for environmental DNA monitoring of marine vertebrates were sent for sequencing to a laboratory in France, SPYGEN. eDNA monitoring can provide a record of vertebrate species inhabiting the area through detections of DNA from biological material such as skin cells, mucus or faeces that remain in the water after an animal has passed through. Initial reports of species detections received from SPYGEN in September 2022 suggest that a high diversity of species inhabit the waters surrounding the Saya de Malha and Ritchie Bank. For the genetic marker amplifying data from marine mammals, a total of eight species were identified at >98% sequence identity (what we would consider a high certainty of species identity). Two of these species (pilot whales, *Globicephala macrorhynchus*, and Blainville's beaked whale, *Mesoplodon densirostris*) were seen in the visual survey and Blainville's were also potentially detected acoustically based on the peak frequency of the detection. A high diversity of sharks and rays were detected with 20 species amplifying at the chondrichthyes genetic marker, six of these at >98% sequence identity: the bowmouth guitarfish (*Rhina ancylostoma*), whale shark (*Rhincodon typus*), tawny nurse shark (*Nebrius ferrugineus*), Chilean devil ray (*Mobula tarapacana*), smooth hammerhead (*Sphyrna zygaena*) and great hammerhead (*Sphyrna mokarran*). The teleost genetic marker provided data from 182 fish, with 72 being identified at the genus and species level indicating a 98% sequence identity at that marker. eDNA fragments that amplified using the vertebrate specific primers provided consistent evidence of these results, with the addition of two bird detections, the red-footed booby (*Sula sula rubripes*) and a species from the genus *Anous* (noddy). Additional funding is being sought to help further analyses of sequence data to provide the basis of a peer reviewed publication, ideally led by a local stakeholder as coauthor.

The team captured underwater footage of the seagrass and mixed coral shallow water ecosystem on Ritchie Bank in the Saya de Malha region. The Saya de Malha Bank region is known to support the world's largest seagrass meadow - and is, therefore, thought to be one of the largest carbon sinks by area in the ocean. A formal Memorandum of Understanding has

been drawn up between Greenpeace and Nekton to support a more detailed analysis of the footage further so as to create an inventory of species present.

The research team collected approximately 8 terabytes of acoustic data with a hydrophone towed from the stern of the *Arctic Sunrise*. Analyses of these data were conducted according to the protocols developed in Webber et al. (2022)[2]. The initial results suggest that total of 184 detections were made in areas beyond national jurisdiction, with at least six species of cetacean detected, including sperm whales, bottlenose dolphin (*Tursiops truncatus*), killer whale (*Orcinus orca*), spinner dolphins, pygmy killer whale (*Feresa attenuata*) and a beaked whale (Ziphiidae) that could not be identified to species level using acoustics alone. Sperm whales were evident on the shelf break surrounding the Saya de Malha. Visual and acoustic data are currently being analysed further to form the basis of a peer reviewed manuscript.

Further ongoing analyses of sperm whale data has included habitat suitability modelling and examining connectivity through a wider dissemination of photoidentification data and analyses of population specific vocalisations. Preliminary modelling using Greenpeace 2021 visual and acoustic data and data derived from Pelagis REMMOA aerial surveys in 2010 suggest high habitat suitability (>0.6) around geographic features such as submarine canyons, seamounts and steep drop-offs around shoals. Shallower areas such as the plateaus of Saya de Malha and Nazareth bank have a very low suitability. A large patch of highly suitable area also appears to be on the slopes of Rodrigues Ridge, La Feuillée Bank, and Saya de Malha Bank. As well as areas of known high habitat suitability around Mauritius and Reunion. The initial results show that the southwest Indian Ocean is important for sperm whales and support the expansion of protected areas, such as IMMAs, within the area. The results of this modelling are currently being drawn together to form the basis of manuscript for submission to Endangered Species Research. Tail fluke images have been uploaded to Flukematcher online repository. To date, there have been no matches with existing whales in the catalogue, but this may change in the future as other whale images are added.

We hope the data collected on the Greenpeace Indian Ocean Expedition 2021, and subsequent findings to be published in peer reviewed journals will further global understanding of the Mascarene Plateau, specifically the region around the Saya de Malha Bank. Such data, through effective collaboration, can help to support the design of effective conservation and

[2] Webber et al. (2022). Streamlining analysis methods for large acoustic surveys using automatic detectors with operator validation. Methods Ecol Evol 13: 1765-1777. doi:10.1111/2041-210X.13907

management measures for the region as well as provide baseline information that enable future research.

Environmental DNA

The science objectives for the Saya de Malha Expedition 2021 included environmental DNA sampling to provide detection data on marine vertebrates. Our primary aim was to help to fill significant knowledge gaps relating to species presence and more generally those relating to marine biodiversity in a rapidly changing marine ecosystem. eDNA monitoring is a novel tool in providing a rapid assessment of species presence within oceanic ecosystems and additional information on species community diversity. The technique is also extremely useful in detecting rare and elusive species that are often not recorded during other surveys. For the Saya de Malha Bank, this research is unprecedented and will provide baseline data on vertebrate species richness in this unique ecosystem.

The technique involved collecting water samples at the surface from the rigid hulled inflatable boats (RHIBs) using a peristaltic pump that then filters 30L seawater, collecting free-floating DNA on a membrane within a specialised filter. A total of 14 surface samples were collected on 9 transects. In addition, 6 samples were collected from depths between 20 - 160m using two 10L Niskin water samplers, where a total of 20L were filtered using the same kits as above. The samples were transported to a laboratory for DNA isolation and sequencing. We anticipate that further bioinformatic analyses and write up will result in a peer reviewed publication.

Status September 2022:

Initial results from eDNA survey were obtained in September 2022. Four regions of the 12S mitochondrial gene were targeted within the samples – one locus each that is designed to detect mammals, chondrichthyes or cartilaginous fish such as sharks and rays, teleost or ray finned fishes (which also detects some sharks and rays) and finally one locus for vertebrates. Each fragment is amplified over multiple replicates in the laboratory to ensure consistency, and therefore, robust results. Results indicate species detections over different levels of certainty, for example high certainty indicates a >98% sequence identity to the reference database used (GenBank). Sequences not assigned a high level of identity to reference sequences indicate species that either have not been sequenced previously or do not match closely to online databases due to the short DNA fragment length. However, with further analyses a picture of the within-group or intra-taxa community based on phylogenetic methods is possible and we hope to complete this in the future with additional funding.

A high diversity of species was detected from the eDNA sampling. For marine mammals, a total of eight species were identified at >98% sequence identity: pilot whales (*Globicephala macrorhynchus*), false killer whale (*Pseudorca crassidens*); spinner dolphin (*Stenella longirostris*); striped dolphin (*Stenella coeruleoalba*); spotted dolphin (*Stenella attenuata*); Indo-pacific bottlenose dolphin (*Tursiops aduncas*); dwarf sperm whale (*Kogia sima*) and, Blainville's beaked whale (*Mesoplodon densirostris*).

For the chondrichthyes genetic marker, a total of 20 species were detected, six of these at >98% sequence identity: the bowmouth guitarfish (*Rhina ancylostoma*), whale shark (*Rhincodon typus*), tawny nurse shark (*Nebrius ferrugineus*), Chilean devil ray (*Mobula tarapacana*), smooth hammerhead (*Sphyrna zygaena*) and great hammerhead (*Sphyrna mokarran*). The teleost genetic marker was able to detect both teleost fish and a number of chondrichthyes, providing sequences from 182 fish, 72 at the genus and species level and 98% sequence identity at that marker. These detections included additional shark species, for example the snaggletooth shark (*Hemipristis elongata*) and spot-tailed shark (*Carcharhinus sorrah*). The diversity of teleost fish included both reef and pelagic species and further work will be placed on assessing which samples yielded which species. eDNA fragments that amplified using the vertebrate specific primers provided data on 149 species, 56 at >98% sequence identity, indicating consistency across taxonomic groups, with the addition of two bird detections, the red-footed booby (*Sula sula rubripes*) and a species from the genus *Anous* (noddy).

Underwater images

We collected underwater footage using a remotely operated vehicle (ROV) in two deployments, resulting in 50 minutes of footage. ROV deployments were conducted on the 17th March (location: -8.857083, 60.210267): and 18th March 2021 (location: -8.853433, 60.2171). In addition, video and still photographs documented the seagrass meadows and corals. Preliminary assessment of the material indicated evidence of mixed seagrass and coral ecosystems: *Thalassodendron ciliatum*, *Acropora* spp., table corals and brain corals, as well as diverse fish species such as wrasse, trevally and grouper.

The images provide an initial dataset with which to examine the seagrass ecosystem, and the fish and coral communities associated with it as well as its overall health and status. All video footage and images have been shared with the Saya de Malha Joint Management Association and are freely available on the Greenpeace International Media Library.

Table 1. Date and location of underwater images within the Greenpeace International Media Library.

Date	Latitude	Longitude	Image comments
06-Mar-21	-9.207	60.362	Seagrass, large table coral
18-Mar-21	-9.195	60.364	Coral
18-Mar-21	-9.195	60.364	Coral and seagrass mix
18-Mar-21	-9.196	60.364	Coral and seagrass mix
18-Mar-21	-9.208	60.365	Coral and seagrass mix
18-Mar-21	-9.471	60.394	Fish shoal, coral
20-Mar-21	-9.200	60.367	Corals, then mixed seagrass and coral

Status September 2022:

A formal Memorandum of Understanding with Nekton has been signed to ensure collaboration on the identification of fish, coral and other species that are visible on the video and stills images. We hope to engage an intern / student to work with Nekton personnel to identify as

many species as possible, given their previous work on creating identification guides for Indian Ocean fishes. We hope this work can start within the next year.

Visual survey: Marine mammals and large fish

More than 500 person hours of visual surveying recorded 201 marine megafauna sightings (28 cetaceans, 1 turtle, fish and 157 birds) associated with the Saya de Malha region (Table 2). This included two feeding groups of sperm whales (*Physeter macrocephalus*) as well as pilot whales, spinner dolphins, Blainville's beaked whales, Bryde's whales and a killer whale. The visual survey of birds revealed species such as petrels, shearwaters, boobies, terns, noddy and frigate birds.

Table 2. Cetaceans observed during visual surveys through the high seas transit to the Saya de Malha region of the Mascarene Plateau.

Common name	**Scientific name**	**Number of encounters**	**Comments**
Sperm whale	*Physeter macrocephalus*	3	Two feeding groups, photoidentification of seven individuals at Saya de Malha.
Bryde's whale	*Balaenoptera edeni*	4	
Short-finned pilot whale	*Globicephala macrorhynchus*	1	
Killer whale	*Orcinus orca*	1	
Blainville's beaked whale	*Mesoplodon densirostris*	1	Two animals verified by photograph
Spinner dolphin	*Stenella longirostris*	6	
Unidentified balaenopterid	-	3	
Unidentified dolphin	-	7	Likely spotted or spinner dolphins but not close enough to the ship to verify.
Unidentified large whale	-	2	
	Total	28	

Spotted dolphins were sighted in Mauritian waters to the west of Saya de Malha Bank during transit to survey locations. At the Saya de Malha Bank, the visual survey also recorded fish, sharks and rays such as: whale shark (*Rhincodon typus*), oceanic manta ray (*Mobula birostris),* sunfish (*Mola mola*) and mahi mahi (*Coryphaena hippurus*) as well as many tuna and unidentified shark that were not noted in the survey.

Status September 2022:

A manuscript reporting on both the results from the visual and passive acoustic monitoring surveys is in preparation. We anticipate that a draft will be finalised for submission before December 2022.

Visual survey: birds

In addition to documenting cetaceans and fish, the survey also noted all bird sightings to species level, where possible, resulting in 157 observations in international waters. Two observers were experienced bird biologists and were able to confirm species identity with high confidence, either by visual observation or by subsequent inspection on photographs. All other sightings were confirmed to the best of the observers' ability and are noted as low or medium confidence unless specifically common and easy to identify. A total of 70 bird encounters were noted within the high seas area of the visual survey at high confidence. Species included: masked booby (*Sula dactylatra*), red-footed booby (*Sula sula*), lesser noddy (*Anous tenuirostris*), bridled tern (*Onychoprion anaethetus*), fairy tern (*Sternula nereis*), wedge-tailed shearwater (*Puffinus pacificus*), Bulwer's petrel (*Bulweria bulwerii*), white tern (*Gygis alba*), brown booby (*Sula leucogaster*). A further 87 bird sightings were noted where the species' identity was deemed to be of medium or low confidence.

Status September 2022:

Data on bird sightings has been lodged with the Government of the Seychelles and the Joint Management Association. A further call to relevant non-government organisations will help to assess whether data are required for current ongoing projects.

Acoustic survey

An approximately 350 m long towed passive acoustic monitoring hydrophone array was deployed from the vessel and analyses completed according to the protocols outlined in Webber et al. (2022)[3]. Continuous recordings were made constituting approximately 8 Terabytes of data that was processed using the open source PAMguard[4] software.

Status September 2022:

The acoustic data collected here formed part of a larger dataset analysed in Webber et al. (2022) and uploaded to OBIS-Seamaps[5]. In addition, a further manuscript is in preparation for submission to a peer reviewed journal by December 2022. Preliminary analyses of acoustic data used the protocols detailed in Webber et al. (2022) and this work is currently being finalised. In short, the whistle and moan detector within PAMGuard was implemented between 1 and 24kHz[6]. Whistles are assigned a likelihood score for each species included in the vocalisation reference database, known as the classifier, which will add up to one when all the species are summed. Species in the classifier were: bottlenose and common dolphin, false killer whale, killer whale (*Orcinus orca*), pilot whale (*Globicephala* spp.), Risso's dolphin and striped dolphin. Because there are a lack of verified acoustic recording of cetaceans in the Indian Ocean, species included in the classifier were recorded in other regions, not the western Indian Ocean. In addition, not all species occurring within the western Indian Ocean were included in the whistle classifier. Any whistle with likelihood score below the threshold of 0.8 was determined to be an unidentified delphinid. Manual verification of recordings was then conducted on sections identified by the detectors as containing potential odontocete presence. The results suggest that total of 184 detection were made in areas beyond national jurisdiction, with at least six species of cetacean detected, including sperm whales, bottlenose dolphin (*Tursiops truncatus*), killer whale (*Orcinus orca*), spinner dolphins, pygmy killer whale (*Feresa attenuata*) and a beaked whale (Ziphiidae) that could not be identified to species level using acoustics alone (Fig. 1)(Table 4). Note that bottlenose dolphins detected may be either *T. truncatus*, or the Indo-Pacific bottlenose dolphin (*T. aduncus*), and more acoustic data verified by sightings would be needed to confidently determine which species were detected due to

[3] Webber et al. (2022). Streamlining analysis methods for large acoustic surveys using automatic detectors with operator validation. Methods Ecol Evol 13: 1765-1777. doi: 10.1111/2041-210X.13907
[4] https://www.pamguard.org
[5] https://seamap.env.duke.edu/
[6] Gillespie et al. (2013). Automatic detection and classification of odontocete whistles. J Acoust Soc Am 134: 2427–2437. doi.10.1121/1.4816555

similarities in the vocalisations between these two species. Sperm whales were evident on the shelf break surrounding the Saya de Malha.

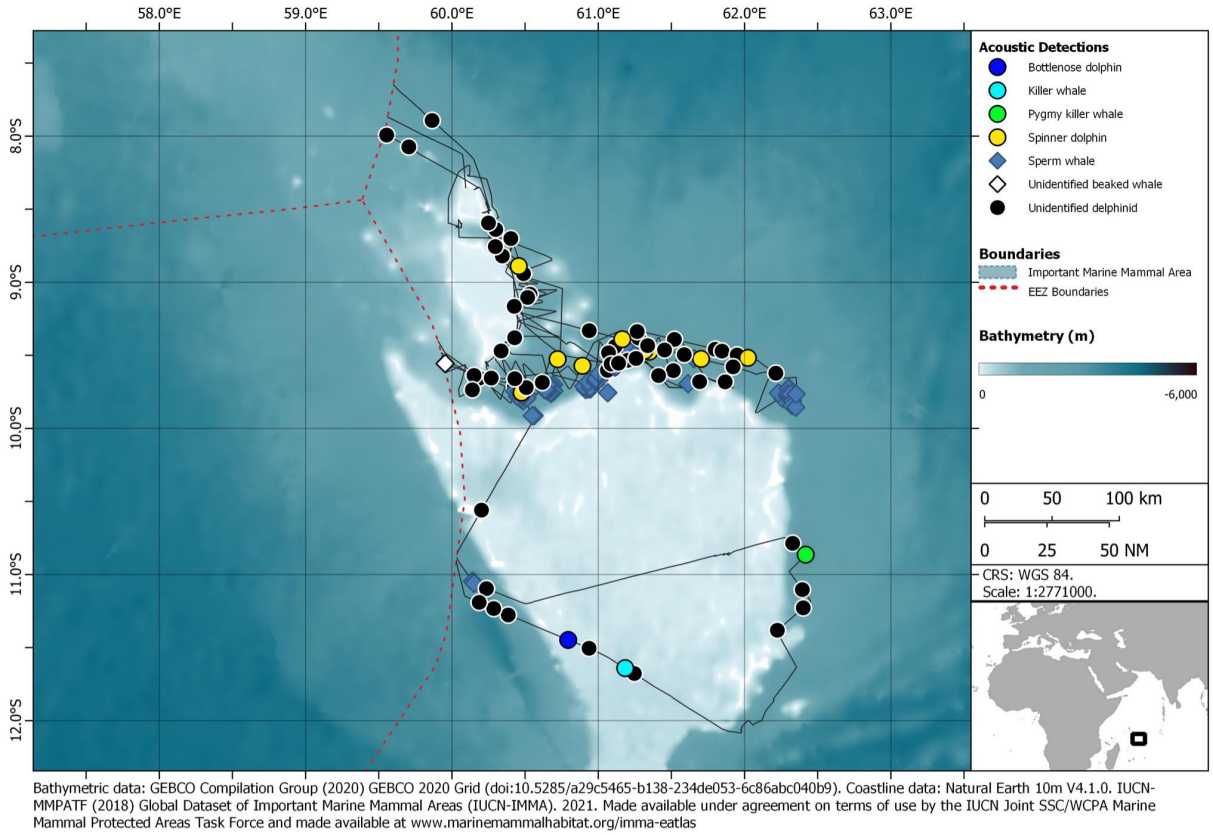

Figure 1. A preliminary map of acoustic detections during the Greenpeace passive acoustic survey of the Saya de Malha Banks and surrounding area conducted in March 2021. The black line shows the track followed by the MY *Arctic Sunrise*.

Table 3. Acoustic detections of odontocetes during surveys onboard the M/Y *Arctic Sunrise* with the associated water depth (mean = x̄, range = R) from GEBCO and PAMGuard whistle classifier confidence of detections where applicable.

Common name	**Species**	**No. detections**	**Depth (m)**	**Comments**
Sperm whale	*Physeter macrocephalus*	111	x̄ = 1423 R = 321–2851	Likely from 31 group encounters.
Beaked whale	*Ziphiidae*	1	811	Peak click frequency 30.3 kHz, likely Blainville's beaked whale
Bottlenose dolphin	*Tursiops truncatus*	1	167	Whistle classification likelihood 0.967
Killer whale	*Orcinus orca*	1	280	Visual confirmation
Pygmy killer whale	*Feresa attenuata*	1	2180	Whistle classification likelihood 0.989
Spinner dolphin	*Stenella longirostris*	10	x̄ = 1788 R = 1185 - 2259	Whistle classification likelihood x̄ = 0.959, R = 0.867 & 0.999
Unidentified delphinid		59	x̄ = 1412 R = 35 - 3103	
Total		184		

Sperm whale research

Photoidentification images were gathered for seven individuals encountered at the Saya de Malha region (Table 4). Vocalisations were also recorded where possible and additional images were collected with the use of drones.

Table 4. Sperm whale groups were encountered at the following locations in the Saya de Malha region.

Date	Latitude	Longitude	Group size	Identified individuals
21st March 2021	-9.698983	60.93675	6	PmaSaya01; PmaSaya02; PmaSaya03; PmaSaya04; PmaSaya05
24th March 2021	-9.867222	61.498888	>2	PmaSaya06; PmaSaya07
25th March 2021	-9.215383	60.44777	1	-

Status September 2022:

We are continuing to process and analyse all sperm whale data including sightings, recordings and disseminating photoidentification images, which were provided in the initial summary report[7]. The following projects are underway and being prepared as manuscripts for peer review.

Sperm whale habitat suitability modelling

Knowing where species can be found, what environmental features influence their habitat choice and how habitat selection changes with time is vital for identifying critical habitats and can help to inform conservation planning processes. The environmental conditions which allow

[7] Thompson, K.F. (2021). Preliminary report on research conducted from MY Arctic Sunrise in Saya de Malha Bank region Indian Ocean, 2021. Greenpeace Research Laboratories Analytical Results Report 2021-04. Available at: https://www.greenpeace.to/greenpeace/wp-content/uploads/2021/07/Preliminary_Research_Report_SayadeMalhaBank_March2021.pdf

the maintenance of a species' population without the need for external recruitment create a species' 'fundamental niche'. Ecological Niche Modelling (ENM) is a statistical method of estimating the fundamental niche of a species for a given temporal and spatial extent. The output of this method is illustrated as a habitat suitability map, showing where a species is likely to occur based on presence/absence data and the accompanying environmental data.

Two datasets were used: 1. Greenpeace 2021 and, 2. Pelagis REMMOA aerial surveys 2010. From each dataset, presence data was derived from sightings and acoustic detection. As neither dataset had true absence data, pseudo-absences were created using a background sampling approach for each datasets' designated survey area extent. ENM requires environmental data which correlate and describe the physical environment for the spatial and temporal extent of the presence/pseudo-absence data. Seabed depth (m) and seabed slope (degrees) were sourced from www.gebco.net. Night Sea Surface Temperature (NSST, °C) and Chlorophyll-a concentration (Chl-a, mgm^3) were retrieved from oceancolor.gsfc.nasa.gov/l3/.Temperature gradient (temp grad, °C) and Eddie Kinetic Energy (EKE, m^2/s^2) were calculated using temperature and current velocity data retrieved from marine.copernicus.eu. Biomod2 package in R (Thuiller *et al.*, 2021)[8] was used for the modelling process. An ensemble approach was adopted to incorporate the strengths of each statistical modelling method, while limiting the uncertainty and weaknesses of each method to the best of the ensemble processes' ability.

[8] Thuiller, W., Lafourcade, B., Engler, R., & Araújo, M. B. (2009). BIOMOD–a platform for ensemble forecasting of species distributions. *Ecography 32*: 369-373.

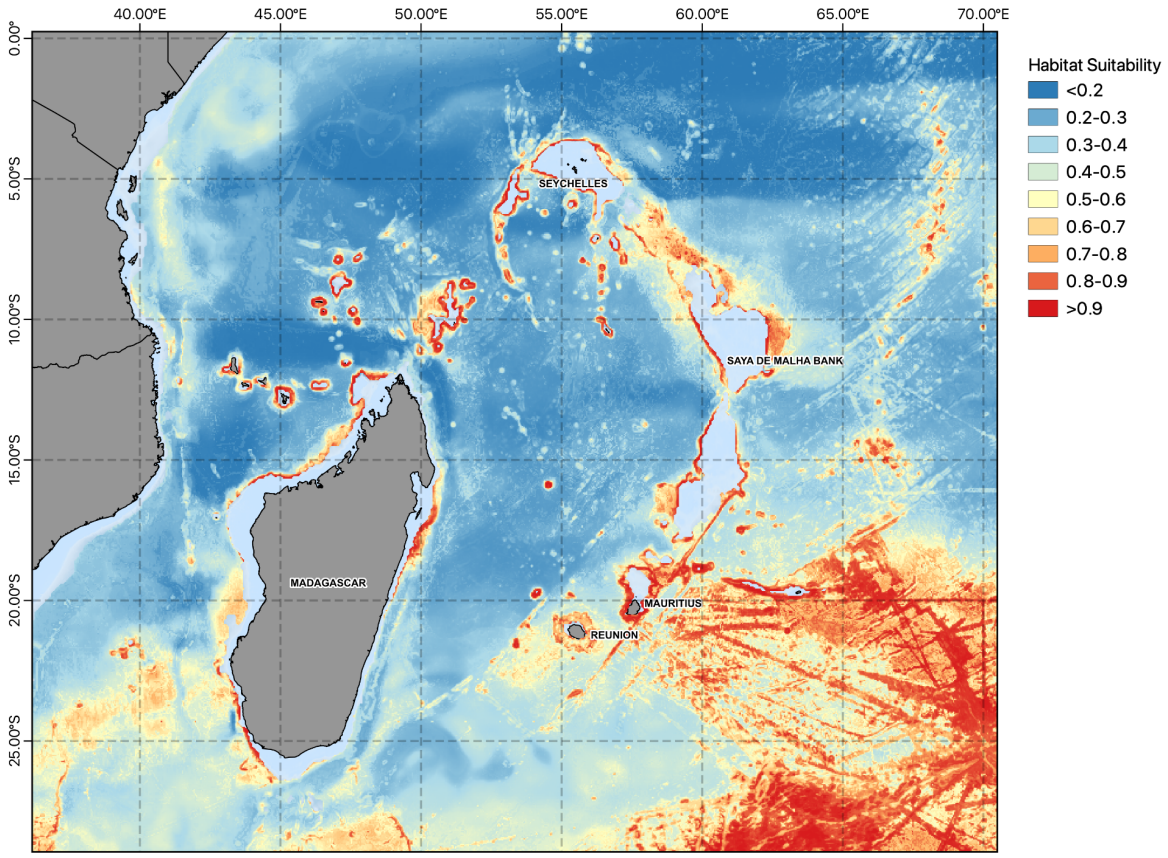

Figure 2. Habitat suitability map for sperm whales across the southwest Indian Ocean as derived from ecological niche modelling using the Greenpeace 2021 visual and acoustic datasets and an additional dataset from Pelagis REMMOA aerial surveys 2010. The red shading denotes high habitat suitability for sperm whales.

High habitat suitability (>0.6) followed geographic features such as submarine canyons, seamounts and steep drop-offs around shoals (Fig. 2). Shallower areas such as the plateaus of Saya de Malha and Nazareth bank have a very low suitability. A large patch of highly suitable area also appears to be around Rodrigues Ridge, La Feuillée Bank, and Saya de Malha Bank. As well as known suitable habitat around Mauritius and Reunion. The initial results show that the southwest Indian Ocean is important for sperm whales and supports the expansion of protected areas, such as IMMAs, within the area. Next steps would be to perform the same

modelling process for other deep diving cetaceans, with a combination of acoustic and visual detection data.

Sperm whale population connectivity

Sperm whale photo IDs were submitted to Flukebook (https://www.flukebook.org/) to match flukes to known sperm whales around the Mascarene plateau. As of 5th October 2022, no matches have been made to the photographed flukes. However, this may change in the future as more individuals are sighted and identified within the Flukebook database.

In addition, an analysis of sperm whale vocalisations that provide information on their vocal clan, codas, is ongoing. Initial results suggest that only one coda was recorded. These vocalisations can be compared with data from other populations to indicate potential connectivity and the identity of the vocal clan that the whales at the Saya de Malha sperm whales may be a part of.

Conclusions

The Greenpeace Expedition to Saya de Malha in 2021 has generated a suite of novel data that are now being analysed further so that manuscripts can be submitted to peer reviewed journals. We will seek further funding so that the eDNA data can form the basis of a future postgraduate project and several peer reviewed articles in collaboration with a university in the region. Visual-acoustic data for cetaceans has undergone a preliminary analysis and is now currently being prepared as a manuscript that will be a short note. In addition sperm whale habitat suitability modelling will also provide the basis of a peer reviewed paper submitted to Endangered Species Research. Greenpeace will continue sharing further findings of the above analyses as soon as results and conclusions are available as finalised manuscripts; all data will be open access on publication.

We hope the data collected on the Greenpeace Indian Ocean Expedition 2021, and subsequent findings to be published in peer reviewed journals will further global understanding of the Mascarene Plateau, specifically the region around the Saya de Malha Bank. Such data, through effective collaboration, can help to support the design of effective conservation and

management measures for the region as well as provide baseline information that enable future research.

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Annex: Publications resulting from this expedition

Several publications are in preparation for submission to international peer reviewed journals, these will be sent to both the JMA and Seychelles government on publication. The following publication is open access.

Webber, T., Gillespie, D., Lewis, T., Gordon, J., Thompson, K.F. (2022). Streamlining analysis methods for large acoustic surveys using automatic detectors with operator validation. Methods in Ecology and Evolution 13: 1765-1777. doi:10.1111/2041-210X.13907