Researchers discover Raja Ampat's reef manta rays prefer staying close to home—which could help save more of them

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The reef manta ray (Mobula alfredi) is a tough swimmer. They can travel hundreds of kilometers to feed themselves. The longest recorded movement for an individual reef manta ray was 1,150km, observed in eastern Australia.

But even though they are able to swim long distances, our study on reef manta rays in Raja Ampat, Southwest Papua, discovered they are more likely to swim short distances. They appear to prefer staying close to their local habitats, strengthening their social bonds and forming distinct populations.

Our research—involving researchers from Indonesia, New Zealand and Australia and published in the *Royal Society Open Science* journal in April—increases our understanding of this globally vulnerable species.

Policymakers can use our findings to enhance conservation efforts for the species in Raja Ampat waters, which currently are facing challenges due to fishing and tourism.

Why don't reef manta rays roam far?

Our study found reef manta rays occupy three distinct habitats within Raja Ampat. As of February 2024, we recorded 1,250 individual manta rays around Waigeo Island's extensive coral reef ecosystem in the northwest of Raja Ampat; 640 manta rays around the coral reef ecosystem in the southeast of Misool, southern Raja Ampat; and no more than 50 manta rays in the Ayau atoll ecosystem up north.

Within their own habitat, the manta rays tend to move around from one area to another, sticking to relatively short distances within 12 kilometers. They only occasionally make longer trips to similar areas in

other habitats across Raja Ampat.

We believe there are a few reasons why reef manta rays in Raja Ampat do not often venture far. The first reason is the presence of natural barriers, such as deep waters—over 1,000 meters below sea level—between Ayau Atoll and Waigeo Island, as well as the sea between Misool and Kofiau, which is 800-900 meters deep.

Traveling through deep waters poses increased risks to reef manta rays due to potential encounters with natural predators, such as killer whales (Orcinus orca) and large sharks, which frequently inhabit deep open water.

The second reason is that each habitat is well-equipped with sufficient resources, such as food and cleaning stations, reducing the need for the reef manta rays to travel extensively.

Our previous research has identified dozens of feeding areas and cleaning stations in each habitat occupied by local populations of reef manta rays in Raja Ampat.

Raja Ampat's 'small town' of reef manta rays

The habits of reef manta rays in Raja Ampat are gradually forming a unique population.

We have found that they do not form a single large population, but instead split into three local populations, creating a metapopulation. A metapopulation consists of several local populations of the same species, each occupying its own habitat but all situated within the same geographic region.

Think of a metapopulation as a small town, consisting of three hamlets.

When each hamlet has enough food and water, the people prefer to stay in their own settlement. But they still live in the same town and occasionally visit each other.

We found this movement pattern based on our tracking process from 2016 to 2021 using acoustic telemetry, which functions similarly to office check-in systems.

In the tracking process, we combined this acoustic tracking with network analysis to map out the movement network of the manta rays, consisting of nodes and links. Nodes represent important areas for the manta rays, like cleaning stations and feeding areas, and links represent the movement between these key areas.

The metapopulation occurs because individual manta rays migrate between local populations. Based on our observation, the migrating manta rays usually head back to their original area—it is often seasonal—while those that spread out generally do not return.

This movement pattern means there is less mixing of individuals between local populations compared to within a single local population.

How to better protect reef manta rays

Some conservation policies and efforts have successfully increased the populations of reef manta rays in Raja Ampat.

But increased human activities such as fishing and tourism in eastern Indonesia still pose challenges. While manta rays are not directly caught or hunted, they often get entangled in fishing lines and nets, which may cause harm and sometimes death.

Additionally, with the increasing popularity of Raja Ampat as a top

tourism destination, overcrowding and aggressive behavior by divers and snorkelers in Raja Ampat disrupt manta ray cleaning and feeding, which may affect their health and fitness.

Conservation strategies for reef manta rays require a more precise and targeted approach to effectively address these growing challenges.

The recognition of these rays as a metapopulation comprising three distinct local populations can inform a strategy shift in conservation management.

Recently, we have presented our research findings and recommendations to the authorities responsible for managing the Raja Ampat Marine Protected Area (MPA) network.

We recommend the MPA management authority in Raja Ampat create and implement three separate management units, each tailored to the specific needs of one of the local manta ray populations.

Separate units are necessary because each habitat has different demographics and is far apart, making it difficult to manage them as a single unit. This strategy is feasible because local rangers in each habitat already conduct regular patrols and monitoring.

We also see the urgent need to protect a critical area for various activities of reef manta rays in Raja Ampat called Eagle Rock, which is currently outside existing protected zones. Located in west of Waigeo, Eagle Rock could be effectively safeguarded by expanding the Raja Ampat MPA network to encompass this area.

Protecting Eagle Rock is crucial, not only because it serves as a vital migration corridor connecting significant areas and habitats within the South East Misool MPA, Dampier Strait MPA, Raja Ampat MPA, and

West Waigeo MPA, but also due to the increased threat from nickel mining activities on Kawe Island.

MPAs prohibit industrial fishing, restrict tourism and all unsustainable activities—including mining—to minimize environmental impact.

Besides mapping out the movement patterns and networks of key areas and habitats of reef manta rays in Raja Ampat, our research lays the groundwork for future studies, including genetic analysis and satellite tracking.

These advanced techniques can offer deeper insights into the population structure, home range, and distribution of reef manta rays in the region, helping to enhance management and conservation strategies.

More information: Edy Setyawan et al, Spatial connectivity of reef manta rays across the Raja Ampat archipelago, Indonesia, *Royal Society Open Science* (2024). DOI: 10.1098/rsos.230895

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