Building Partnerships to Reduce Maritime Noise Pollution in Coral Reefs

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Raja Ampat
Credit: Beth Watson/ Coral Reef Image Bank

WWF's Mission:

"Our mission is to conserve nature and reduce the most pressing threats to the diversity of life on Earth."

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Disclaimer

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy at the University of Virginia. This paper is submitted in partial fulfilment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, or by any other agency.

Honor Statement

On my honor, I have neither given nor received unauthorized help on this assignment.

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Glossary and Word Bank

Biodiversity Hotspot – A biogeographic region that is both a significant reservoir of biodiversity and is threatened with destruction.

Flagship species – a species picked to serve as an ambassador, icon, or symbol for a particular campaign, issue, habitat, or environmental cause.

Holistic reef management – also called integrated reef management, this management incorporates the land-sea connection, all pollution inputs, local communities, environmental economic services, and extractive resources into the management of a reef ecosystem.

Maritime Noise Pollution – Noise from ships, drilling, and other human activity in the ocean or other bodies of water that inhibit the natural processes of ecosystems.

NGO or Non-Governmental Organization – an organization that serves a mission or a cause, and exists neither in the private sector or directly run by a government. Generally, these organizations do not function with a profit motive, and in the United States may be referred to as non-profits.

Non-state actor – A non-state actor is any organization that operates either locally or transnationally that does not fall under the effective jurisdiction of any one state entity. There is an argument to be made that international corporations are blurring the line to become non-state actors that can exercise some independence.

WWF – World Wildlife Fund

Executive Summary

Coral reefs are biodiversity hotspots and economic engines for local communities that are constantly under threat from human activities, including but not limited to overfishing, habitat destruction, and climate change (Ateweberhan et al., 2013). Often overlooked is the increasing threat posed by noise pollution from ship traffic in biologically sensitive area. Though the research on the impact of noise pollution on coral reefs is in its infancy, the data indicate that noise pollution impacts from ship traffic have negative effects on the health and viability of coral reefs. Existing research on noise pollution has focused on marine mammals as flagship species, and coral reefs can serve as another flagship project where noise pollution is a concern (Tournadre, 2014). Additionally, as coral reefs suffer increasing impacts from an expansion of ship traffic and other human interference, the response to protect coral reefs has in the past been focused on specific interventions that could improve reef health. However, as the research on holistic reef management becomes more salient, opportunities will arise for action on maritime noise pollution (Bachtiar et al., 2019).

The World Wildlife Fund should consider options to leverage its competitive advantage in the non-governmental organization sector. The three alternatives that should be considered are to continue with the statue quo, to pursue partnerships wit the United States Navy, and by pursuing partnerships with corporate and industry groups. This document recommends the World Wildlife Fund move to protect coral reefs from noise pollution by embarking on building partnerships with different industry groups involved with the shipping industry to build a case of best practices with dealing with the threat posed by noise pollution to reef ecosystems. The World Wildlife Fund has expertise in building partnerships across sectors, both public and private, that allow it both the reputation and track record to propose this partnership as the research comes in, so as to proactively manage noise pollution in coral reefs. This would build off of momentum established by the World Wildlife Fund's historical relationships and data-driven policy recommendations to further environmental causes.

This document will also summarize research regarding the best practices of partnership management across sectors, in order to build sustainable relationships and effective teams across both the World Wildlife Fund and any potential partners. In laying out these best practices for

implementation, this document hopes to build off of the established relationships and developed reputation that the World Wildlife Fund has created over the recent past, and to strengthen them. Ideally, the implementation of this relationship-building will allow the World Wildlife Fund to increase its effectiveness in other related relationships to better serve its mission and implement projects.

Overall, this opportunity to engage with partners to promote relationships than will be able to affect change will set up the World Wildlife Fund in a position to drive the policy conversation as new research comes out. With the advent of holistic reef management and increasing understanding of the impacts of the previously overlooked pollutant effects of noise in underwater ecosystems, especially coral reefs, the World Wildlife Fund and its partners will be optimally positioned to respond accordingly with best practices and produce policy recommendations to governments as well as implement scientifically sound mitigation strategies with the corporate partners.

Problem Statement

Coral reefs are biodiversity hotspots that provide ecological services and economic functions for communities all across the world. Coral reefs are threatened by a myriad of individual stressors in the face of a changing climate. An overlooked pollutant, noise pollution, primarily from ship traffic, is a stressor on coral reefs across the world. As ocean-going vessels increase in mileage, the effects of noise pollution on stressed reefs will only grow. As a leader in the environmental policy sector, the World Wildlife Fund is well-positioned to build partnerships that could lead to reduction in ship-based noise pollution stressors on coral reefs.

Background

Within an ocean that provides $2.5 trillion in benefits every year, coral reefs are some of the most bio-diverse of the world's marine ecosystems (WWF, 2019). Within reefs holistically, the Coral Triangle region, which stretch from Indonesia in the west to the Philippines in the north and the Solomon Islands in the east, contains a hotspot for diversity. In particular, the eastern Indonesian reefs are perhaps the most diverse reefs in the world for coral, fish, mollusk, and other species (Edinger et al., 1998). 76 percent of described coral species can be found in the Coral Triangle, with highest coral diversity per hectare in the easternmost section of Indonesia,

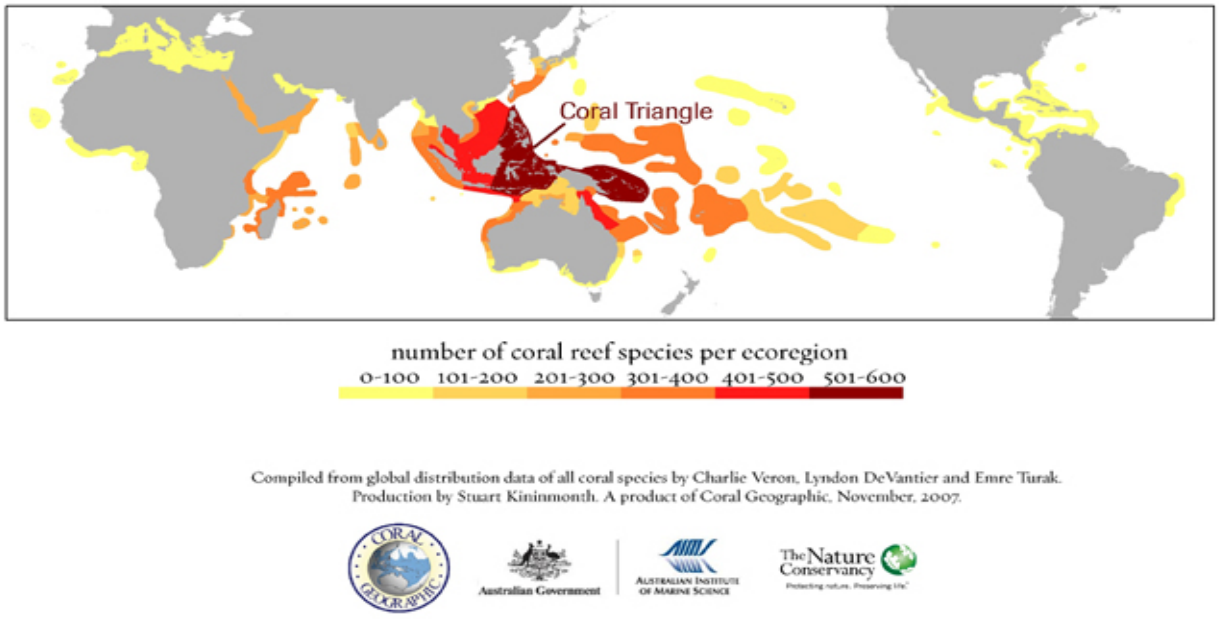


Figure 1: Number of Coral Reef Species per Ecoregion.

the Bird's Head Peninsula in Papua Province, according to a 2008 Nature Conservancy report (TNC, 2008). Reef systems in the Coral Triangle provide safe haven for many species of corals and reef fish. Beyond corals, over 1500 species of fish reside in the so called "Heart of the Coral Triangle." 52 percent of Pacific reef fish species occur in an area that encompasses roughly 3 percent of the area of the Pacific Ocean (Allen, 2007).

Due to the intense diversity of these reefs, these coral systems could show resiliency over geologic timescales. However, the abundance of these reefs have proven exploitable for local communities. Many local communities derive much of their income and sustenance from these reef systems. Population growth and land usage place increasing pressure on reefs. Climate change exacerbates the stressors of human populations (Ateweberhan et al., 2013). Ocean acidification and increased temperatures stress coral reef systems across the globe.

Literature Review

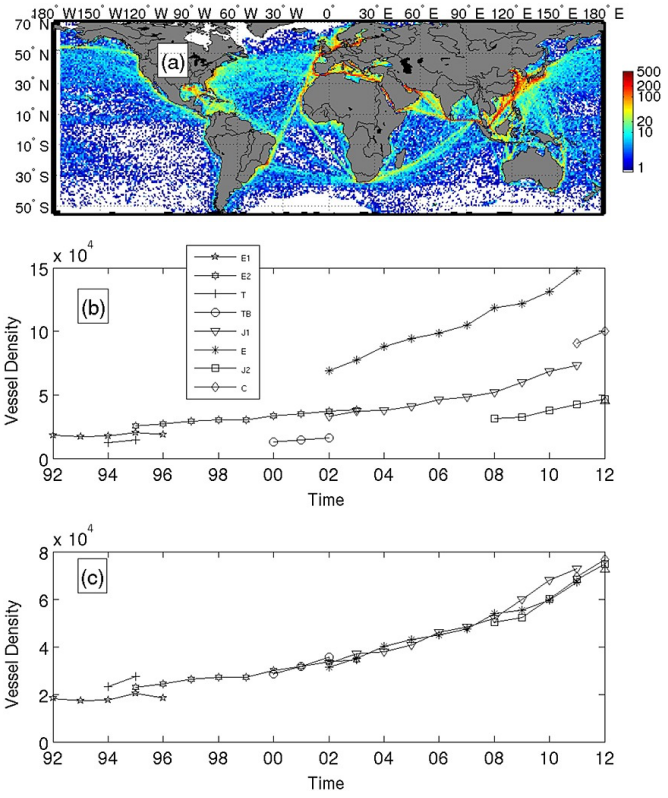
Coral Reef Risk Factors and Threats

Solving climate change and ocean acidification exists beyond the scope of this project. However, there are opportunities to increase the resiliency of the reef systems of the Eastern Indonesian region through proper management and by decreasing threats on a community level. Research has been done on many threats, including as overfishing, dynamite fishing, cyanide fishing, pollution, and siltation. Research on the effects of those risk factors on reef systems, in Indonesia or elsewhere, may be applicable to the conservation and management of these ecosystem areas. Existing syntheses of the existing research and techniques are scant but emerging (Please reference Appendix I for a further discussion on the risks associated to reefs).

Noise Pollution

However, one major non-point stressor that is often overlooked is noise pollution. Noise pollution, primarily from ship traffic, stresses marine life and reduces marine creatures' quality of life. This added stressor can seriously impact the resiliency of reef life to other stressors, including but not limited to the growing overall threat of climate change.

Figure 2: Ship Traffic from 1992 to 2012, Tournadre, 2014



This increase in noise pollution in the oceans can be attributed to increases in shipping in the past three decades. A 2014 study by Jean Tournadre found that ship traffic has increased significantly from 1992 to 2012, an increase of fourfold. This shipping traffic has been increasing primarily in the Western Pacific and Indian Oceans, traversing through highly sensitive and biodiverse coral ecosystems, as represented by the map from the study (Tournadre, 2014, Figure 2.).

Marine noise pollution protections has in the recent past been primarily focused on cetaceans and other marine mammals. In busy shipping areas such as Puget Sound or Stellwagen Bank, shipping lanes have been implemented to concentrate ship traffic to avoid marine mammal strikes but has had the added benefit of reducing marine noise (Smrcina, 2006). In Glacier Bay National Park and Preserve in Alaska, the popularity of cruise ships has forced management to institute quiet-periods to protect the health of the sea lions, whales, and fish of that particular ecosystem (Gabriele et al., 2018). Additionally, synchronization of cruise ship and shipping traffic through the National Park and Preserve while slowing them down seems to be the current favored implementation method, but the benefits are measured primarily for cetacean species (Frankel et al, 2017). There exists opportunity to expand the implementation of noise pollution reduction throughout other sensitive areas, particularly coral reefs.

World Wildlife Fund's Current Oceanic Conservation Efforts

The current efforts of the World Wildlife Fund regarding reefs has generally focused on management of those resources for the sustainability of the human-reef ecosystem and the controlled extraction of fishery resources with an eye to community development and long term sustainable practices. In general, the Word Wildlife Fund's efforts have been in a few major arenas: program implementation and advocacy/policy development. The implemented restoration projects have built up reefs to allow them to recover, and marine protected areas have allowed fish stocks room to be managed appropriately. Additionally, work at the national and international level to devise overall fisheries management plans based on scientific principles are among the WWF's many efforts to preserve and restore the oceans.

The World Wildlife Fund has dedicated on of its six main focus areas for dedication of time and resources to the preservation and conservation of the world's oceans under the Global Oceans Programme (WWF, 2019). Within the Global Oceans Programme, there are multiple areas of focus, with heavy emphasis on fishing, cetacean conservation, and coral reefs, as well as smaller focus areas including changing the dynamics of the market as well as a focus on coastal areas. This offers the WWF the opportunity to allocate resources amongst its sub-focus areas, as outlined in periodic updates for whole-ocean strategy (WWF Oceans, 2019). However, this division of focus areas, while concentrating resources effectively amongst programs, can lead to silos of interests, allowing trans-focus area issues, such as maritime noise pollution, to slip through the cracks.

The World Wildlife Fund also has focused on marine mammal protection, which has included noise reductions. However, most of the focus has been on reducing ship strikes and illegal harvesting, rather than reducing noise pollutions as a targeted strategy. Additionally, the WWF has highlighted shipping as one of its "problem areas" to focus on in oceans, but has not expressed concern for noise pollution as a specific opportunity within shipping. The WWF's guiding document on Ocean strategy, the "Living Blue Planet" report published in 2015, references these dangers with there quadrupling of ship traffic in the past two decades, and the dangers of pollution from cruise ships, but noise pollution is noticeable in its absence (WWF, 2015).There is a large opportunity for synthesis within the existing mission of the World

Wildlife Fund, without introducing mission creep, to offer science-based policy solutions through partnerships to reduce noise pollution when developing a holistic reef management strategy, as well as campaigning for reduced oceanic noise pollution overall.

Non-profit/Private and Non-Profit/Public partnerships

Over the past few decades, there has been a major shift in the power from national governments towards non-profits and corporate interests. Based on Weisbrod's assertions from his 1998 paper, non-governmental organizations fulfill roles not able to be cultivated by governments or private corporations (Weisbrod, 1998). This does not mean that national or international governance are irrelevant; rather the ability of private organizations to accrue decision-influencing or decision-making power has only increased. Within this, a differentiation between markets where these three separate styles of associations may operate has become merged. Therefore, there could be competition between groups of different management styles and purposes when dealing with similar problems, and they may tackle these problems from different perspectives.

In lock-step with the increasing internationalization of trade, jurisdictional lines have been blurred. With this in mind, there are further opportunities for building partnerships outside of traditional interest groups to promote policy-making across boundaries, particularly in issues of nebulous governance structures like maritime jurisdictions (Pattberg, 2005). Pattberg proposes a theory of "coregulation" as the best management practice moving forward. Rather than "self-regulation" by corporate interests, leveraging civil society, non-governmental actors like the WWF can cooperate with private and public partners to best construct data-driven policy. The further implications of this new research as well as further research will be referred to in the Implementation recommendation section.

Partnership Management Best Practices

Sullivan and Goldson argue in their 2017 paper that non-state actors (here they focus on corporations) are able to change governance in two ways: internally through their political pressures, and externally, through rollout of services and the actions they directly take. They point out that two major factors must be present for corporations to take steps with governance

towards policy aims, that there must be an economic incentive and that external pressures must align with the corporation adopting these new external governance strategies (Sullivan, 2017).

Non-governmental organizations actually share the same internal and external governance influence levers as corporations, just on different scales. However, the value-add of non-governmental organizations is that they do not respond to the incentive factors to change behavior the same as corporations. These are the gaps in which non-governmental organizations like the WWF can step in. If there is not high enough economic incentive through return on investment, non-profit actors can contribute money or deliver products to shift the needle for corporate best practices in the future. Additionally, non-profit actors may also align to exert pressures to push corporations. In this way the niche of interaction between government, non-governmental organization, and corporation may be leveraged to shift policy objectives. These best practices will be further summarized and applied in the implementation section of this report.

Conclusion of Literature Review

Realistically, the science regarding maritime noise pollution on coral reefs directly is weak, but the studies are starting to be published. However, the interpolation of data from other sources show that coral reefs are already under threat from many sources of pollution and other human impacts. Additionally, human-caused maritime noise pollution is both shown to have significant adverse impact on other marine ecosystems, as well as being manageable and fixable by mitigation techniques. However, these technical solutions do not themselves build a policy. While there are scientific and implementable technical solutions to this problem of maritime noise pollution on coral reefs, the WWF should look at these technical solutions in context. Therefore, the alternatives that are the outgrowth of this literature review will focus on leveraging the unique strengths of the non-governmental organization model of the World Wildlife Fund, particularly in its ability to leverage connections it has made over time with both government and non-state actors.

Realistically, the policy options laid before the WWF in this document reflect the nascent science, and as more science is rolled out to the public and published in higher quality journals, perhaps the technical solutions and their specific costs and benefits will become crystallized.

However, because this problem has been sidelined because there is a lack of flagship species for a coral reef ecosystem such as cetaceans, the specific detrimental impact of noise pollution has been overlooked for the sake of researching other, more easily identifiable pollution sources. As scientists move to include more variables in their holistic reef management plans, there will be an opportunity for them to include noise pollution measurements and impacts in a more accurate understanding and reflection of reef health. This data should be used when making decisions regardless of whichever alternative below is pursued. The opportunity for action has presented itself, and the WWF is position itself as a prime candidate to lead the way on creating value for coral reefs by addressing the impact from maritime noise pollution.

Alternatives

The primary opportunity to pursue alternatives is likely the building and pursuit of strategic partnerships that will allow the scientific analysis to be created, with the opportunity for technical or policy solutions to be rolled out across partners beyond the current impact of WWF restoration projects. The major benefit to this overarching strategy rather than direct project implementation is that the WWF's expertise can be promulgated to partner organizations whose feet on the ground position them to be more well-suited to the implementation could allow the WWF to focus on its expertise of advice and scientific analysis and leaving the project management to the strategic partners. This is already the WWF's comparative advantage over other near-peer non-governmental organizations, as its corporate partnerships are already amongst the models for non-governmental and public or non-governmental and private partnerships. Because of the WWF's established track record of leveraging these partnerships, the WWF is uniquely suited to use its expertise to promulgate these following opportunities.

The three alternatives considered that will be described in more detail below are as follows.

- Alternative I: Let Current Trends Continue
- Alternative II: Partnership with United States Navy
- Alternative III: Partnership with Corporate Shipping Interests

Alternative I: Let Current Trends Continue

The first alternative is to let current trends continue. Through the WWF's advocacy towards marine ecosystems, particularly reefs, there could be the potential that noise pollution is reduced in concert with other protection mechanisms. The current inclusion of noise management practices from cetaceans may come over as best practices from managed natural areas such as Glacier Bay National Park and Preserve and filter through to international coral reef protected areas. However, with no impetus to focus on noise pollution as an added stressor on reef ecosystems instead of the obvious stressors like sedimentation, overfishing, and destructive reef fishing practices, there is likely the same outcome that no concerted effort towards reducing sonic pollution levels in coral reefs will occur. As climate change continues to threaten reefs, ignoring this added stressor could be a dramatic oversight that hinders increases in reef resilience even if other protection steps are made.

The main benefit to pursuing this alternative comes primarily though the strengths of the current programs of the World Wildlife Fund. Were the WWF an organization that had capacity to impact change in this policy area, but was making no strides and had no prioritization in the policy area with regards to maritime noise pollution or any other maritime issue, then this alternative would be ineffective and likely useless. However, given the realization that this issue does exist, as highlighted in this report, and understanding the WWF's current programs, plans, and activism regarding the health and future of the world's oceans, there is opportunity to say that though overlooked, maritime noise pollution, especially with regards to coral reefs, will necessarily be solved as holistic reef management plans come into play.

Realistically, there is uncertainty that the current efforts with regards to coral reef conservation and maritime noise pollution are necessarily in concert and overlapping. Additionally, there is no guarantee that the scientists who are conducting research into establishing holistic reef management plans have expertise in noise pollution on coral reefs. However, this alternative recognizes the high probability that noise pollution research in maritime environments, including but not limited to coral reefs, will be greatly expanded over the next few years, allowing scientists and policy makers the opportunity to incorporate noise pollution damages and potential technical solutions into their decision making when they plan for managing reef systems.

This alternative theoretically gives a low-cost management opportunity for those in policy-making and decision-making areas of the WWF. Because the science is so new, just being aware of the impact of maritime noise pollution on coral reef ecosystems should impact the decisions being made, in a minor way, and current trends point to more data being incorporated into planning for reef health. Because of this, not adding a specific intervention by building a new partnership specifically focused on the effects of maritime noise pollution on coral reefs, and leveraging existing partnerships regarding coral reefs to solve all the impacts of human effects on coral reefs and incorporate some maritime noise pollution mitigation into that schema.

Alternative II: Partnership with United States Navy

The second alternative is to partner with the United States Navy. The United States Navy is a massive actor. The Navy operates many vessels all across the world's oceans, with 289 currently deployable vessels, over 330,000 Active Duty service members, and many support vessels (US Navy, 2019). Because of the United States Navy's consistent forward operating presence, including freedom of navigation patrols, American ship presence is especially focused in the South China Sea and the sea lanes near Malaysia, Indonesia, and the Philippines. These are some of the busiest sea lanes for commercial shipping in the world, and overlap some of the most diverse reef systems in the world.

It is clearly in the U.S. Navy's interest to promote both environmentalism and reduction in shipborne noise. Within the U.S. Navy's purview, there are major goals for long-term sustainability (US Navy Energy, Environment, and Climate Change, 2019). Amongst these priorities are the commitment to environmentally sustainable operations strategies. The application of sustainable operation particularly refers to legal environmental responsibility wherever the U.S. Navy operates across the world. While much of the Navy's current sustainability focus are on initiatives such as the "Great Green Fleet" and other carbon-neutrality focused goals, there is also a highlight on the environmental best practices as well.

Strategically, the United States Navy uses sonar technology to find potential targets. One major impact of this technology has been the added stress of additional sonic pollution on at least cetaceans, with some mass stranding events attributed to the use of sonar technology in concentrated areas (Scully, 2015). This has opened the Navy up to legal liability by potentially

violating the Endangered Species Act, National Environmental Policy Act, and the Coastal Management Act. In order to comply with these legal requirements and potential legal challenges, the Navy could benefit from cooperation with the WWF to reduce noise pollution and planning. Additionally, it is within the U.S. Navy's tactical and strategic interests to work to reduce noise pollution. Because of sonar listening as a major component of finding enemy combatant vessels, the imperative to focus on reducing the noise profile of U.S. Navy vessels increases their survivability.

The WWF would benefit from this partnership for two major reasons: one, the sheer size of the U.S. Navy would be a major partner towards reducing noise pollution, and (declassified) best practices could be shared with other partner navies and American shipping interests. The Navy already hopes to share environmental best practices amongst allies and partners to help reduce environmental impact, and has tried to position itself as a leader in the space, going so far as to build relationships during major international exercises such as RIMPAC (Eckstein, 2016). The other major synergy is that the WWF's partnership with the U.S. Navy on noise pollution could be leveraged as a model for either working with other government agencies or for further collaboration with the Navy with other of the WWF's or Navy's sustainability initiatives.

Alternative III: Partnership with Corporate Shipping Interests

This alternative would parallel the partnership opportunity with the U.S. Navy but would instead work with commercial shipping industry groups. The opportunity given by the United States' preferential treatment of American flagged vessels through the Jones Act. This level of protectionism established by the United States allows for the jurisdiction of American policies over a significant portion of the international shipping fleet. Partnering with industry groups would allow the WWF the opportunity to scientifically promulgate best practices among the different members of the trade industry, as well as present a united front and securing buy in when potentially proposing industry-affecting regulations and other policies (WWF, 2015).

The commercial shipping industry stands as the most efficient and most effective method of moving large quantities of materials across long distances of ocean. The recent globalization of trade has increased the numbers of ships traveling across long distances of sea spaces. As sea travel remains one of the most carbon-efficient and cost-effect methods of shipping, this looks to

only grow as the world moves in some degree to de-carbonize. Building this relationship now would leverage the opportunity to build trust and relationships between the WWF and corporate partners in the model of the WWF's non-profit/private partnerships in the past. As best practices of science regarding the impact of maritime noise pollution and holistic reef management become published and analyzed, the WWF's partnership in this space gains ever more importance.

Realistically, the WWF's history as a thought leader with approaching partners that are not merely other non-governmental organizations gives it the credibility and the background knowledge to create a partnership with the industry groups. The framework for the new partnership could take many forms, which will be discussed in the implementation section, but the core framework as established by the WWF's Global Marine Programme would be a base opportunity for scalability. The WWF, under the Global Marine Programme, already has established partnerships in different focus areas that would be beneficial to pull experience, leadership, and partners from in order to build a dedicated and targeted partnership to tackle maritime noise pollution. Already under the Global Marine Programme, there are focus areas in Coral Triangle, Market Transformation, and in Whale and Dolphin Conservation. These silos could be tapped to take legitimacy to lend to the new maritime noise pollution partnership, and allow an easy jumping off point for all future task forces and focus areas that the maritime noise pollution industry partnership develops into.

Criteria

The criteria needed for analyzing these alternatives that were considered are broadly in order to determine the impact and effectiveness of the alternative, while also trying to see the costs that it would bring to the WWF. The different criteria considered will be rated individually for each alternative, and then the policy recommendation will necessarily be chosen from the summation of the evaluated criteria.

The criteria selected for consideration for evaluating the presented alternatives are as follows:

I) Cost of establishing a relationship

II) Effectiveness of the relationship

III) Potential scale of impact

IV) Political/organizational feasibility

Realistically, these criteria should highlight the areas of focus for the World Wildlife Fund in term of strategy when considering these different alternatives, and the insights given by the criteria evaluation process should help illuminate the process of alternative selection. There are always many variables that could have been selected when measuring criteria, so the section below will provide a rationale as to why each criterion was selected and how it will be measured as to provide for best evaluative practices.

I. Cost of establishing a relationship

This cost will be in terms of the resources that the WWF would need to dedicate to each Alternative's defined relationship to cooperate on policy goals. However, this will have to be clearly defined in each alternative as to the level of the cooperation. This would likely be shouldered primarily in administrative and staffing costs, and so these estimates will reflect that. Alternative I would not add any cost to the WWF in terms of funding or staffing. Costs are estimated over a five year period, with a 5% discounting rate.

The current average salary for a WWF Project manager is "competitive with other non-profits" and starts around $50,000-60,000 a year (WWF Salaries, 2018). An intern would be much cheaper for starting, and before the project gets fully underway, an intern may be assigned to do much of the heavy lifting for administrative work. Phasing will be further discussed in implementation, but a five year time horizon for implementation is how costing will be evaluated.

I) Alternative I would add no cost

II) Alternative II would require at least a full-time intern to manage the relationship's administrative duties, but would likely rely on the part time contribution of the name of existing WWF Staffers and Administration to lend a name that the Navy would be able to respect in the hierarchy. The cost therefore would in present terms cost $216,473.83-259,768.60.

III) Alternative III would require a full-time staffer to coordinate and plan the implementation of the working group and industry group partnership. Because there are multiple constituencies that need to be managed, as well as responsibilities for the public-facing component of implementation, a full-time resource is needed to have it carried out effectively. Similarly to Alternative II, the costing for this alternative would in present terms cost $216,473.83-259,768.60, but program costs for hosting and facilitating the partnerships would increase this cost to likely double that to $519,237.20 over the five years this relationship is being built.

II. Effectiveness of the relationship

The effectiveness of each relationship will be evaluated with the ability of the relationship to make an impact. Questions that will be evaluated while generating this criterion include the following How willing is this other organization to partner with the WWF? Do they already have significant environmental campaigns? Have they cooperated in other areas with the WWF? Are there synergies between the WWF and this organization on mission or problem area? he answers from these questions will be rated on a scale from low to high, and unpacked in the recommendation section.

III. Potential scale of impact

The relationship could be measured with the partner's organization ability to impact the problem. The problem is reducing oceanic noise pollution on coral reefs, the key question then is what is the partner's ability to mitigate that noise level? The research is not yet available for a predictive analysis of decibel levels, so the future reaching scale of impact will be rated from low to high. This, along with the cost, makes up the most important criterion in terms of the decision making process, as scalability significantly impacts the future benefits. However, current data is not able to unpack the actual benefits to reefs in a monetary or economic sense of reducing noise pollution on reefs, but in the future, this data will be available as holistic reef management and environmental service evaluation, and should be incorporated into future planning.

IV. Political/organizational efficacy

The WWF should ask questions about the political or organizational efficacy of each alternative. This is a secondary criterion to the others. This is to evaluate the readiness of the internal organization of the potential partners to implement whatever technical solutions would exist and result from the increased awareness brought to maritime noise pollution. The estimated efficacy of the readiness of the potential partner internally as probed by these questions will be rated on a scale from low to high, and explored further in the recommendation section.

Evaluation

These particular criteria should provide an insight as to why the provided alternatives were chosen for evaluation and why a particular alternative was selected and recommended for implementation. Realistically, these particular criteria are an attempt to give a holistic overview of the impacts and costs of the implementations of these alternatives, and the methodology behind the recommended implementation will be highlighted accordingly in the following section.

Table of Relevant Outcomes

	Cost of establishing a relationship	**Effectiveness of the relationship**	**Potential scale of impact**	**Political/organizational efficacy**
Alternative I: Let Current Trends Continue	Low (Near $0)	Moderate	Low to Moderate	High
Alternative II: Partnership with United States Navy	Moderate $216,473.83-259,768.60	Likely Low to moderate	Moderate	Moderate
Alternative III: Partnership with Corporate Shipping Interests	Moderate to High $259,768.60-519,237.20	Moderate	Moderate	High

Recommendation

The recommendation of this report is for the WWF to pursue Alternative III: Partnership with Corporate Shipping Interests. While there is almost no cost for the organization to pursue Alternative I: Let Current Trends Continue, the existing organizational framework that the WWF has built up over the past years, while robust, is not in a direct position yet to implement any significant policy actions in order to move the needle with regards to maritime noise pollution in coral reef areas. Current practices in the Asia-Pacific would allow the WWF to slowly phase in maritime noise pollution protection into the planning and management of these reef systems, but the taxing of current relationships and inducing mission creep into existing partnerships is a concern.

Partnership with the U.S. Navy is additionally a great option that could be implemented in the future, but the organizational cost of the relationship-building component on the front end of establishing such a partnership specifically makes this alternative mutually exclusive in the near- to medium-term versus pursuing Alternative III. The main drawback of Alternative II in comparison to Alternative III is that the organizational hierarchy of the military means that there are strategic components to their decision making, and while making the "Great Green Fleet" is a stated objective of naval planning, their focus at the current strategic moment is to increase the number of ships in the fleet significantly, sometimes at the expense of environmental concerns. While this provides the opportunity for a potential partnership to implement best practices with regards to maritime noise pollution, there is a concern that the upper echelons of military leadership will be less amenable to cooperation on a broad scale, and would rather use the partnerships more in line with a greenwashing rather than actual partnership-building, at least for the medium-term. Additionally, the chain of command system in the Navy that prioritizes frontline commanders' promotion to high commands incentivizes a bias amongst that leadership to warships and flight systems, rather than a holistic view of the impact of the Navy's vast support vessel network and supply chains. This baked-in biasing may reduce the potential effectiveness of a partnership with the Navy versus an ideal outcome. Obviously, this may be mitigated with best-practices of partnership management, but the risk associated with pioneering on both maritime noise pollution management and also trying to stake a new methodology of

partnering with the military as a non-governmental organization stacks up less favorably than Alternative III.

The reason Alternative III: Partnership with Corporate Shipping interests was chosen was because it scored the highest on the effectiveness of the relationship and potential scale of impact, as well as on political/organizational efficacy. The higher cost of this alternative is the main sticking point that could lead to hesitation in its implementation. However, the WWF has been performing well financially for the recent half-decade, despite taking in $335,567,235 in FY18, while reporting expenditures of $336,184,874 over the same period. This running deficit of $617,639 is not indicative of any poor management in the organization, as its funding streams are diversified and resilient. In fact, the health of the organization for the future is being secured through confirmed future funding, through pledged contributions, bequests, and endowments. The WWF actually had a net increase in assets over FY17 of $14,903,230. In light of this, and due to the future funding and fundraising opportunities to support a new program like Alternative III, the outlay of $100,000-$120,000 a year actually seems to fit the scope and mission of the WWF (WWF, 2018). It is because of the financial health of the organization, as well as its proper stewardship, that the organization can commit to this proactive Alternative, rather than a reactive technical solution for noise pollution.

Implementation

Realistically, there are three major considerations for the best practices of implementation. These are:

I) Optics
II) Timeline
III) Partnership Management Best Practices

Though these recommendations would be applicable to all three alternatives, they most strongly influence the rollout of the recommended alternative, Alternative III: Partnership with Corporate Shipping Interests. In doing so, the goal of the World Wildlife Fund should be to construct a stable, public-facing, mutually beneficial relationship that is able to take the particulars of Alternative III and to build a platform from which the World Wildlife Fund will be able to roll out programs and plans down the road, as science comes out for implementing best management practices for mitigation of maritime noise pollution and managing reef health

holistically. In the meantime, it is in the World Wildlife Fund's best interest to proactively build these relationships, start the conversation, and work to build trust with the corporate stakeholder groups in order to gain a competitive edge on other organizations which might also eventually be interested in a maritime noise management strategy, but do not have the same effectiveness, scale, or relationship-building ability as the WWF.

Optics

As in all relationships between different actors, optics of the relationship will be vital to the continued success of implementation of Alternative III, setting up an opportunity for future deepening and broadening of the relationship with an industry group over time. The World Wildlife Fund, as all non-profits in the United States, has a dual constituency: it has a duty to fulfill its mission as well as serving the needs of donors who contribute financially to its successes. In this way, the WWF needs to balance the relationship that it builds with industry groups in order to not lose its moral backing, while also demonstrating that it can affect change. The danger here is the fact that because the WWF works through partnership, any moral grandstanding within the relationship can be a barrier to proper relationship building. The way in which the WWF launches advocacy campaigns, informational material, and press releases surrounding the partnership with industry groups or individual corporations will have an outsized impact on the future success of the project. As the WWF's ocean team moves forward with constructing this partnership, it must remain in constant communication with its public relations department, in order to leverage the successes that result from these connections with industry groups to further donation gathering and increase the organization's standing amongst peer groups.

The other consideration for optics is the reduction in mission creep, or the perception thereof. While this new partnership will exist in concert with other efforts initiated by the WWF, including the recent rollout of the campaign to pressure governments in the Arctic to tackle maritime noise pollution, particularly with regards to increased shipping levels and their impact on cetacean species, this could be seen as a new expansion that exists outside of the historic and contemporary mission of the WWF (Protect Arctic, 2019). There were over 27,000 signatures on the petition to the Arctic governments as of the publishing of this document. This indicates that

the current donor base and supporter base of the WWF are supportive of goals to reduce maritime noise pollution. The caveat is that cetaceans are flagship species, and as no such one-to-one comparable species exists for the coral reef ecosystem, the hope is that the previous advocacy work that the WWF has done to force recognition among the public, and in particular its interested donors, that they would be influenceable enough to uptake this additional threat into their motivation to donate to the WWF. This increased willingness to support the WWF, however, hinges on the implementation of this partnership, and the actualization of implementable partnership results. Without tangible news that shows the donor base that the WWF is using their donations effectively to fulfill the mission, and a rationale as to "why maritime noise pollution for coral reefs needs partnership now," then the value that the WWF may add to the partnership will fade over time.

Timeline

Timeline considerations need to factored into the implementation and rollout of these partnerships. It is quite obvious that coral reefs are facing an existential threat from climate change and pollution, as well as other harmful human impacts, but the public conversation around maritime noise pollution has not manifested in the zeitgeist in this particular sub-situation. This means that the WWF could not, therefore, jump in and immediately move the needle through this partnership. However, by working with industry groups or by working directly with corporations, this new initiative could be up and running much more quickly than collaboration with the Navy or other government actors. Realistically, the WWF could jumpstart the process and act as an accelerant to changing the conversation by inviting corporate interests that have already established themselves as partners in other oceanic areas. By leveraging current partnership efforts in reducing maritime noise pollution for cetaceans and the Arctic, as well as connecting those corporate interests involved in the WWF's coral reef and coastal initiatives, there can be an established nucleus from which the rest of the maritime noise pollution and coral reef initiative can then be constructed from a more established starting point.

In practice, this initiative and partnership would likely start off as a working group mechanism as the particulars of the technical reach of solutions and the scientific data on the realistically solvable scope of the problem become more available. This working group would

provide the kernel of support from which the rest of the initiative can grow, whether it is taken into a more cogent WWF action plan with programming components, or whether it remains more of a forum for best practices, updates, and scientific findings to be shared with the corporate interest. As this group scales up, more organizations which are not directly corporate interests can be invited, provided that they sign on to the mission and vision of the working group. Thus, the skeleton of the zone of preferred alternatives can be constructed, and other groups that sign onto the vision will have to accede to the tone and scope as laid out by the WWF and whichever partners it so chooses to cooperate with from the beginning. This allows flexibility in timeline for funding depending on the availability of funding and staffing the WWF is able to allocate to the project.

Partnership Management Best Practices

There has been a surge in research on both teams and non-governmental organization best practices in recent years. However, this research is still nascent when dealing with partnerships and teams that have constituent members that are from theoretically opposing groups, or groups that do not shar many of the same goals. This is critical to understand when dealing with the crossed paths of NGOs and corporate groups. Luckily, the WWF has been a pioneer in working with corporate groups without "selling out" and has initiated many successful partnerships over the years.

The article "Odd Couples: Understanding the Governance of Firm-NGO Alliances" by Miguel Rivera-Santos and Carlos Rufín provides a clear outline of the best practices, even a decade after its original publishing (Rivera-Santos & Rufín, 2010). Their main recommendations on these alliances that have partners with differing incentive structures and different outcomes matrices focus on how the constraint and direction of the partnership can be properly planned and incentivized. The authors claim that there are a few levers to be manipulated to increase the success of the relationship. These are equity, non-equity hostages (such as reputation), contracts, scope, initial trust, negotiation, and behaviors within and outside the alliance. The levers that are most important to focus on in implementing Alternative III would be non-equity hostages, scope, and initial trust. Luckily, the WWF's history of creating similar partnerships establishes an initial trust when approaching the partnership that other organizations may not secure. One place in

which the author of this report disagrees with Rivera-Santos and Rufín is that they claim that NGOs, because they only deal with public goods, are unable to force equity hostages. In reality, with the scope of an organization such as the WWF (over $300 million annual expenditures and revenues) the sheer scale of pass through monies can in fact allow the organization the opportunity to establish some equity swap.

However, because this new hybrid model of revenue generation for non-profits is in its infancy, there are some ethical concerns about the full shift from a non-profit to a revenue-generating partner of corporations in this context. Therefore, the non-equity hostage should be the incentive mechanism the WWF should apply in this situation. By leveraging reputation benefits from cooperating with the WWF, as well as the potential threat of receiving the brunt of the WWF's advocacy action for malpractices, the WWF could softly coerce corporations to sign on to the vision. The fact that the WWF could receive 50,000 signatures in favor of action on Arctic noise pollution in a short time provides credence to the idea that the WWF could leverage the inaction of corporate groups against them, and incentivize them to join forces with the WWF in this partnership. In fact, the WWF should present this as data when trying to build the partnership, setting the tone that the public is becoming cognizant of the issue, even if it is slightly out of the scope of this relationship. Interestingly, the international corporate actor must rely on the WWF for the information regarding the problem, in establishing the "base of the pyramid" for the context, so the WWF has the opportunity to frame the non-equity hostage taking and the scope because of their information asymmetry when starting to approach the relationship, and must leverage this responsibly for future success (Hahn & Gold, 2014).

The scope of this relationship is the last major lever that the WWF should be aware of manipulating. By narrowing the scope as much as possible, it is easier to form a common vision around this small strategic problem. This way corporations can be assured that the non-equity or equity hostage taking by the WWF would not be leveraged against them for other of their sins at least in the short term. *Ceteris paribus*, reaching common ground is easier when the definition of the problem is clearly defined and scope is minimized to the smallest effective dose. This could be achieved by collaborating specifically with the Corporate Social Responsibility departments of these Multinational Corporations (Austin& Seitanidi, 2012).

As more research is done on best practices for these types of partnerships, the recommendations in this section may actually change. However, the base assumptions of the nature of the different types of organizations likely will stay the same, but only the scale will change. NGO governance and management is a relatively new field of study, and the newfound size of NGOs has only increased in the past decade, with little precedent of this provision of public and club goods that exists in a realm outside of governments. As an international organization that operates on rules that are in the process of being defined, the WWF is poised to roll out these best practices and establish ethical and value-based norms for large-scale cooperation, but also as in this case, targeted and focused partnerships to achieve specific strategic policy goals. For further reading, highlighting the whole continuum of types of NGO-corporate partnerships, particularly in the sustainability field, please refer to the "Sustainability through Partnerships: Capitalizing on Collaboration" report prepared by the Network for Business Sustainability (Gray & Stites, 2013).

Implementation Recommendations

An existing model that the WWF has already collaborated on to implement that could be imitated is that of the Global Mangrove Alliance (Global Mangrove Alliance, 2019). Formed under the aegis of the WWF, with some of the contributions of WWF's coastal scientists and oceanographers, the Global Mangrove Alliance functions as a particular group that bridges science, advocacy, industry, government, and implementable policy programs. This model offers certain opportunities that the WWF should follow when implementing Alternative III: Partnership with Corporate Shipping Interests. The strengths of this model are that within the umbrella of the WWF's vast conservation and protection mission, the smaller, more focused grouping that has a singular mission can then avoid mission creep, serving as a forum dedicated to one particular policy sub-area. The new group that focuses on Maritime Noise Pollution on Coral Reefs would likely need a good brand, logo, and identity, but the details of that process are beyond the scope of this report. However, the opportunity for a new organization, that incorporated both the WWF's staff members and scientists as well as corporate shipping interests, will be better positioned to act as an organization that builds its own reputation. However, because of the globally recognized brand of the WWF as the parent of this new group,

it will gain immediate legitimacy upon rollout, becoming an international thought leader in the maritime noise pollution best practices and coral reef conservation sphere. This would allow the WWF to allocate some of its siloed resources to this interdisciplinary forum to promoting conversation, but further than that, not becoming an echo chamber for either scientists or corporate interests. The staff charged with leading and building this partnership should be particularly aware of their role as mediating and promoting implementable solutions, while also focusing on the importance of keeping a strategic view, within the context of the fight against climate change and coral reef destruction more generally. This staff member should resist the urge to broaden the scope of this organization; rather, the singular vision of the group should be a strength for defining the relationships between corporate interests and the WWF.

Conclusion

As this report lays out, coral reefs are biodiversity hotspots and economic engines for local communities, but are constantly under threat from human activities. As these problems are not limited to overfishing, habitat destruction, and climate change, the increasing threat posed by noise pollution from ship traffic in biologically sensitive areas needs to be addressed. Though the research on the impact of noise pollution on coral reefs is in its infancy, the data indicate that noise pollution impacts from ship traffic have negative effects on the health and viability of coral reefs. Whereas existing research on noise pollution has focused on marine mammals as flagship species, coral reefs can serve as another flagship project where noise pollution is a concern. Additionally, as coral reefs suffer increasing impacts from an expansion of ship traffic and other human interference, the response to protect coral reefs has in the past been focused on specific interventions that could improve reef health.

However, as the research on holistic reef management becomes more salient, the World Wildlife Fund should consider options to leverage its competitive advantage in the non-governmental organization sector. The options that should be considered are to continue with the statue quo, to pursue partnerships with the United States Navy, and by pursuing partnerships with corporate and industry groups. This document recommends the World Wildlife Fund move to protect coral reefs from noise pollution by embarking on building partnerships with different industry groups involved with the shipping industry to build a case of best practices with dealing

with the threat posed by noise pollution to reef ecosystems. The World Wildlife Fund has expertise in building partnerships across sectors, both public and private, that allow it both the reputation and track record to propose this partnership as the research comes in, so as to proactively manage noise pollution in coral reefs. As stated before in the implementation section, this alternative would build off of momentum established by the World Wildlife Fund's historical relationships and data-driven policy recommendations to further environmental causes.

The World Wildlife Fund should work to implement the best practices of partnership management across sectors, in order to build sustainable relationships and effective teams across both the World Wildlife Fund and any potential partners. In laying out these best practices for implementation, this document hopes to recommend methodologies for the World Wildlife Fund to build off of the established relationships and developed reputation that the World Wildlife Fund has created over the recent past. In strengthening them, the WWF would able to move with speed and caution to implement the recommended alternative, Alternative III: Partner with Industry Groups. Ideally, the implementation of this industry group relationship-building will allow the World Wildlife Fund to increase its effectiveness in other related relationships to better serve its mission and implement projects.

Overall, this opportunity to engage with partners to promote relationships than will be able to affect change will set up the World Wildlife Fund in a position to drive the policy conversation as new research comes out. With the advent of holistic reef management and increasing understanding of the impacts of the previously overlooked pollutant effects of noise in underwater ecosystems, especially coral reefs, the World Wildlife Fund and its partners will be optimally positioned to respond accordingly with best practices and produce policy recommendations to governments as well as implement scientifically sound mitigation strategies with the corporate partners.

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Appendices

Appendix I: Non-Noise Pollution Threats to Reefs

Indonesia, local humans impact coral reefs through blast fishing, overfishing, cyanide fishing, and reef eutrophication, and reef pollution.

Blast fishing practices occur when fishermen use dynamite to destroy the tops of reefs and the shockwave stuns or kills the fish, which can then be harvested. This causes severe physical damage to the physical structure of the reef. Edinger and colleagues in 1998 published a paper that identified a baseline of reef degradation in Indonesia based on land-based pollution and destructive fishing practices (Edinger et al., 1998). Bombed reefs (reefs subject to dynamite fishing) had roughly 50 percent less diversity in coral species, than comparable reefs that did not suffer these fishing practices.

Cyanide fishing still occurs in Indonesia in the face of laws outlawing its use and practice. Cyanide is a toxin used to stun fish for their live capture, often for export to reef-keeping hobbyists in the United States and Europe. A 2017 study analyzed the imported fish for the aquarium hobby to the EU and found that 15% of all imported fish still showed signs of cyanide poisoning though the efficacy of such a test that does not need the death of the fish remains questionable. (Vaz et al., 2017).

The aquarium hobby offers significant export opportunities for local communities, but the data reported by local governments has proven to be inconsistent. A review of the 2005 export data from Indonesia showed that over 3 million individual fish were exported to the United States alone, and the reef-keeping hobby has only grown since then (Rhyne et al., 2012). Because cyanide is such a powerful tool for fish harvesting (stunned fish are much easier to catch than healthy fish), the practice continues even though banned. Overfishing is a problem both for sustenance and over-collection for the aquarium trade. Export numbers likely underreport the amount of fish caught in these reefs, as up to 24.2% of collected fish are deemed too unhealthy, small, or ragged to export and are either killed or dumped back on the reefs in poor health (Militz et al., 2016).

Sedimentation limits the types of corals that can grow, and damages the reefs from runoff from the land. Land usage in the region therefore discernibly impacts reef health. Additionally, the increasing land-based pollution of reefs, as measured by water quality parameters, also showed negative correlation with coral diversity. However, these sites that were sampled with land based pollution suffered from differing forms of pollution, and the authors noted that it was "difficult to separate clearly the effects of sewage, agricultural and aquaculture runoff, sedimentation and industrial effluent" and so may be less reliable (Edinger et al. 1998).

Corals can still grow, and techniques are being pioneered to select corals better adapted to these environments, but the efficacy is questionable (Militz et al, 2016). Plastic pollution chokes reefs, and the likelihood of corals contracting disease rises from 4 percent to 89 percent for corals in contact with plastic (Lamb et al., 2018). Concerned about the quality of data in measuring the health of reefs, which had to that point been significantly focused on coral growth rates, many of the authors of the Edinger et al 1998 study collaborated again in 2000 to study and see whether coral growth rates could be a good proxy variable for reef health indications (Edinger et al., 2000). According to their data, reef health could be degrading while coral was still growing at a reasonably quick rate. The coral reefs in eutrophic conditions had a net reef loss even though individual corals managed to grow, while those coral reefs near mangroves and in less eutrophic conditions were less likely to have net loss of carbonate. This forces whole-reef health perspectives, not just the speed of individual colony growth to determine reef health. This has significant implications for the preservation of the reefs, and could make analysis and study of outcomes more expensive.

Appendix II: Reef Restoration Solutions

Reef restoration has been trialed in many places in the world. Restoration methods generally consist of artificial structures that are either passively or actively populated with corals. These corals in active restoration can be grown in nurseries in situ before being deployed to to restored reef. Restored reefs in Indonesia after dynamite fishing show better coral cover than un-restored dynamited reefs, but not as much as no-take zones (Williams et al., 2017). Scientists have tested different methods of reef restoration, including concrete slabs, plastic netting suspended over the substrate, and rock piles. The rock pile method was the most effective at encouraging coral growth (Fox et al., 2005). The usage of plastic netting in restoration causes concerns if Lamb's data of coral disease if even close to accurate.

The newest move is towards integrating the reef system with the human system in management practices. This social-ecological model takes inspirational account of the rubric established by Game et al., in 2013 (Game et al., 2013). This analysis realizes that conservation plans need specific and defined problems, prioritization, and hidden cost calculation, a new to many in the conservation science world. Analysis of the resilience of a reef to facilitate better decision making is predicated on understanding ecosystem-scale integration (Maynard et al., 2015) Scientists subsequently published a study on the ability of reef fishes to recover, not just the coral (MacNeil et al., 2015).

Human intervention can have positive impacts, such as removing coral predators before a bleaching event, but this likely is too management intensive to be broadly applicable (Shaver et al, 2018). In a controversial article, Graham and colleagues found that even no-take protected areas do not necessarily predict a return to ecosystem stability (Graham et al., 2015). It is clear that the science regarding policy opportunities is in its infancy. As recently as 2017, a study was published that called for new interventions to save coral reefs (Anthony et al., 2017). A reasonable policy and intervention framework was outlined by Anthony et al, in 2014, based on identifying potential pressures on reefs, but their conclusion was limited in actual implementing policy (Anthony et al., 2014). In 2019, Bachtiar et al tried to devise a scale to identify resiliency in reefs on six variables, but their data ended in 2009, and may not show the effects of climate change (Bachtiar et al., 2019).