A decade of successful partnerships through NOAA's Coral Reef Conservation Program Fishery Liaisons in the US Pacific Islands Region

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Abstract Insufficient local capacity continues to constrain coral reef conservation on many islands. For the past decade NOAA's Coral Reef Conservation Program (CRCP) and Pacific Islands Regional Office have supported Coral Reef Fishery Liaisons (Liaisons) in the US Pacific. The Liaisons have significantly improved partnerships and technical capacity as they collaborate with and provide direct support to local resource agencies, non-governmental organizations, and communities, all to improve fisheries management and conserve reef habitat. Through close agency/public partnerships Liaisons help address and reduce threats to coral reefs, enhance technical capacity, develop and implement projects, and increase compliance with mandates. The Liaisons' diverse portfolio includes field surveys, permit reviews, management planning, and community outreach, which provide unique synergistic benefits in understanding problems and developing solutions across the region. Successes include: culturally attuned, village watershed-management plans in American Samoa; novel scientific reef resiliency studies in the CNMI; reducing reef habitat impacts from a planned military buildup in Guam; and a Local Action Strategy to manage reef fisheries in Hawaii. Benefits of the Liaisons, criteria for success, and areas for future direction are discussed.

Keywords: coral reef/fishery/watershed management, marine habitat, partnerships, NOAA Coral Reef Conservation Program, Pacific islands, reef resilience

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Introduction

In most small islands, capacity development needs for local coral reef conservation must be addressed to enhance management. To meet this need, NOAA's Coral Reef Conservation Program (CRCP) and NOAA Fisheries Pacific Islands Regional Office (PIRO) cooperatively support four Coral Reef Fishery Liaisons (Liaisons) in the US Pacific Islands. The Liaisons operate from the major populated islands in American Samoa, CNMI, Guam, and Hawaii, and are managed and coordinated through the PIRO Habitat Conservation Division. Fishery Liaisons provide direct support to local governments and stakeholders through technical assistance, project coordination, and community outreach and engagement. Many of the Liaison functions are shared in common resulting in synergistic benefits in understanding problems and developing solutions across the region. These include: 1) agency coordination and networking, 2) support for Local Action Strategies, 3) community-reef/watershed management, and 4) stakeholder education/outreach, in all jurisdictions; and 5) marine habitat impact reviews, in all areas except Hawaii; and 6) field research/assessments, primarily in Guam and CNMI. Highlights of their successes are reported here.

Methods/Results

Agency Coordination and Networking

Many major efforts of the Liaisons are shared in common, while essentially all encompass extensive agency (local to federal) and stakeholder (non-governmental organizations [NGOs], communities) partnerships. Major tasks include providing technical support to set priorities and implement projects. All Liaisons interact regularly with their state/territory jurisdiction's Coral Reef Point of Contact (POC), providing expert advice and guidance on anything related to local coral reefs. They also work closely with other NOAA Liaisons in their respective jurisdiction, on many local coral reef concerns. Coordination with local agencies is primarily with departments and divisions responsible for fisheries/marine resources governance, coastal management, environmental quality/protection, and marine resources enforcement. Networking is largely with local academic institutions and environmental NGOs concerned with coral reef science and conservation, as well as with ad hoc state/territorial reef advisory bodies. Federal coordination is primarily within NOAA (e.g., PIRO, Pacific Islands Fisheries Science Center [PIFSC], National Ocean Service [NOS]), for

collaboration across the CRCP. Significant work is also conducted in collaboration with offices of the Departments of Agriculture (DoA), Defense (DoD) and Interior (DoI), and with environmental NGOs, to ensure resource conservation. In close partnership with the above entities, the Liaisons help address the main threats to reefs, coordinate and implement monitoring (e.g., bio-physical, ecological, socioeconomic), develop community-based coral reef management plans, engage and educate students and communities on environmental awareness, and facilitate focused workshops on reef conservation. In addition to meeting project goals that lead to beneficial management actions, Liaisons also enhance partnerships through increasing trust and buy-in among local agencies and stakeholders, by giving them an opportunity to help conceptualize and implement projects, ultimately promoting successful coral reef conservation. A unique value of the Liaisons is to provide neutral external coordination to enhance interagency communication and help resolve issues that fall between the gaps of local agency capacity. Liaisons also provide technical and logistical support to federal visitors frequenting the islands, helping to facilitate projects and activities, including lead support for NOAA projects, NOAA ship cruises, local permitting requirements, and participate in public meetings on fishery issues.

Each Liaison also promotes diverse partnerships for unique contributions in their respective jurisdiction. In American Samoa, conservation related documents are translated into Samoan, and networking with villages and agencies helps build support for coral reef management and appropriate regulations that also enhances enforcement. In the CNMI and Guam, specific activities include emergency response (e.g., ship groundings, marine mammal stranding, communications cable breaks), coral reef monitoring and assessment, climate change studies (reef resilience, coral bleaching), biosecurity (invasive species assessments), and habitat assessments. Local and federal partnerships initiated and maintained by the Guam Liaison were essential for the designation of the Manell-Geus watershed as a Habitat Focus Area under NOAA's Habitat Blueprint *(*www.habitatblueprint.noaa.gov*).* In Hawaii, the Liaison also serves as the Pacific Islands Marine Protected Area Community (PIMPAC) co-coordinator, networking with agencies and organizations in Micronesia and Pacific Island US Territories to build enforcement and develop capacity and plans for marine resource protection (www.pimpac.org*).*

Support for Local Action Strategies

In each jurisdiction, Liaisons provide support for the development and implementation of Local Action Strategies (LASs) and Coral Reef Management Priorities (CRCP 2010). These LASs are a US Coral Reef Task Force (CRTF) let initiative to identify and implement priority actions aimed to reduce major threats to coral reef ecosystems in each jurisdiction, primarily fishing impacts, pollution, and climate change. In coordination with local Steering Committees and POCs, Liaisons assist with implementing LASs by helping to initiate, develop and support projects funded under State and Territory Cooperative Agreements with CRCP. Additionally, Liaisons help implement LAS projects at the request of local natural resource agencies, contribute to the development of management priorities, and develop and support adaptive plans (e.g., Conservation Action Plans, marine managed areas, impact response plans), coordinate workshops, facilitate public hearings, assist with marine clean-ups, collect independent- and dependent-fishery data, incorporate traditional knowledge, and engage GIS mapping.

Case Study: Agency Partnerships and the Hawaii Fisheries Local Action Strategy:

The Hawaii Fisheries Liaison's primary role is to support the Fisheries Local Action Strategy in Hawaii (FLASH) to promote sustainable reef fishery management and help reduce primary threats that cause marine/habitat impacts. This is accomplished through direct support to relevant local resource agencies (e.g., Division of Aquatic Resources [DAR], and Division of Conservation and Resource Enforcement [DOCARE]), and engaging the expertise of a FLASH Steering Committee (FSC). Established in 2003, the FSC is comprised of ~12 reef fishery experts, with representation from local resource agencies, universities, NGOs, and NOAA. The Liaison serves as the FLASH Coordinator to develop strategic plans for guidance and to identify best approaches to reduce threats. The FSC reviews, prioritizes, and recommends research and management projects for State partners to implement, following goals and objectives of the plan. These plans have successfully guided project development and implementation and have helped the State improve rules and management of its nearshore resources. Specific examples of benefits achieved as a result of these partnerships include: life history information on exploited reef fish, identification of the top 10 indicator fish species for monitoring and management, and meta-analysis of reef fish data from compilation of 25 different databases (>25,000 Hawaii fish surveys since the year 2000 [Friedlander et al. 2013]). The Liaison worked closely with the Hawaii POC to develop the

'Hawaii Coral Reef Strategy: Priorities for Management in the Main Hawaiian Islands 2010-2020' (State of Hawaii 2010) and set local priorities in annual CRCP-supported request for proposals to support reef/resource management. Further benefits included: 1) a baseline marine protected area (MPA) assessment; 2) improved enforcement of coastal marine resource laws (e.g., support for a Makai [ocean] Watch Program Coordinator, which engages community volunteers and NGOs to observe and report violations; and 3) establishing community-based creel surveys [fishery-dependent data collection at landing sites] at local bays on Oahu and Maui). Additionally, through a partnership with the University of Hawaii Environmental Law Program, the FLASH secured funding for an Enforcement Legal Fellow. This attorney trains district and circuit court judges from Hawaii's Environmental Court on resource regulations, assists officers with environmental cases (e.g., fishery citations), and is developing a more appropriate sentencing system.

Community-Reef/Watershed Management

All Liaisons contribute, in various degrees, to the collaborative development and implementation of watershed management initiatives in their respective jurisdiction. Support is provided to priority projects in the Guam Manell-Geus watershed, CNMI watersheds of Laolao Bay and Garapan on Saipan, and Talakhaya on Rota, West Hawaii and West Maui, and Fagaalu watershed in American Samoa. Assistance includes partnerships with multiple agencies and organizations for the development and evaluation of adaptive management plans. Maximum engagement of stakeholder is essential for input at all phases of development, coastal mapping, utilizing traditional knowledge of marine resources, and training workshops on aspects of management (e.g., protected or special use areas, ecosystem models), monitoring, and enforcement. Regular communication through outreach is also essential for local support. In Guam, the Manell-Geus Habitat Focus Area seeks to minimize watershed impacts to improve reef resilience, while also improving the community's resilience to climate change impacts (NOAA 2016). This effort, led and coordinated by the Liaison, leverages a diverse team of partners to implement projects to reduce erosion on steep hillsides and streambanks impacted by wildland fires, feral wildlife, and off-road vehicles. The Hawaii Liaison, through the Fishery LAS Steering Committee, helps to promote proposal development and selection of priority projects that support similar efforts at priority coral reef/habitat sites in Hawaii, in collaboration with multiple partners.

Case Study: Development of a Watershed Management Plan in Fagaalu, American Samoa:

Fagaalu is a steep coastal watershed located on the south shore of American Samoa near the mouth of Pago Pago Harbor. A major factor impacting the bay was sediment runoff from an upland rock quarry that flows into streams and the bay. Other factors polluting the bay included runoff from roads, the main hospital, poorly functioning septic systems, and numerous hillside piggeries. In 2010, the Fishery Liaison initiated a CRCP-funded project that supported community-based management in Fagaalu, a priority watershed for the CRTF Watershed Partnership Initiative, using a participatory approach. Participatory, Learning, and Action (PLA) tools were used to engage all sectors of the community and resources partners to discuss how the village watershed management plan should be developed (Sauafea-Leau 2010). This included the village of Fagaalu, the Land-based Sources of Pollution (LBSP) working group (comprised of local and federal resource agencies), and the Nature Conservancy Micronesia. Recommendations were agreed upon that formed the basis for a Fagaalu village watershed management plan, the first such plan in the territory. The plan was finalized, reviewed and approved by the village council in 2011. From 2012-2015, additional projects followed, in which the Liaison was instrumental. Assistance was also provided to NOAA Fisheries scientists for a benthic survey and coral demographic study in the bay, to academic researchers characterizing sediment impacts (Holst-Rice 2016), to a National Coral Reef Monitoring Program (NCRMP) socioeconomic survey, to Community Coastal Mapping workshops, and to CRCP and the local Coral Reef Advisory Group for raingarden installations to contain sediment. The plan was also reviewed periodically with development of the Fagaalu Watershed Supplement Implementation Plan that provides additional information on watershed restoration activities and aligns the plan to be more consistent with EPA guidelines. In 2013, a corrective action supported by a CRCP contract helped placed mitigation measure and retention ponds at the quarry source to minimize sedimentation loads into streams and reefs. In 2015, an additional CRCP project in partnership with the National Park Service helped reduce sedimentation to the bay to improve coral reef habitat by removing ~6,000 invasive, Tamaligi nitrogen-fixing trees and restoring >800 acres with

native trees. Particularly important to the Liaison's successful efforts were a sincere understand of the culture and people, and fluency in the local language.

Stakeholder Education, Outreach, and Engagement

All Fishery Liaisons lead and participate in diverse outreach activities to promote community education of and engagement in coral reef conservation. Community education and outreach helps produce a more informed electorate, which appreciates and values coral reefs, the marine environment, and natural resource conservation. These efforts also help develop strong supportive relationships, vital for developing marine policies that are realistic and acceptable to the diverse community, resulting in improved stewardship of coral reef ecosystems. In Hawaii, education/outreach is advanced primarily through a Fishery Extension Agent (FEA), managed by the Liaison, who serves as neutral Liaison to disseminate information among the shore-side fishing community, scientists, and managers, so as to build trust in regulations and improving compliance. The FEA regularly engages stakeholders in training, tournaments, festivals, and expos, helps guide discussion on controversial proposals, and gives presentations to local schools and stakeholders on reef fishing and conservation. Significant contributions by the FEA include hosting regular 'Scientist and Fishermen Exchange' (SAFE) meetings on controversial issues, and 'Talk-Story' sessions with agency directors and the fishing community. In CNMI, education of the community is accomplished through thematic workshops (e.g., reef ecology/ conservation, fishery management, climate change/resilience, GIS), public school events (e.g., value of reef herbivores), training of student interns through focused projects (e.g., seagrass mapping), and development of outreach materials (e.g., fish size-at-maturity posters and measurement guides). In Guam, the Liaison manages the Guam Community Coral Reef Monitoring Program (GCCRMP) (GCCRMP 2016). Through collaboration with local partners, this program provides classroom and in-water snorkeling training on coral reef species monitoring and related socioeconomic aspects. Over 1,200 people have now been trained and can adopt and monitor their own reef areas. The GCCRMP supports Science, Technology, Engineering, and Math (STEM) programs in the schools. Further education/outreach is provided by the Liaison who teaches undergraduate marine biology, severs on graduate student committees, and hosts student interns, at the University of Guam. The Liaison also co-leads the Tasi (sea) Group of the Guam Nature Alliance (https://guamnaturealliance.org/), Guam's award winning environmental education organization. In American Samoa, the Liaison engages the public in similar

educational activities, as well as in unique ways, such as developing infomercials on importance of large reef predators, and coordinating enviro-discovery summer camps for local high school students.

Marine Habitat Impact Reviews

Healthy marine habitat is imperative to productive and sustainable fisheries. Essential Fish Habitat (EFH) is defined as 'those water and substrate necessary for fish to survive through their life cycle (e.g., spawn, breed, feed, grow to maturity)', which includes effectively all coral reef ecosystems in the US Pacific Islands. EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act stipulate that Federal agencies which fund, permit, or undertake activities that may adversely affect EFH are required to consult with NMFS regarding potential effects of their actions. The Liaisons review local proposed projects that may impact marine habitat in compliance with mandates- primarily EFH, as well as related laws (e.g., Fish and Wildlife Coordination Act, and Clean Water Act). Examples of projects include seawall, harbor, and bridge construction and maintenance, DoD trainings (e.g., amphibious assault-craft landings), and coastal infrastructural improvement. Liaisons conduct EFH reviews in cooperation with federal and local partner agencies, and in consultation with the PIRO EFH Coordinator, and may participate in underwater site assessments. A variety of conservation measures including best management practices (BMPs) are recommended, such as project redesign, before/during/after-impact water quality monitoring, sediment control barriers, coral transplantation, and adaptive management. Reviews can provide 'Conservation Recommendations' to avoid, minimize, or mitigate (unavoidable) impacts to EFH. In many cases, the US Army Corps of Engineers is required to consult with NOAA Fisheries to authorize projects. For large projects, EFH reviews are often included as part of an EA or EIS.

Case Study: Marine Habitat Review of Impacts from the Proposed Guam Military Buildup: The Fishery Liaison played an important role in helping to minimize impacts to coral reefs during the National Environmental Policy Act (NEPA) and Essential Fish Habitat (EFH) consultations associated with the Guam Military Buildup (DoN 2009). As initially proposed in 2007, the buildup and troop movement would have increased the island's population by over 25% and affected multiple aspects of the environment, community, culture, and economics on Guam. Initial plans proposed to dredge ~50 acres of coral reef

habitat for an aircraft carrier wharf/turning basin, with additional indirect impacts to many reefs in the harbor. The Liaison served as part of the multi-agency task force and working groups as a subject matter expert on Guam's coral reef ecosystems and fisheries, facilitated working sessions of the natural resource agencies during partnering efforts with the DoD, and was part of a core team that developed marine resource metrics for adaptive program management. Technical assistance was also provided to other agencies for analysis of impacts, field support, and coordination of data collection. Through the agencies' cooperative efforts, the aircraft carrier wharf project was elevated to the Council for Environmental Quality (CEQ). The DoD was then required to develop additional alternatives and refine impact assessments. Plans for the carrier wharf/turning basis were subsequently deferred, sparing over 50 acres of coral reef habitat (DoN & DoA 2010). The overall buildup was scaled back due largely to funding constraints, while DoD still plans to station 5,000 Marines on Guam, which necessitates many projects continue, with respective impacts (DoN 2015). Work continued through the consultation process for the buildup and associated infrastructure improvement into 2016. This process enabled the Liaison to strengthen partnerships with local and federal agencies, particularly the Federal Highway Administration (FHWA) and DoD, which improved coordination, cooperation, and early consultation to minimize impacts to EFH.

Field Research/Assessments

Fishery Liaisons help coordinate and/or participate in field assessment, monitoring, and research in Guam, CNMI, and American Samoa. On-site assessment and research using scuba, as NOAA Scientific Divers, are a major role of the Liaisons in Guam and CNMI. Fish and benthic resource species and habitat surveys are conducted to monitor coral reef ecosystem health, species of concern, disturbance response, and impact assessments (Burdick and Brown 2011). Liaisons assist with local socioeconomic surveys in all jurisdictions. They also provide local coordination, logistical support, and technical assistance to a host of regularly visiting scientists from federal agencies and academic institutions. Furthermore, Liaisons prepare research proposals and serve as Principal Investigators on CRCP and other funded projects (e.g., reef resilience, coral bleaching, ESA listed coral species surveys).

Case Study: Reef Resiliency Field Research and Assessment in the CNMI:

Reef resiliency studies were conducted to evaluate the capacity of coral reefs to resist and recover from anthropogenic and natural disturbances around populated islands of the CNMI. The Fisheries Liaison initiated this effort in 2010 in collaboration with the CNMI Coral POC. Financial support was secured mainly from CRCP and the Pacific Islands Climate Change Cooperative (PICCC), as well as from broader partnerships. This collaborative effort included a dozen primary investigators and many others in support roles. Marine Applied Research Center (MARC) was contracted to lead the investigation. Work initiated around Saipan in 2012 and expanded to Rota and Tinian in 2014. The project team conducted underwater comprehensive surveys at 78 forereef sites along the 30-ft contour. 'Indicators' assessed, following Green et al. (2009), McClanahan et al. (2012), and Heenan and Williams (2013), included macroalgae cover, bleaching resistance, coral-recruitment, -diversity and -disease, herbivorous fish-biomass and -diversity, temperature variability, physical impacts, sedimentation, nutrients (pollution), fishing access, and larval connectivity. The Liaison conducted 752 fish surveys, identifying 242 fish species (>30,000 individual fish). Site-specific findings served to inform potential management actions: land-based sources of pollution reduction, fishery resource management and enforcement, coastal planning, improved evaluation of MPAs, bleaching monitoring and supporting recovery, reef restoration, and outreach and stewardship (Maynard et al. 2015a, b). The success of this major research effort required the Liaison to coordinate an extensive and diverse cadre of partners- including an interdisciplinary team of local and federal agencies, academics, non-profit organizations, and contractors, working over 4-years, and supported by five different funding sources. The Liaison provided grants management, local permitting and coordination, data quality control, and reviewed all products. This applied analysis was the first of its kind and serves as a tool to minimize reef impacts and identify solutions to maximize mitigation efforts. The benefits and versatility of this work are becoming increasingly realized, as researchers and managers more widely utilize this work to bridge science to management solutions, to significantly improve reef resource conservation in Micronesia and beyond.

Discussion

Benefits of Fishery Liaisons

Over the past decade, the Fishery Liaisons have significantly increased capacity for coral reef conservation in the Pacific Islands Region. Liaisons have facilitated numerous partnerships in each of their jurisdictions improving interagency and community relations and communications in the process. Working relationships, enhanced through the Liaisons, have been established and strengthened among federal and local agencies and organizations and have been maintained, which should improve future relations and progress to protect coral reef habitats. They helped identify goals and set priorities for direction, plans, and projects, and secured funding for and actively participated in the implementation of priority projects. Outreach conducted by Liaisons has improved community awareness, knowledge, understanding, and appreciation of coral reef ecosystems, and their value and need for protection. Liaison coordination and outreach efforts also helped improve compliance with local resource laws and the effectiveness of marine enforcement efforts. Liaisons have also minimized the loss of EFH and the fishery resources upon which island communities depend. In addition, technical assistance provided by the Liaisons has contributed significantly to resource and habitat assessment, monitoring, and novel research, and has facilitated local agency efforts, NOAA research cruises, and work by visiting researchers. Although difficult to quantify, cumulative efforts of the Liaisons have clearly resulted in improved coral reef conservation throughout the US Pacific Islands.

Criteria Important for Success

Reflecting on the past decade of accomplishment through partnerships by the Liaisons, key criteria for success became apparent. Of foremost importance was the need for cultural awareness and political sensitivity. Not all agencies, stakeholders, or communities hold consistent views regarding reef conservation. Political appointees and agency staff are also continually changing. Recognition of and sensitivity to multiple and alternative points of views is essential to build the support and partnerships necessary for effective reef conservation. In addition, Liaisons need to be willing to genuinely engage partners and community members early in management considerations, to promote understanding, buy-in, and compliance with resultant measures. Having a clear and strategic plan to guide synergistic efforts with related groups/activities pursuing coral reef conservation is equally important. Liaisons need to have strong communication and listening skills to maximize mutual understanding and avoid obstacles. Liaisons also need to help stakeholders understand the science

behind conservation actions and policies and give them access to accurate and unbiased scientific research and assessments, as well as the appreciation of traditional knowledge, to support management decisions. Further benefits may be realized through improving political will for marine environmental concerns, through appropriate channels and means, while remaining neutral on policy options. Prior experience working with local resource agencies and active extracurricular community involvement have also proven beneficial to Liaison success. And finally, age-old virtues such as patience, flexibility, effort, and perseverance are necessary to weather the daily challenges associated with coral reef conservation in the twenty-first century.

Areas for Future Direction

While the Pacific Islands Liaison program has been highly successful, some key areas for future direction and improvement might include: 1) Build additional capacity and streamline existing efforts to keep pace with increasing conservation needs. Additional staff in Guam and Hawaii have improved community outreach, engagement, and conservation outcomes, and should be considered for the other jurisdictions. 2) Continue to develop tools to improve regulatory processes: streamline EFH consultations; leverage listing of corals under ESA to address recovery of entire coral reef ecosystems; develop and use tools/methods to evaluate ecosystem functional value of specific habitats. 3) Provide management-driven, applied science to assist in decision-making and build community support: expand reef resilience studies throughout the region; evaluate small-scale connectivity to improve prioritization of place based conservation. 4) Improve capacity for science interpretation and community outreach to build support for coral reef conservation: interpret scientific findings through easily understood formats that can be shared with communities and decision makers; increase awareness, preparedness, and resiliency adaptation to variable impacts of climate change. 5) Increase the integration of key programs to maximize coordination and support from partner agencies and communities/stakeholders, while minimizing repetitive efforts: watershed/reef management plans; enforcement compliance; climate change; habitat protection; assessment/research; education/outreach. 6) Improve regional collaboration and capacity: support international capacity building through technical assistance (e.g., peer-to-peer exchanges) to better manage and protect coral reef ecosystems throughout the Pacific basin.

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