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Tide Pooling for a Solution: Strategic Communication to Strengthen the Pūpūkea Marine Life Conservation District

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**Tide Pooling for a Solution: Strategic Communication to Strengthen the Pūpūkea
Marine Life Conservation District**

A Capstone Report, June 2020



Photo: Mālama Pūpūkea-Waimea

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1. Executive Summary

This report focused on a timely marine conservation issue in Pūpūkea, O‘ahu, Hawai‘i regarding the lack of enforceable administrative rules in Kapo‘o, also known as the Pūpūkea or Sharks Cove tidepool, that is a part of the Pūpūkea Marine Life Conservation District (MLCD). To support the rule change process to revise the administrative rules, I worked with Mālama Pūpūkea-Waimea (MPW), a local nonprofit, to create and apply an ArcGIS Story Map. To build the Story Map, I explored available published literature, examined human use data from Kapo‘o, and observations from beach closures in response to the COVID-19 pandemic. From the literature, I gleaned information on the role and function of tide pools in Hawai‘i, impacts from recreational use in coastal environments, marine managed areas in Hawai‘i. From the human use data, I found that the majority of visitors at Kapo‘o engaged in swimming, snorkeling, and shoreline use; and the monthly average number of people participating in these three activities combined increased by 58 people, or 7%, from 2017 to 2019. Observations during a two-month beach closure due to the pandemic included an anecdotal increase of juvenile fish, native algae, and sightings of rarely observed marine life, with no to minimal human disturbance. The Story Map will be used by MPW to educate the Pūpūkea community and visitors, and will support the group through the future rulemaking process to make MLCD rules enforceable in Kapo‘o. Future studies will be conducted to understand Kapo‘o’s ecological role in the MLCD, to explore its role as a nursery and refuge for marine life, and to determine the magnitude of fishing and recreational impacts on the ecosystem.

2. Introduction

The coastal waters of Hawaii are known for their impressive coral reefs and other marine habitats that host a unique assemblage of native and endemic marine life. These nearshore natural resources have played important roles in the former and current lifestyle of people of in Hawai‘i in several ways, including food provisions, supporting the economy and by providing recreational activities such as snorkeling and SCUBA diving that are enjoyed among residents and tourists.¹

Under increasing pressure from Hawai‘i’s growing population and influx of visitors, reef-associated fish have drastically declined over the last one-hundred years due to unsustainable fishing techniques, habitat destruction, and the loss of traditional management practices.² Other anthropogenic threats to nearshore environments exacerbated by human presence include erosion, pollution, and coastal development on a local scale; and globally, climate change is now having an effect on reef communities.³ There is great economic value in protecting nearshore marine resources, such as coral reefs with an estimated \$10 billion value,

¹ Cesar, H. and van Beukering, P. (2004). Economic Valuation of the Coral Reefs of Hawai‘i. *Pacific Science*, Volume 58: 231-242.

² Friedlander, A.M *et al.* (2018). Human-induced gradients of reef fish declines in the Hawaiian Archipelago viewed through the lens of traditional management boundaries. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 28(1), pp.146-157.

³ Hughes, T.P. *et al.* (2017). Coral reefs in the Anthropocene. *Nature*, 546(7656), pp.82-90.

for future generations to enjoy because they inherently attain value from the rich biodiversity, conservation activities, and a number of ecosystem services they provide.⁴

Marine Managed Areas (MMAs) are recommended as a part of an ecosystem-based approach to deliver key conservation benefits through protection measures that conserve biodiversity, properly manage fisheries to restore and preserve ecosystem function,⁵ and to preserve historical and cultural resources.⁶ Existing MMAs in Hawaii are individually small, as well as few and far between, with a total area that covers 5% of State waters.⁷ In 2016, the State Department of Land and Natural Resources (DLNR), Division of Aquatic Resources (DAR) made a commitment to protect 30% of nearshore waters by 2030 through adaptive management approaches and stakeholder engagement in their [Marine 30x30 Initiative](#) (30x30). However, it is also important to strengthen the ecological resiliency of protected areas that currently exist to achieve the 30x30 target.⁸

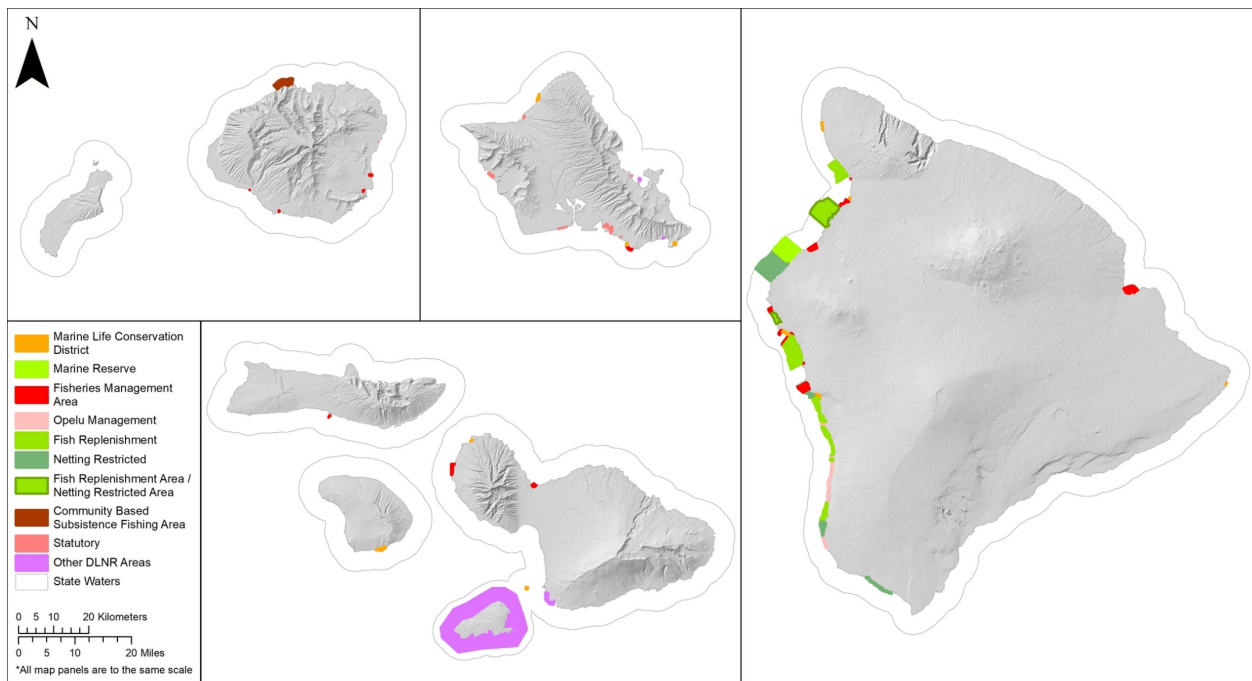


Image 1. Marine managed areas within Hawai'i State waters (0-3nm). See "Characteristic of effective marine protected areas in Hawai'i" by Alan M. Friedlander et al. (2019) for detailed map.

⁴ Cesar, H. and van Beukering, P. (2004). Economic Valuation of the Coral Reefs of Hawai'i. *Pacific Science*, Volume 58: 231-242.

⁵ Friedlander, A.M. et al. (2019) Characteristic of effective marine protected areas in Hawaii. *Aquatic Conserv: Mar Freshw Ecosyst.*, 29: 103-117.

⁶ States of Hawaii. (2020, February 13). *Marine Managed Areas*. State of Hawaii Division of Aquatic Resources. <https://dlnr.hawaii.gov/dar/marine-managed-areas/about-marine-managed-areas/>

⁷ State of Hawai'i. (June 2020). *Marine Managed Areas Dashboard*. <https://dashboard.hawaii.gov/en/stat/goals/5xhf-begg/4s33-f5iv/ydtj-mhgw>

⁸ State of Hawaii Division of Aquatic Resources. (2016). *World Conservation Congress Legacy Commitment: Hawai'i 30 by 30 Oceans Target*. https://dlnr.hawaii.gov/dar/files/2016/08/30x30_Effective_Mar_Mgmt.pdf

The Pūpūkea MLCD was established in 1983 and Kapoʻo became a part of the MLCD in 2009 through Executive Orders. However, the administrative rules of the MLCD have not yet been amended to expressly include the tidepools so that fishing restrictions can be legally enforced by the State of Hawaiʻi. Potential threats to Kapoʻo's ecological resiliency include fishing, trampling of coral and disturbance of wildlife by swimmers and snorkelers, erosion and pollution exacerbated by coastal development. A 2019 study conducted in the Pūpūkea MLCD underscored the doubling of human use in the area from 2010-2019 and partially attributed the increase in human use to significant declines in species richness, biomass, and abundance. In Kapoʻo, specifically, shore-based human use during the same period had tripled.⁹ It has been over 10 years since Kapoʻo officially became a part of the Pūpūkea MLCD, and it has also been this long that the tidepools have gone unprotected in the face of increasing human pressures. In an effort to stimulate public awareness of this issue and increase stewardship of Kapoʻo until rules are changed, strategic communication will be an effective tool to ensure the resiliency of Pūpūkea.

MPW is a community nonprofit based on the North Shore of Oʻahu, and their mission is to replenish and sustain the natural and cultural resources of Pūpūkea through public outreach, education, and advocacy. MPW is currently petitioning DAR to change the administrative rules to include the tidepools, thus making MLCD rules enforceable there. To support MPW through the potential upcoming rule change and promote conservation of Kapoʻo, my capstone project focused on 1) synthesizing available literature to collect foundational historical and ecological information, 2) analyzing and visualizing human use data from the tidepool area, and 3) building an ArcGIS Story Map to share this information with key stakeholders.

3. Synthesizing Relevant Literature

3.1 Purpose and Methods

The synthesis of available literature was necessary because an updated collection of information on Kapoʻo and the greater Pūpūkea MLCD was not previously available. I conducted a literature review by considering available and relevant scientific literature related to MMAs in Hawaiʻi, the Pūpūkea MLCD, the role of tidepools in Hawaiʻi and around the world, and studies related to recreational implications on coastal environments in Hawaiʻi. I reviewed nearly 50 peer-reviewed papers and this content was selectively incorporated into the Story Map. Informal conversations were also held with the MPW board and staff members to discuss the cultural history and importance of the area and was an important element to include in the Story Map, in addition to Kapoʻo's natural significance.

3.2 Marine Life Conservation Districts in Hawaiʻi

There are 11 MLCDs statewide with three on the island of Oahu all of which vary in habitat composition, size, and levels of protection. MLCDs were initially designated to offer public

⁹ Seascope Solutions LLC. (2019). Pūpūkea-Waimea MLCD Coral and Fish Assessment: 2010-2019.

interaction opportunities and conserve biodiversity,¹⁰ and locations were selected based on a 15 criteria including accessibility to the area, high biological diversity, and exposure to winds and seasonal surf.¹¹ Assessments of MLCDs have proven effective in Hawai'i with fish biomass 2.6 times greater than in open areas and greater abundance of apex predators; however, studies suggest MMAs in the State can potentially be more effective through the implementation of a statewide network.¹² A network of smaller MMAs are found to be more useful than increasing the size of an individual MMA that can often result in high socio-economic costs that hinders implementation.¹³

The Pūpūkea MLCD (Image 2), in the coastal waters off the North Shore of Oahu, was established in the early 1980s to protect the natural and cultural marine resources that exist in this area. The Pūpūkea MLCD partially lends its uniqueness to a tidepool-like ecosystem, known as *Kapo'o*, and a freshwater input from Waimea River that sets Pūpūkea apart from other MLCDs in the State. These features make the Pūpūkea MLCD an important conservation area that could potentially offer valuable insight into the interconnectedness of marine and terrestrial ecosystems in Hawai'i. Additionally, the Pūpūkea MLCD is part of the Hawaiian Islands Humpback Whale National Marine Sanctuary, and is the second most popular snorkelling destination after the world famous Hanauma Bay in East Honolulu.

Prohibited activities in the Pūpūkea MLCD include: 1) catching, taking, killing, possessing, or removing any finfish, crustacean, mollusk, including sea shell and *opihī* (limpet), live coral, or other marine life, or eggs; 2) taking, altering, defacing, destroying, possessing, or removing sand, coral, rock, or other geologic feature, or specimen; and 3) possessing in the water, any spear, trap, net, crowbar or other device that may be used for the taking, injuring, or killing of marine life, or the altering of a geological feature. Limited fishing activities are permitted in Waimea Bay only, by certain fishing methods during certain times of year of target species under Hawaii Administrative Rules (HAR) Section 13-34. Restrictions on boating and water vessel operations also exist in within the MLCD under HAR Section 13-256-63.

3.3 Legislative History

In the early 1970s, the neighborhood board of Pūpūkea was approached by divers who reported a decline in fish numbers and expressed interest in better management of the area's marine resources through the implementation of a MLCD. A study in 1975 conducted by the DLNR evaluated Pūpūkea as a potential MLCD, and ranked it as the second most suitable and

¹⁰ Friedlander, A.M. *et al.* (2007) Coupling ecology and GIS to evaluate efficacy of marine protected areas in Hawai'i. *Ecological Applications*. 17(3), pp. 715-730.

¹¹ Kimmerer, W.J. and W.W. Durbin. (1975). The Potential for Additional Marine Conservation Districts on Oahu and Hawaii. University of Hawaii Sea Grant.

¹² Friedlander, A.M. *et al.* (2019) Characteristic of effective marine protected areas in Hawaii. *Aquatic Conserv: Mar Freshw Ecosyst.*, 29: 103-117.

¹³ Aburto-Oropeza, O. *et al.* (2011). Large recovery of fish biomass in a no-take marine reserve. *PLoS ONE*, 6, e23601.

publicly accepted site after Kahe Beach Park on West O’ahu.¹⁴ Since its designation nearly 40 years ago, the Pūpūkea MLCD has gone through several rule revisions to further restrict fishing by capture methods and target species, as well as to expand its boundaries in 2003.

In June 2009, Governor Linda Lingle signed two Executive Orders transferring Kapo’o back to the State from the City & County of Honolulu, and designating the Pūpūkea MLCD and Kapo’o under the control and management of DAR. DAR now enforces rules for the MLCD under Hawaii Administrative Rules Section 13-34—the legal document that mandates protections on the Pūpūkea MLCD. However, these rules do not include Kapo’o since the jurisdictional transfers. Though the tidepools have technically been a part of the MLCD for over 10 years, the lack of administrative protections serves as a loophole in which fishing and other prohibitions cannot be legally enforced.

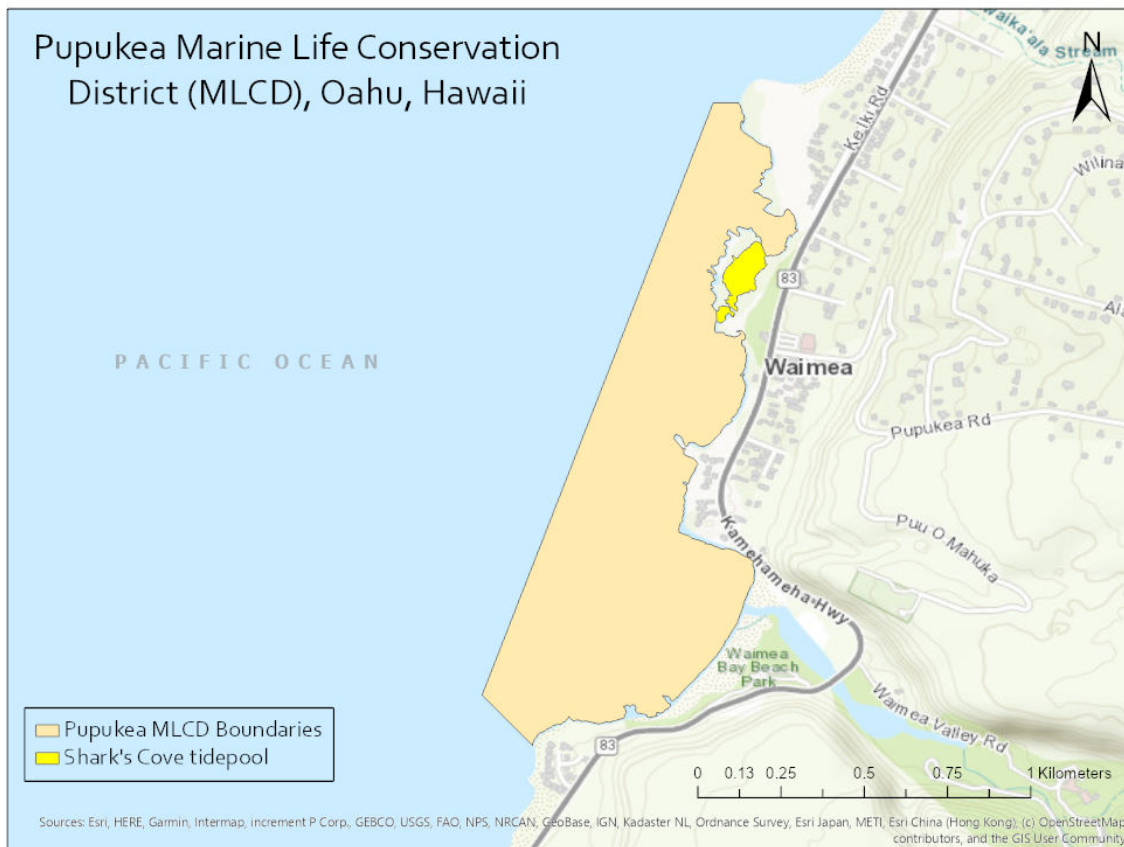


Image 2. Map illustrating the boundaries of the Pūpūkea Marine Life Conservation District, O’ahu, Hawai’i that also includes Kapo’o in yellow.

¹⁴ Kimmerer, W.J. and W.W. Durbin. (1975). The Potential for Additional Marine Conservation Districts on Oahu and Hawaii. University of Hawaii Sea Grant.

3.4 Tide Pool Ecology and Ecosystem Roles in Hawai'i

There is limited research that explores the role of tidepools as an important nursery habitat for reef-associated fish in Hawai'i; however, it is known that juvenile fish recruitment is an important factor contributing to adult fish abundance in coastal Hawaiian waters.¹⁵ Therefore, it is imperative to understand this habitat's potential function to elucidate best management practices and designating areas for protection.

Nursery habitats in the Caribbean can be characterized by seagrass meadows and mangrove forests that provide an abundance of food and structural refuge for juvenile fish, and contributes to survivorship to adulthood.¹⁶ These habitats are less common in Hawai'i, but research has shown that juvenile reef fish are often associated with semi-sheltered backreef habitat, coral patch-reefs, and in protected lagoons¹⁷ similar to that of Kapo'o. O'ahu's tidepool fish assemblage represents high endemism and low species richness, which is facilitated by a combination of harsh environmental conditions, substrate, and the isolated nature of intertidal zones in Hawai'i.¹⁸

Additionally, the early life stages of nearshore fishes are often subject to intense predation pressures and are found to seek refuge in rugose coral and perhaps within the structural complexity of Kapo'o. The protected, soft bottom environment that can be found in tidepools offers ideal habitat for species important for recreational fishing and consumption, such as *aholehole*, *Kuhlia xenura* and *Kuhlia sandvicensis*, that have been confirmed to exclusively utilize tidepools as juveniles.¹⁹ Understanding utilization patterns by marine life in tidepools can also inform us about the cultural importance of protecting such areas to ensure juvenile recruitment to adulthood and spillover into open areas, and highlights the need for continued research to inform conservation efforts.

3.5 Status of Kapo'o and Need for Rule Change

Since the increased protections and boundary expansion in 2003, significant increases in fish biomass and resource fish abundance is more readily observed in the Pūpūkea MLCD²⁰ as well as outside its boundaries due to spillover—emigration of adult and juvenile fish to unprotected

¹⁵ Walsh, W. (1984) Aspects of nocturnal shelter, habitat space, and juvenile recruitment in Hawaiian coral reef fishes. Dissertation at the University of Hawaii at Mānoa, Department of Zoology.

¹⁶ Iglesias, I.S. (2012) Are Rocky Intertidal Pools a Nursery Habitat for Juvenile Reef Fish? An Investigation of the Spatial and Temporal Abundance Patterns of Juvenile Fishes Utilizing Basalt Tidepools on the Island of Oahu and a comparative growth analysis of the endemic *Kuhlia xenura*. Master's Thesis at the University of Hawaii at Mānoa, Department of Zoology.

¹⁷ DeMartini, E. (2009) Influences of wind-wave exposure on the distribution and density of recruit reef fishes at Kure and Pearl and Hermes Atolls, Northwestern Hawaiian Islands. *Environmental Biology of Fishes* 85: 319-332.

¹⁸ Cox, T.E. *et al.* (2011) Spatial and vertical patterns in the tidepool fish assemblage on the island of Oahu. *Environmental Biology of Fishes*. 90 (4): 329-342.

¹⁹ McRae, M. *et al.* (2011) Habitats used by juvenile flagtails (*Kuhlia* spp.; Perciformes: Kuhliidae) on the Island of Hawaii. *Pacific Science*. 65 (4): 441-450.

²⁰ Friedlander, A.M. *et al.* (2019).

areas.²¹ The effectiveness of the Pūpūkea MLCD has shown to be successful in reef surveys conducted over the last decade with an increase in fish biomass and biological diversity.²² However, a 2019 assessment of the Pūpūkea MLCD's coral and fish assemblages from 2010-2019 found that species abundance, biomass, and species richness had significantly declined.²³ This report noted the tripling of shore-based human use at Kapo'ō, and suggested human-disturbance may be a contributing factor to fish declines in addition to illegal fishing and land-based runoff exacerbated by coastal development.

The number of annual visitors to O'ahu has increased by nearly 50-percent from 2010-2019,²⁴ and human use data collected from recent years by MPW confirms this increase at Kapo'ō by, both, local residents and tourists. MPW also reports year-round use of the tidepools that, historically, had minimal human use during the winter months.²⁵ On average, MPW performs 90 educational interventions a year in Kapo'ō and adjacent areas thwarting MLCD rule violations and provides educational outreach to thousands of people visiting MPW's Saturday outreach tent at Pūpūkea Beach Park neighboring Kapo'ō.²⁶ Poaching within the Pūpūkea MLCD and Kapo'ō has also been of great concern in recent years. It is not yet known how many of the violations reported to the Department of Conservation and Resource Enforcement (DOCRE) are related to poaching, but observations from community members report frequent disregard of fishing restrictions in the early morning and after dark hours. It is likely that many fishermen are unaware that the Pūpūkea MLCD exists; however, several fishermen that are well-aware of the lack of unenforceable rules in Kapo'ō and plan to fish there until administrative protections can expressly include the tide pools.²⁷

Increasing numbers of annual visitors to O'ahu and to Kapo'ō, fishing pressures, in addition to coastal development in the area, underscores the need for comprehensive administrative rules to protect the tidepools. Revised rules will directly reduce impacts to Kapo'ō from visitations and fishing pressure because DOCARE can the legally address violations such illegal gear possession (*e.g.* fishing poles, hand nets, spears) and the collection of marine life and geological features (*e.g.* sand, shells). Until administrative rules can be amended, educational outreach to inform the public about the existence of the Pūpūkea MLCD and its prohibitions is necessary to ensure that Kapo'ō's ecological resiliency in the face of poaching and potentially heavy human use.

²¹ Stamoulis, K.A. and Friedlander, A.M. (2013) A seascape approach to investigating fish spillover across a marine protected area boundary in Hawai'i. *Fisheries Research*, 144, pp.2-14.

²² Rosinski, A.E. (2012) Creating Comprehensive Protected Areas: The Ecology of the Pūpūkea Tide Pools and Their Value to the Pūpūkea Marine Life Conservation District. *University of Miami Rosenstiel School of Marine and Atmospheric Science, Internship Report*.

²³ Seascape Solutions LLC. (2019). *Pūpūkea-Waimea MLCD Coral and Fish Assessment: 2010-2019*.

²⁴ State of Hawai'i. (May 2020). DBEDT Quarterly Tourism Forecast. Department of Business, Economic Development & Tourism. <https://dbedt.hawaii.gov/visitor/tourism-forecast/>

²⁵ Yagodich, Jennifer. (Director of Educational Programs, Mālama Pūpūkea-Waimea), in discussion with author. January 2020.

²⁶ Yagodich, Jennifer. (Director of Educational Programs, Mālama Pūpūkea-Waimea), in discussion with author. May 2020.

²⁷ Yagodich, Jennifer. (January 2020). *Personal communication*.

4. Patterns in Recreational Use in Kapoʻo

4.1 Purpose and Methods

MPW staff have anecdotally observed more people using the tidepools over the past five to ten years. In addition, there was historically minimal human presence in Kapoʻo during the winter months due to large waves from November to February. In recent years, staff believe this pattern has changed and now the tidepools see higher activity year-round. Recreational human use of Kapoʻo and, the adjacent, Sharkʻs Cove have been collected by MPW volunteers from 2010 to present. However, these data had never been analyzed and therefore patterns in use were unconfirmed. I analyzed this citizen science data and incorporated the findings into the Story Map to illuminate patterns in human use and to better understand the magnitude of impact on Kapoʻo from human disturbance and presence in the tidepools.

The MPW human use data were collected on weekend days (mostly Saturdays) at or around noon tallying the number of people engaging in 14 activities including snorkeling, swimming, beach/shore use, reef walks, diving in three distinct zones: Kapoʻo, inside and outside Sharks Cove. There is little to no expected duplication of persons across activities as the data was collected in a short amount of time. I analyzed human use specifically in the Kapoʻo from 2017-2019 for this project and calculated the monthly average for the three most common activities from 2017 to 2019. Data from 2010-2016 was not digitized; therefore, was not included in the analysis. Additionally, no human use data was available from October to December 2018 and February 2019 for analysis.

4.2 Results

The three most common activities in the tidepools are swimming, snorkeling, and beach/shoreline use, accounting for nearly 95% of all activities observed at Kapoʻo. The monthly average total number of people in the tidepools participating in snorkeling, swimming, and use of the beach/shoreline showed a 7% increase, from an annual average of 122 people in 2017 to 180 people in 2019. The average number of people swimming, snorkeling, and using the beach per month showed a 1.1%, 1.3%, and 4.5% increase, respectively, from 2017 to 2019. During time period, both the individual activities and the combined count illustrated peaks during the summer and winter months confirming increased recreational from November to February.

Percent Breakdown of Recreational Activity in Kapo‘o from 2017-2019

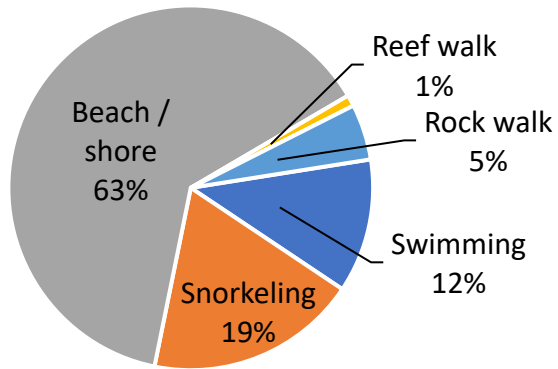
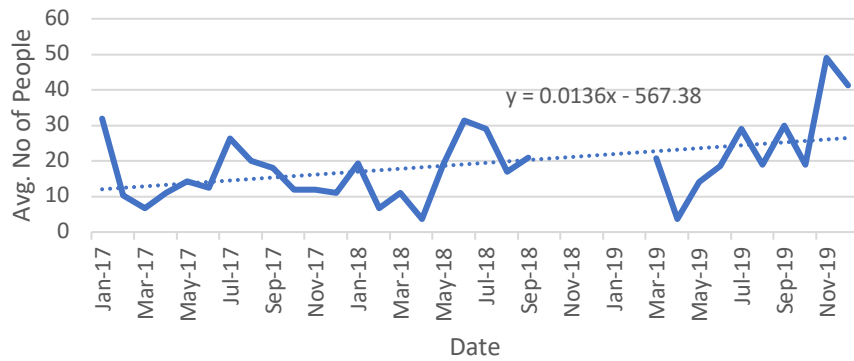


Figure 1. Percent breakdown on recreational use in Kapo‘o based on the monthly average of people.

(A) Avg. No. of People Swimming by Month, 2017-2019



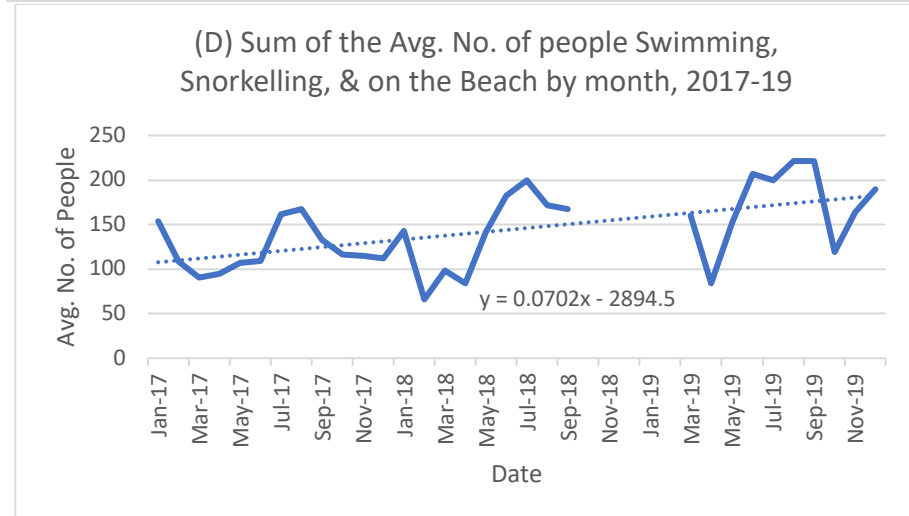
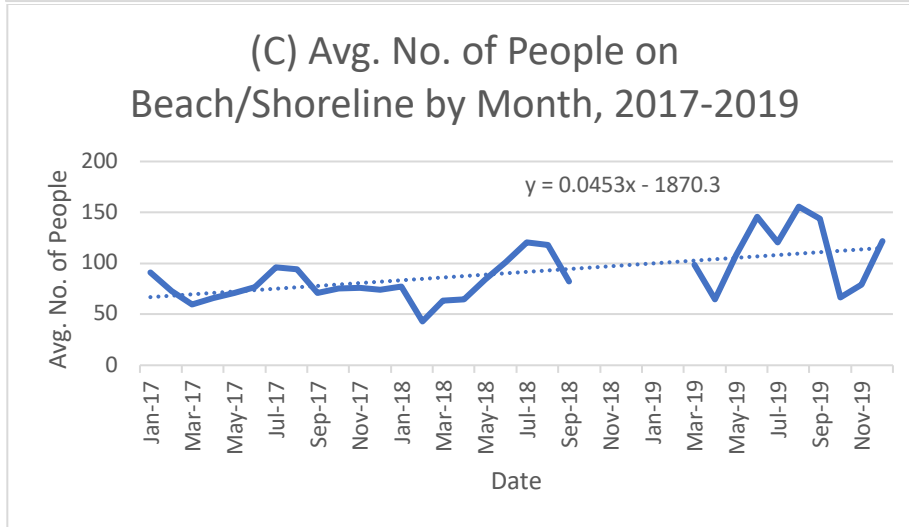
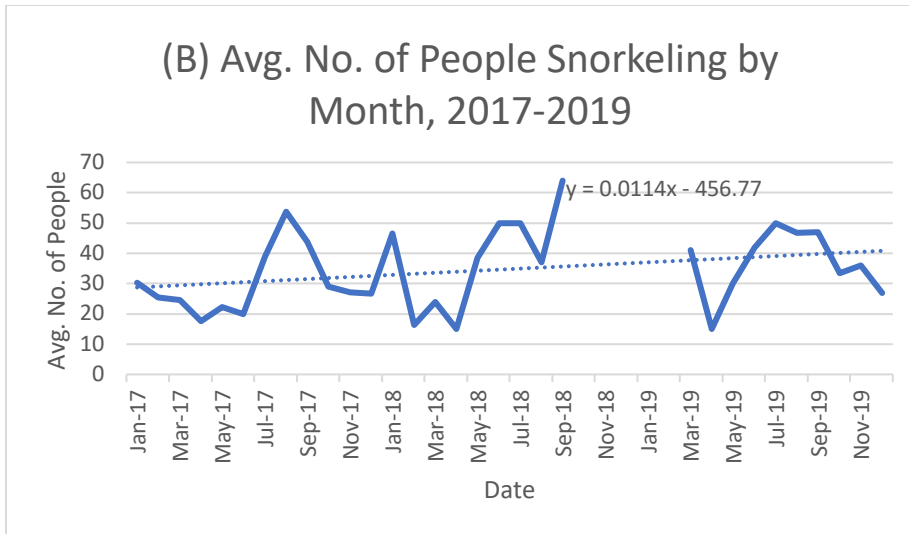


Figure 2. Trends of monthly average number of people recreating in Kapo’o from 2017-2019. No data available from October-December 2018 and February 2019. A) Monthly average number of people swimming. B) Monthly average number of people snorkeling. C) Monthly average number of people on beach/shoreline. D) Total monthly average number of people swimming, snorkeling, and on the beach/shoreline.

4.3 COVID-19 Pandemic Beach Closures at Kapo’o

On March 19, 2020, the Governor of Hawai’i mandated a Stay-at-Home order in response to the COVID-19 pandemic, and with this, the closure of beach parks and other public areas. For a period of nearly two-months, there was minimal to no human presence in Kapo’o and MPW began to observe ecological changes that anecdotally have not been observed in years. The presence of large schools of juvenile fish, rare and unreported marine life, and the increased growth of native macroalgae were reported.²⁸

This event provided the opportunity to observe the ecology of the tidepool in the absence of human use and to better understand the magnitude of recreational impacts, such as human disturbance, on marine life in Kapo’o. It also revealed that the tidepools may be functioning as a nursery for juvenile fish and shed light on the resiliency of the area to rebound from the pressure of year-round human activity. MPW took advantage of this event to record rough estimates of fish, invertebrate, and macroalgae abundance. These data will be useful when compared to past and future ecological assessments of Kapo’o when recreational use is present.

5. Story Map as an Educational Tool

5.1 Purpose and Methods

There was a need within MPW to have a tool that staff could use to share information with visitors and local residents and to advocate for the administrative rule changes to the MLCD, which would increase protections for Kapo’o. In our increasingly virtual world, an ArcGIS Story Map can be used to reach a broader audience to communicate information in an interactive and visually appealing way. A Story Map is an internet-based platform that integrates maps, text, photos, audio and videos into standalone resource that is great for public engagement because it can be easily shared through a website or social media. A Story Map was developed for MPW to serve as a *one stop shop* for information on Kapo’o. The goal of this Story Map is to promote stewardship of Kapo’o and the surrounding MLCD for an audience beyond the reach of MPW’s in-person outreach until administrative rules can be amended to include the tidepools for DOCARE to enforce.

The Kapo’o Story Map included information from the literature review and the analysis of MPW human use data strung together by elements of communication strategies and/or social marketing techniques that helped this Capstone Project take on the form of an educational campaign for MPW. Social marketing is a systematic approach to elicit behavior change and stakeholder action for social good by breaking down barriers that hinders engagement and motivation. The [Nature Conservancy’s Reef Resilience Network](#) was an important resource in the development and application of this communication strategy.

²⁸ Yagodich, Jennifer. (Director of Educational Programs, Mālama Pūpūkea-Waimea), in discussion with author. May 2020.

Effective communication with a variety of stakeholders is essential for any successful marine resource management or conservation strategy; therefore, it was important to assess what my goals and objective were and identify opportunities and challenges with the creation and implementation of a Story Map. With the goal to build support for amending the administrative rules and raising awareness of the issue in a way that increases user stewardship of Kapo’o, it was important to identify who the stakeholders were, what about Kapo’o do they value, and what barriers may be in the way of them taking action in the creation of the Kapo’o Story Map. Target audiences included local and out-of- and in-state visitors participating in swimming, snorkeling, and SCUBA diving activities; and recreational fishermen.

5.2 Future Use

MPW can disseminate this Story Map in several ways such as providing the link or QR code to this Story Map on their webpage and social media platforms. A QR code and/or link can also be printed on outreach materials and signage found in the area to reach those who are not active on social media. This Story Map also has the potential to reach lawmakers during the public hearing process to amend the rules for Kapo’o’s inclusion under the MLCD regulations.

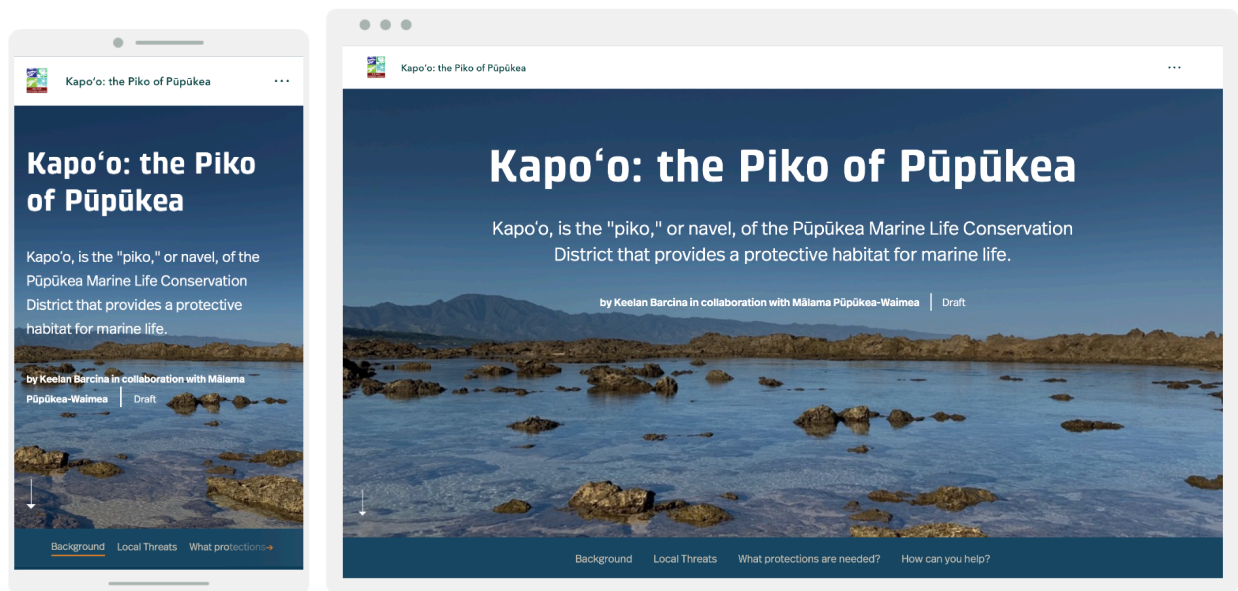


Image 3. Kapo’o ArcGIS Story Map displayed on a mobile phone (left) and computer desktop (right).

Click [here](#) or scan the QR code to explore the Story Map!



6. Conclusions

There have been several studies done in Kapoʻo, but only two were specifically done to assess the biological and environmental characteristics of the tidepools; one in 1975 and the second in 2012. Despite the limited amount of information exclusive to Kapoʻo, there is an endless amount of information around the role of tidepools in Hawaiʻi. Research detailing impacts on coastal ecosystems from recreational activities, unsustainable fishing practices, and coastal development; and the efficacy of MMAs in Hawaiʻi contributing to the spillover of marine species into open areas; provides supporting information for the administrative protection of Kapoʻo. To best highlight this issue, I created the Kapoʻo Story Map that incorporated my literature review and analysis of human use data to raise awareness and educate the public on protecting Kapoʻo until administrative rules are amended to include the tidepools. This Story Map will also be used as a tool by MPW to inform policymakers on the urgency of addressing this issue during the rule making process.

6.1 Challenges

The literature review done in this project proved to be a daunting task as more generalized information surfaced during my research. There is limited amount of research related specifically to tidepools in Hawaiʻi, their ecological role and functions, Kapoʻo and the greater Pūpūkea MLCD; however, there is a plethora of theoretical and anecdotal information that one can use to infer that Kapoʻo functions as a nursery and refuge for marine life despite the absence of information explicitly stating this. In the opposite regard, this made it simpler to synthesize information pertaining to Kapoʻo and the Pūpūkea MLCD.

It was also challenging to examine long-term trends of human use in Kapoʻo only analyzing three years of data, of which there were missing data points. Observations include increased year-round human use in recent years, especially during winter months, from what was historically reported. Historical human use data dating back to 2010 is available, but unfortunately was not in a digital form to analyze and confirm anecdotal trends.

Creating a Story Map to engage a variety of stakeholders through different platforms while using a single tool proved to be challenging. Tourists, recreational fishermen, and local residents receive and process information in entirely different ways that can make a single communication tool ineffective for one audience or the other. To best address this issue during the creation of the Kapoʻo Story Map it was important to understand and consider how each stakeholder receives information regarding the tidepools and identify the best means by which the Story Map will be disseminated each group. Tourists are likely to learn about the tidepools and the Story Map through active outreach, whereas local residents are more likely to passively receive this information on a sign or through social media.

6.2 Next Steps

I will continue to help MPW fill in knowledge gaps related to the ecological role and function of Kapoʻo by surveying the biological community and environmental variables that influence marine life in the Pūpūkea tidepools. Additionally, continuing to collect human use data will help MPW to better understand the magnitude of the impacts related to various activities in Kapoʻo. I will also digitize human use data prior to 2017 to create a more comprehensive human use dataset from 2010 to present and support upcoming studies on a human carrying capacity of Kapoʻo.

Kapoʻo's unique tidepool-like features and shallow water habitat is home to a variety of marine life, and its biological and cultural importance go hand in hand. The lack of enforceable administrative protections threatens Kapoʻo's resiliency by recovering from the stresses of fishing and potentially heavy human use. Without a full understanding of the magnitude of recreational impacts in Kapoʻo we could potentially lose these resources before fully understanding its ecological role in the Pūpūkea MLCD. This project aimed to highlight this marine conservation issue in a way that strengthens environmental stewardship within the community that advocates for Kapoʻo's protection and will be used as a tool to promote movement towards achieving Hawai'i's marine resiliency goals.