State of Hawaiʻi
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Aquatic Resources
Honolulu, Hawaiʻi 96813

May 26, 2023

Board of Land and Natural Resources
State of Hawaiʻi
Honolulu, Hawaiʻi

NON-ACTION ITEM:
JOINT DIVISION OF AQUATIC RESOURCES (DAR) & DIVISION OF BOATING AND OCEAN RECREATION (DOBOR) INFORMATIONAL BRIEFING ON THE PROPOSED AMENDMENT AND COMPILATION OF HAWAII ADMINISTRATIVE RULES (HAR) CHAPTERS 13-31, "MOLOKINI SHOAL MARINE LIFE CONSERVATION DISTRICT, MAUI," AND 13-257, "DAY-USE MOORING RULES"

HISTORY

The Molokini Shoal Marine Life Conservation District (MLCD) was initially established in 1977. The area is located about 3 miles from Maui in the middle of the ʻAlalākeiki Channel, and includes 77 acres of submerged basalt rocks, coral reefs, and sand channels. Although the area was established as a strict no-take reserve, there was no identified concern with non-extractive marine tourism activity at that time and therefore, no rules were established to control or set limits on this type of activity.

In 1995 new rule amendments were added to address concerns with potential overuse by marine tour vessels and with specific concerns over environmental impacts from these vessels including anchor damage to the coral reef habitat. At that time, a commercial use permit system was established with 42 permits issued. These permits were only issued to commercial operators who could demonstrate active use of the MLCD. The permits were non-transferable and there was an expectation of permit attrition over time as companies went out of business. Since that time, only 2 permits have not been renewed. Therefore, 40 permits remain actively used and the vessels that hold those permits have increased significantly in size and passenger capacity.

In 2009, the commercial permit terms and conditions were amended to more carefully manage activities of concern within the MLCD. Each permit was capped at their current passenger capacity (as set by the US Coast Guard Certificate of Inspection). It was also, at this time the all commercial permittees were required to report their use by numbers of guest taken to the MLCD, type of activity, time of day, and specific location of activity. Use reports in 2010 documented nearly 300,000 visitors were taken to the Molokini

MLCD that year. This number has steadily increased to the current numbers that are now consistently in excess of 300,000 visitors per year.

In 2009, a comprehensive human use and social carrying capacity study was conducted (An executive summary of the study is attached as **Exhbit 1**). This study found that over two thirds of all respondents reported feeling crowded by the number of people and boats while they were at Molokini. This same study suggested 50% of those surveyed felt an acceptable number of boats within the MLCD would be between twelve large vessels and seventeen small vessels.

In 2016 and 2017, a study was conducted to look into the movement patterns of key reef predators while collecting information on noise within the MLCD and correlating this with use data submitted by permitted commercial operators (Attached as **Exhibit 2**). This study found that 50% of the ʻōmilu (Bluefin Trevally) were displaced from their preferred shallow reef habitat when there were more than twelve vessels within the MLCD. A follow up study was conducted in 2020 to evaluate the effects of the COVID-19 shutdown on commercial tours to Molokini and the subsequent return of visitors through early 2021 (Attached as **Exhibit 3**). This work found a rapid and significant increase in fish biomass within the MLCD during the COVID-19 shutdown. With the return of visitors to Molokini, the fish biomass rapidly dropped back to pre-pandemic levels. The changes in fish biomass were driven primarily by changes in the abundance of mobile reef predators and further supported the findings of the previous work conducted in 2016.

All of these scientific peer reviewed studies highlight the need to take a close look on crowding concerns within the Molokini MLCD. To that end, DAR staff began a careful review of the commercial use patterns within the MLCD and began a process to involve and consult with stakeholders in the development of updated rules that would better address the current situation within the MLCD and that would help reduce and/or prevent future impacts to the unique and fragile marine resources of the area.

SCOPING AND STAKEHOLDER CONSULTATION

On November 15, 2018, DAR staff held an informational meeting with all interested Molokini commercial operators. A working group of key commercial tour representatives was established along with a scoping process to carefully discuss and plan for future rule amendments. The main resource management goals of this effort were outlined as the following:

1) Reduce crowding
2) Ensure fair and equitable use by all boaters
3) Ensure for reliable and dedicated funding for aquatic management needs
4) Update DAR and DOBOR rules as needed (13-31 and 13-257)

Commercial Operator Working Group meetings, public scoping meetings and meetings with other key stakeholder were held on the following dates:

December 11, 2018 **1st Molokini Commercial Operators Working Group Meeting**

January 8, 2019 **2nd Molokini Commercial Operators Working Group Meeting**

January 24, 2019 **3rd Molokini Commercial Operators Working Group Meeting**

February 4, 2019 **Scientist Presentation on Study Results Informing Management Concerns**

Presentations to commercial operators and general public on the social carrying capacity study (Dr. Brian Szuster, UH) as well as the reef predator movement study(Dr. Alan Friedlander, National Geographic and UH).

February 5, 2019 **4th Molokini Commercial Operators Working Group Meeting**

Time for the working group members to ask question and discuss the details of the social carrying capacity and reef predator movement studies and better understand how these studies are guiding management efforts.

February 19, 2019 **5th Molokini Commercial Operators Working Group Meeting**

February 22, 2019 **Hawaiian Cultural Stakeholder Meeting**

February 26, 2019 **Non-Commercial Boating Stakeholder Meeting**

March 21, 2019 **General Public Information and Scoping Meeting**

Presentation on studies informing management goals, outline of major management goals and the timeline to amending the rules. Breakout to smaller groups for facilitated scoping for more general public input into rule changes. A summary of the feedback received from this public scoping meeting is attached as **Exhibit 4**.

April 18, 2019 **6th Molokini Commercial Operators Working Group Meeting**

This meeting was centered around the specific plan for rule amendments and was another chance to get industry input into these future changes before any amendments were finalized for formal administrative rule making.

January 14, 2020 **7th Molokini Commercial Operators Working Group Meeting**

This meeting reviewed mooring locations and numbers, discussed concerns with recently discovered Un-exploded ordnances, and reviewed the current state of proposed new rules for the area.

April 15, 2020 **8th Molokini Commercial Operators Working Group Meeting**

This meeting we continued to review the mooring locations, discuss how non-commercial mooring use has been going, and reviewed their current schedules.

April 2020 *The Scoping and meeting process was halted during the early days of the COVID-19 Pandemic. Commercial operators were prohibited from running tours and/or greatly restricted in their passenger numbers until early fall of 2020.*

June 16, 2021 **9th Molokini Commercial Operators Working Group Meeting**

In this meeting we continued discussions on moorings and schedules, but also discussed the rule proposals and got specific input on the final rule amendment plans including the proposed fee structure.

October 6, 2021 **10th Molokini Commercial Operators Working Group Meeting**

This was the final meeting to get working group input into the rule proposals before the rules were drafted up for board submittal.

January – March 2022 *Draft rules were shared with all permitted commercial operators via email and also with various non-commercial boaters who have expressed concerns with Molokini management in past meetings.*

AMENDMENTS TO CHAPTER 13-31, HAR, (MOLOKINI MLCD)

The proposed amendments to the Molokini MLCD rules will:

1) Prohibit any commercial activity involving swimming, snorkeling, diving, kayaking, or paddling without a valid Molokini MLCD Use Permit;
2) Prohibit anchoring within the Molokini MLCD;
3) Replace the current fee of $50.00 for a two-year Molokini MLCD Use Permit with a new, tiered fee schedule for a two-year Molokini MLCD Use Permit consisting of three tiers of permit fees based on the passenger capacity of the vessel as follows:

Vessel Category	**Permit Fee Amount (Every Two Years)**
Category 1 (<25 Passengers)	$1,500.00
Category 2 (25-74 Passengers)	$3,000.00
Category 3 (75+ Passengers)	$6,000.00

   (This should result in $61,500 collected per year to fund the Division's management expenses within the Molokini MLCD); and
4) Grant the Department discretion to waive permit fees in certain circumstances **(For example**: Commercial fees could be waived for commercial operators who agree to stay out of the Molokini MLCD during peak crowding periods 8:30 a.m.-10:30 a.m.).

AMENDMENTS TO CHAPTER 13-257, HAR, (DAY-USE MOORING RULES)

The proposed amendments to the day-use mooring rules will:

1) Repeal the Day-Use Mooring Zones for the Island of Hawai‘i;
2) Establish a maximum time limit of 2.5 hours for use of any day-use mooring;
3) Prohibit overnight use of day-use moorings;
4) Clarify where anchoring is allowed;
5) Add provisions for the installation of day-use moorings, including approved mooring buoy design guidelines;
6) Clarify that any deviations from the mooring buoy design guidelines within the chapter must first be approved by the Board;
7) Require that the Board make specific findings before approving a mooring buoy design that differs from the mooring buoy design guidelines within the chapter; the Board will be required to find that:
   a. A specific design offers environmental or structural advantages over those specified in the day-use mooring buoy guidelines; and
   b. Such environmental or structural advantages outweigh any negative impacts to aquatic resources;
8) Require the Department to develop a Day-Use Mooring Buoy Site Proposal for each day-use mooring buoy site (Subject to approval and modification by the Board) with the following considerations:
   a. Public input;
   b. Impact upon aquatic resources;
   c. Use patterns with respect to the proposed site; and
   d. Any other information relevant to site selection and mooring buoy installation;

9) Require the Department to maintain and make available on DOBOR's website a listing of sanctioned day-use mooring buoys installed in the waters of the State including a reasonable effort by the Department to provide an accurate location for each state-owned day-use mooring buoy via GPS coordinates;
10) Prohibit rafting of vessels from any day-use mooring buoy;
11) Clarify that any vessel owner or operator assumes the sole risk of using any day-use mooring;
12) Add specific exemptions to the day-use mooring rules for emergency situations, law enforcement, patrol, or rescue craft, Department vessels and personnel performing official duties, vessels and personnel performing authorized homeland security training operations, and the U.S. Coast Guard;
13) Update the Map for the Molokini Island Day-Use Mooring Area;
14) Clarify the Boundaries of the Molokini Island Day-Use Mooring Area;
15) Remove the separate mooring zones within the Molokini Island Day-Use Mooring Area;
16) Update the fee for commercial use of a day-use mooring within the Molokini Island Day-Use Mooring Area from $100.00 per month or two percent of gross receipts, whichever is higher, to a flat fee of $200.00 per month with an exemption for commercial operators presently paying the ocean stewardship user fee;
17) Clarify that the commercial day-use mooring fees are in addition to fees required under HAR §13-31-5 and Chapter 13-234, HAR;
18) Provide exclusive use of recreational day-use moorings within the Molokini Island Day-Use Mooring Area to recreational vessels;
19) Require all recreational day-use moorings to be indicated with a surface float;
20) Update the window where reactional vessels are prohibited from using vacant commercial day-use moorings within the Molokini Island Day-Use Mooring Area from 8:30 a.m.-11:30 a.m. to 7:30 a.m.-9:30 a.m.;
21) Prohibit all anchoring within the Molokini Island Day-Use Mooring Area; and
22) Add other non-substantive housekeeping amendments for clarity and consistency.

The draft amendments to Chapters 13-31 and 13-257, HAR, are attached as **Exhibit 5 and Exhibit 6** respectively.

Respectfully submitted,

BRIAN J. NEILSON, Administrator
Division of Aquatic Resources

APPROVED FOR SUBMITTAL

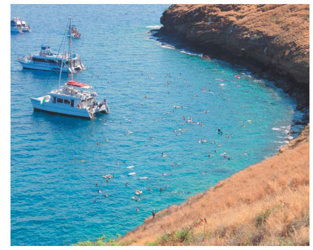
DAWN N. S. CHANG, Chairperson
Board of Land and Natural Resources

Attachments:

- Exhibit 1 – Executive Summary of Social Carrying Capacity Report (Szuster and Needham 2010)
- Exhibit 2 – Reef Predator Movement Report (Filous et al. 2071)
- Exhibit 3 – Impacts of Decreased Tourism During to COVID-19 Pandemic (Weng 2023)
- Exhibit 4 – March 21, 2019, Summary of Public Comments from the Public Scoping Meeting
- Exhibit 5 – Proposed HAR §13-31 (Ramseyer format)
- Exhibit 6 – Proposed HAR §13-257 (Ramseyer format)

ITEM F-4 - EXHIBIT 1



MARINE RECREATION AT THE MOLOKINI SHOAL MLCD

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SUGGESTED CITATION

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EXECUTIVE SUMMARY

Hawaiʻi hosts approximately seven million visitors each year who spend more than $11 billion during their visit. More than 80% of these visitors engage in coastal or marine recreation activities such as snorkeling or scuba diving. Given this level of recreational use, Hawaii's Department of Land and Natural Resources (DLNR) faces a set of management challenges in areas under their jurisdiction including: mitigating reef environments from degradation, protecting public access, determining recreational use thresholds and managing use levels to ensure that these thresholds are not violated, and ensuring that user experiences are not compromised. This study presents a comprehensive assessment of social impacts related to marine recreation activities at the Molokini Shoal Marine Life Conservation District (MLCD). It presents a rigorous scientific approach capable of assessing social impacts related to marine recreation use, and applies this approach at the Molokini Shoal MLCD to test its performance and potential transferability to other high priority marine recreation sites across the state.

ADMINISTRATIVE CONTEXT

Marine recreation planning and management in Hawaiʻi takes place within an administrative context that includes several state agencies and a broad range of relevant regulations. Management of MLCD is the responsibility of the Division of Aquatic Resources (DAR) which is an administrative unit of the DLNR whose mission is to "manage, conserve, and restore" Hawaii's aquatic resources and ecosystems for present and future generations. The Division of Boating and Ocean Recreation (DOBOR) is responsible for the management and administration of recreation and coastal areas programs in all waters out to three nautical miles, and the Division of Conservation and Resources Enforcement (DOCARE) is responsible for enforcement activities at state marine recreation sites.

Marine Life Conservation Districts (MLCD) in the State of Hawaiʻi are regulated under the Marine Life Conservation Program as defined by *Hawaiʻi Revised Statutes Chapter 190, Sections 1-5.* Fishing and other consumptive uses are usually prohibited in MLCD, but these areas commonly support non-consumptive commercial activities such as dive operations and snorkeling tours. DLNR regulation of commercial activities that affect MLCD is guided by a set of policies which includes a hierarchy of priorities. The highest priority is to conserve natural and cultural resources, and commercial activities should only occur on state owned or managed lands or waters if these do not unduly damage the resource. The second priority is public access which should only be maintained as long as natural and cultural resources are preserved. Commercial activities are third in this hierarchy and should only be permitted if impacts do not impinge on the resource or

use by the general public. The commercial use policy also states that Limits of Acceptable Change (LAC) principles should be used to manage commercial use of state controlled resources. The Molokini MLCD was created in 1977 through HAR 13-4-31 which outlines boundaries, prohibited and allowed activities, exceptions, permits, and penalties. The DLNR has issued 41 commercial use permits at the Molokini MLCD under the authority of HAR 13-31-5 to engage in commercial scuba diving, snorkeling, snuba, swimming, and sightseeing tours. Day use moorings were also installed at the site under the authority of HAR 13-4-257 which was enacted in 1994.

ENVIRONMENTAL CONTEXT

Molokini islet is the southern rim of an extinct volcanic crater and the shallow inner cove is the crater's submerged floor. The islet is owned by the U.S. Fish and Wildlife Service and managed as a bird sanctuary, and the Hawaiian Islands Humpback Whale National Marine Sanctuary surrounds the MLCD. The crater offers protection for fragile benthic species and the site is well removed from offshore sediment inflows that frequently disrupt nearshore reef habitats. The most common substrates are turf algae, sand, and approximately 38 species of hard corals. The environmental status of Molokini MLCD is regularly evaluated by DAR as part of a broader marine environmental monitoring program in the State of Hawaiʻi. Coral reefs at Molokini are considered to be "relatively healthy" in spite of substantial marine recreation use and impacts associated with these activities are mitigated by the site's isolation and depth.

Fish surveys at Molokini MLCD have identified high species diversity, richness, and biomass that varies spatially due to factors such as food availability and habitat structure. Tropic structure among habitats was 42% herbivores, 41% predators, and 17% secondary consumers with dominant species such as surgeon fish, trigger fish, sharks, jacks, and parrot fishes. The most common fish are orangespine and unicornfish, but bluefin trevally, giant trevally, and the bigeye emperor fish are also widespread. Juvenile white tip reef sharks are frequently seen at Molokini, and abundant plankton along the outer crater wall can attract whale sharks and manta rays. Fish surveys at Molokini found more apex predators, herbivores, and larger fish of heavily-targeted species than in other comparable open access areas of Maui County.

FOCUS GROUP SUMMARY

Results of focus groups with commercial operators, government agencies, native Hawaiians, and recreation and environmental interest groups showed both similarities and differences among stakeholders with interests in Molokini. With respect to similarities, the focus groups demonstrated a lack of communication among agencies and stakeholders, and all groups desired improved collaboration. Stakeholders identified a lack of agency leadership, management, and enforcement, no clear objectives or goals for the site, and a lack of rigorous human use data. Also, there was a lack of dedicated funds for management, planning, operations, maintenance, data collection, communication outreach and inreach, monitoring, and enforcement. Confusion over agency jurisdiction and responsibility, and lack of information from agencies were also identified as issues. There were significant concerns voiced over management of moorings. A desire for all types of sustainability, site enhancement, and effective education of users was present, but no one suggested making the area an "off limits" sanctuary or preserve. All participants agreed in principal on objectives for Molokini (sustainable environment, sustainable businesses, quality user experiences, respect Hawaiian culture) with a few minor differences in priorities.

Differences between commercial operators and community groups were also evident. Commercial operators were more concerned about business operations and client safety, and believe that that the existing situation works well (except agency – operator relations). Community groups, on the other hand, believed that changes need to occur. Disagreements were identified over the number and size of boats that should be allowed in the MLCD, and the appropriate amount of human use that should be allowed at the site. Ideas varied regarding the appropriate type and number of non-commercial moorings. Perceptions about the degree of non-commercial versus commercial conflict at Molokini were also identified. Different perspectives on educating visitors at Molokini were evident, with community groups believing that the Hawaiian cultural aspect is largely absent in interpretation provided on tour boats.

MARINE RECREATION USE AND SOCIAL CARRYING CAPACITY

Onsite Observations

Researchers traveled on 28 commercial trips to Molokini and documented that most trips departed harbors or boat ramps by 7:30 AM, returned by 12:30 PM, and visited a secondary site before or after visiting Molokini. All boats had onboard toilets and most trips offered meals and played music on the boats. Barbequing occurred on most large boats, but not on smaller boats. Guides handling or showing marine life to clients was observed on some trips, introductory diving was observed on some smaller boats, and fishing was observed on a few larger boats. Dumping waste overboard and feeding fish was not observed on any trips. Information about safety, equipment, nature, underwater species, coral reefs, proper etiquette, fish feeding, and touching marine life was provided on almost all trips. Most trips on large boats provided information about history and impacts on the environment, but smaller boats did not discuss these issues. Few trips provided information about native Hawaiian culture.

Personal and Trip Expectations

Pre-trip (*n* = 712) and post-trip (*n* = 439) onsite surveys were administered to people visiting Molokini on tour boats in both high and lower use periods. Results showed that 85% of visitors to Molokini were snorkeling and 15% were scuba diving. Almost all people on large boats were snorkeling and all but a few on smaller boats were scuba diving. Approximately 30% of visitors were using their Molokini trip to try this activity for the first time with 32% snorkeling and only 12% diving for the first time. Most visitors were minimally or moderately experienced and involved in these activities. Only a few were highly specialized with snorkelers less specialized than scuba divers. In total, 81% of respondents were first-time visitors who had not previously been to Molokini, but visitors on smaller dive boats were more likely to have been to Molokini before. Most respondents visited Molokini in groups of two or four people, but group size was much smaller on dive boats with the largest proportion traveling on their own in these boats.

Almost all Molokini visitors had biocentric (nature oriented) values toward the environment, and there were no groups with mixed or anthropocentric (human focused) value orientations. Almost all visitors also had protectionist (nature oriented) specific values toward coral reefs, and there were no groups with mixed or use-related value orientations toward reefs. Visitors on smaller dive boats were more likely to hold stronger protectionist orientations toward reefs. Pre-trip and post-trip responses showed that trips to Molokini had no immediate change on visitor value orientations toward coral reefs (i.e., visitors were not more environmentally oriented or appreciative of coral reefs immediately after their trip). In total, 52% of survey respondents were female, but more males (61%) were present on the smaller dive boats and more females (55%) were present on larger snorkel boats. The largest proportion of visitors was between 40 and 49 years old, and average age of respondents was 41 years old. Almost all respondents did not live on Maui (97%) with only 4% residing in the state of Hawai'i. Over 79% of visitors resided in the United States and 15% were from Canada. Most visitors from the United States lived in the western states of California, Washington, and Oregon.

Satisfaction

Results showed that the overall satisfaction of Molokini visitors was extremely high, with 95% of respondents satisfied with their trip and almost no respondents dissatisfied. The majority of passengers also considered Molokini to be the best attraction in Maui. Over 60% of visitors considered their trip to be exactly what they expected and one-third believed that it was better than they expected. High overall satisfaction, however, is typical in recreation and tourism settings, and does not mean that visitors were satisfied with all aspects of their visit to Molokini. Visitors were most satisfied with customer service from tour staff and the equipment and boats used on these tours. A large proportion of visitors, however, were dissatisfied with the inability to escape crowds of people, and that they did not learn about history of the area or native Hawaiian culture.

Visitors on smaller dive boats were much less likely to learn about nature, reefs, history, and Hawaiian culture. These visitors were also less likely to experience calm ocean conditions, try new activities, rest and relax, photograph marine life underwater, and spend time with friends or family. They were, however, more likely to meet new people and see a lot of fish, a variety of fish species, and different types of coral. Over 80% of visitors learned that feeding fish and touching marine life is harmful on their trip. A majority of visitors also increased their awareness of the marine environment, learned that their daily actions affect these areas, and that humans impact the marine environment and their own behaviors cause problems in there areas. Visitors also learned that that they can help the marine environment by donating or volunteering. Only a few visitors learned information that increased their awareness of native Hawaiian culture. Visitors on large snorkel boats were much more likely than those on smaller dive boats to experience these learning opportunities during their trip.

Visitors on large snorkel boats rated almost all experiential attributes of their trip to be important and were satisfied that they experienced these attributes, indicating that they felt managers and operators on these boats are doing a good job. Managers and operators should, however, monitor attributes such as seeing a large number and variety of fish, viewing larger marine life and colorful coral, and learning about nature, reefs, and marine species. Visitors strongly expected to encounter these attributes on their trip, but only slightly agreed that they actually experienced these on their trip. Visitors on smaller dive boats rated many attributes of their trip to be important and were satisfied that they experienced these on the trip. Many passengers on these smaller boats, however, expected to photograph marine life underwater and learn about history of the area and native Hawaiian culture, but most were dissatisfied that they did not experience these on their trip. Managers and operators should also address issues such as seeing large marine life and colorful coral, and learning about nature, reefs, and marine species because visitors on these smaller boats strongly expected to encounter these on the trip, but only slightly agreed that they actually experienced these features.

Attributes that met or exceeded visitor pre-trip expectations included those related to boat staff and equipment, trip organization and food, safety, spending time with friends or family and meeting people, time in the water, water cleanliness and visibility, scenery, coral conditions, having fun, and value for money. However, attributes that did not meet visitor pre-trip expectations involved educational information and opportunities for learning (e.g., marine life, coral, nature, Hawaiian culture), trying new activities, taking risks, being adventurous, and seeing many fish and other marine species.

Social Carrying Capacity

Respondents encountered an average of 62 people on their boat, but not surprisingly, this differed by boat size with respondents encountering an average of 78 people on large boats and 17 people on smaller boats. Encounters reported by visitors were similar to use levels counted by trained researchers (average or mean of *M*= 64 people per boat: 96 on large boats, 14 on smaller boats). Respondents also saw an average of 84 people in the water on their trip to Molokini, with visitors on large boats seeing more people in the water (*M* = 98 people) than what visitors on smaller boats encountered (*M* = 42 people). These encounters are likely related to boat size. Passengers remained close to their boats and only likely counted people they saw or encountered in the water surrounding the boat on which they were traveling (i.e., they did not count users on other boats moored in other areas of Molokini). Trained researchers recorded that the average number of people in the water was almost double (*M* = 162) the number reported by visitors. Respondents saw an average of 153 people in total at Molokini with visitors on large boats reporting more encounters (*M* = 177 people) than those on smaller boats (*M* = 82 people). Visitors likely only counted the number of people they saw on their boat, in the water surrounding their boat, and on and near boats moored immediately next to the boat on which they were traveling. Researchers recorded the average number of users at Molokini any one time was 326 people, which is double the number reported by visitors.

Most visitors (63%) reported seeing 6 or fewer boats on their trip at Molokini, but it can be challenging for visitors to accurately count since line of sight can easily be blocked by other boats at Molokini. Trained researchers counted an average of 12 boats at any one time at Molokini. Researcher counts of the average number of boats (12) and occupancy of boats (96 on large boats, 14 on small boats) can be used to estimate current visitation at the site. Assuming 6 large boats and 6 smaller boats, the number of people at Molokini at any one time is approximately 660 people (240,000 people visiting Molokini per year). This estimate should be treated with caution because it does not account for boats that make two or more trips to Molokini each day, differences in proportion of large and small boats, economic factors affecting tourism, and weather preventing boats from visiting. For example, if 75% of boats at Molokini were large and one of these boats was making a second trip each day, the estimate would be 1,002 people per day (365,000 people per year).

Visitors to Molokini would accept encountering a maximum of approximately 63 people on their boat, 102 people in the water, and 160 people in total at one time. Respondents on large boats would accept encountering substantially more people than what those on smaller boats would accept encountering. Using the maximum acceptable number of people as a standard for management at Molokini may be inappropriate, however, because the ability to distinguish or count people is constrained when visitors are underwater or when line of sight is impeded by waves and boats. Use levels at Molokini are also directly linked to the number and size of boats carrying passengers to the site, and these factors are likely more appropriate for determining standards of quality.

Number of boats had a stronger influence than size of boats on acceptable use levels. The majority of people visiting Molokini did not accept the presence of more than a relatively even mixture of 15 small and large boats at one time, and this could represent a possible standard of quality for management purposes. The acceptable use level would rise to 17 boats if all boats present were “small” and fall to only 12 boats if all boats present were “large”. These minimum acceptable boat numbers can also be combined with researcher counts of average boat occupancy to estimate social carrying capacities at Molokini. For example, if half of the boats are small and half are large, estimated site capacity would be 915 people at one time. If all boats are large, the maximum acceptable site capacity would be approximately 1,105 people at one time.

The majority of visitors expected to escape crowds at Molokini, but over two-thirds of respondents felt crowded at this site with 67% feeling crowded by the number of boats and number of people on their boat, 70% feeling crowded by the number of people in the water, and 73% feeling crowded by the total number of people at Molokini. Crowding levels this high suggest that Molokini is "overcapacity" and immediate management action is necessary to improve and preserve visitor experiences. Without immediate action, the site is likely destined to become a "sacrifice area" of high-density use where the quality of the environment and visitor experiences are compromised. A majority of respondents reported encountering more people on their boat, in the water, and in total at Molokini than they would tolerate. This suggests that human use levels (i.e., number of people) are a problem at Molokini and the site is operating over its capacity. A majority of respondents reported encountering fewer boats at Molokini than they would tolerate, suggesting that although the number of people visiting Molokini is problematic, the number of boats may be less of a concern. However, over 65% of visitors still felt crowded by the number of boats at Molokini, and this suggests that managers should consider actions that control both the number of people and number of boats at this site.

Conflict

Over 70% of snorkelers observed other snorkelers being too close, not looking where they were going, and bumping into people. Fewer than 26% of divers observed these snorkeler behaviors. The majority (56%) of snorkelers and 30% of scuba divers experienced conflict with other snorkelers, with almost all of this being interpersonal or face-to-face conflict. Approximately 30% of scuba divers observed other divers being too close, not looking where they were going, and bumping into people. Fewer than 5% of snorkelers observed these scuba diver behaviors. Over 75% of scuba divers did not experience conflict with other divers and almost 90% of snorkelers did not experience conflict with scuba divers at Molokini. These results suggest that there was relatively little conflict with scuba divers, but quite a high amount of conflict with snorkelers, and most of this conflict was in-group interpersonal conflict with other snorkelers.

Only 18% of respondents saw snorkelers chase or harass marine life at Molokini. Fewer than 10% of visitors saw snorkelers or scuba divers feeding fish or bumping, handling, or standing on coral at this site. More people on larger boats saw snorkelers chase or harass marine life (21%) and more users on smaller dive boats saw scuba divers bump, handle, or stand on corals (23%). Only 13% of respondents saw tour boat staff handle or touch marine life at secondary sites (e.g., Turtle Arches / Turtle Town) and 8% witnessed staff handling marine life at Molokini. Approximately one-third of people on both the large snorkel boats (31%) and smaller dive boats (36%) believed that it would be acceptable for tour boat staff to handle or touch marine life during the tours.

Support for Management

Over 83% of respondents supported prohibiting fish feeding at Molokini. Over two-thirds of visitors supported restricting use levels at Molokini by limiting the number of boats allowed per day (79%), limiting the number of people allowed per day (73%), and restricting the size of boats allowed (66%). These high levels of support for such direct and restrictive actions on use levels and visitation are rare in recreation and tourism. Over two-thirds of respondents also supported doing more to inform passengers about the marine environment (75%), appropriate behavior (67%), and native Hawaiian culture (64%). Approximately 50% of visitors supported improving maintenance and upkeep of harbor and boat ramp facilities, 41% supported designating some boat moorings solely for non-commercial use, and 36% supported spatially zoning activities at Molokini. Fewer than 30% of visitors supported prohibiting music, barbequing, and introductory dive training on boats, but users on smaller dive boats were more supportive of these restrictions. Few visitors (9%) supported closing Molokini to all recreation and tourism use. Approximately 66% of respondents believed that there are currently too many moorings at Molokini and that there should be fewer moorings. Most respondents (74%) were aware that Molokini was a marine life conservation district, 26% were unsure, and only 1% believed that it was not a conservation district.

Future Visitation

Almost all visitors (82%) said that they would return to Molokini. Approximately 44% would come back with different expectations about the site; 16% would not come back because they felt that they do not need to visit twice; and 11% would not come back because they believed that they can have better experiences elsewhere on Maui.

TABLE OF CONTENTS

REFERENCES

APPENDICES

ITEM F-4 - EXHIBIT 2

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Displacement effects of heavy human use on coral reef predators within the Molokini Marine Life Conservation District

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ABSTRACT

The impact of marine ecotourism on reef predators is poorly understood and there is growing concern that overcrowding in Marine Protected Areas (MPAs) may disturb the species that these areas were established to protect. To improve our understanding of this issue, we used acoustic telemetry to examine the relationship between human activity at the Molokini Marine Life Conservation District (MLCD) and the habitat use of five reef-associated predators (*Caranx melampygus*, *Caranx ignobilis*, *Triaenodon obesus*, *Carcharhinus amblyrhynchos*, and *Aprion virscens*). During peak hours of human use, there was a negative relationship ($R^2 = 0.77, P < 0.001$) between the presence of bluefin trevally (*Caranx melampygus*) and vessels in subzone A. No other species showed strong evidence of this relationship. However, our results suggest that during this time, the natural ecosystem function that the reserve was established to protect may be compromised and overcrowding should be considered when managing MPAs.

1. Introduction

In recent decades, predators have experienced dramatic declines across the world's oceans (Jackson et al., 2001; Friedlander and DeMartini, 2002; Dulvy et al., 2004; Myers and Worm, 2005; Sandin et al., 2008; Codarin et al., 2009). In response to these declines Marine Protected Areas (MPAs) have been promoted as an effective management tool to improve the conservation of fish populations (Russ et al., 2004; Rice et al., 2012; Russ et al., 2015). Numerous studies have documented an increase in both abundance and size of fishes, particularly large predators inside MPAs (McClanahan et al., 2007; García-Rubies et al., 2013). The increase in biomass and diversity of fishes inside MPAs provides a major attraction to the marine tourism industry and the popularity of marine ecotourism (e.g., snorkeling, SCUBA, and boating) within MPAs has increased tremendously in recent years (Garrod and Wilson, 2003; Needham et al., 2011). Marine ecotourism promotes non-consumptive resource use and stimulates local economic enterprises. However, this industry can have negative effects on the socio-ecological ecosystem, including damage to the marine environment and displacement of fisheries (Milazzo et al., 2002; Jentoft et al., 2007; Meyer and Holland, 2008; Charles and Wilson, 2009). Furthermore, the social perception of overcrowding in MPAs is common in the marine ecotourism industry (Bell et al., 2011); however, little information exists on the potential effects of overcrowding on the behavior of marine fishes. Correspondingly, management strategies for non-consumptive recreational activities in MPAs are deficient (Davis and Tisdell, 1995; Harriott et al., 1997; Needham and Szuster, 2011; Thurstan et al., 2012).

In Hawaii, the Marine Life Conservation District (MLCD) program was established in 1967 to conserve and replenish Hawaii's marine resources for the purpose of education and human enjoyment (DAR, 1992). The program has been successful in maintaining high biomass and diversity of fish assemblages within their management boundaries (Friedlander et al., 2003; Friedlander et al., 2007a; Friedlander et al., 2007b). Today, there are 11 MLCDs in the main Hawaiian Islands (MHI) and these locations have some of the most intact populations of reef predators in the region. Friedlander et al. (2007a, 2007b) found that there was a greater abundance (62%) and biomass (52%) of predators inside Hawaii's MLCDs when compared to adjacent outside areas. These predators and the abundant fish life within the MLCDs are a significant

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attraction for Hawaii's marine tourism industry, which is valued at $ 700 million USD per year (Cesar and Van Beukering, 2004). The Molokini Shoals MLCD was established in 1977 and is the second most visited MPA in the state. Currently, there are 40 commercial vessels permitted to operate snorkel and dive tours to the Molokini MLCD and the annual economic benefit of these recreational activities is estimated at $ 20 million USD (Needham and Szuster, 2011). Over the past decade, the number of visitors to the MLCD has been steadily increasing and in 2015, a total of 334,036 people visited the MLCD. The increasing popularity of recreational activities in Hawaii's MLCDs and other MPAs poses the question, is there a relationship between the intensity of anthropogenic use in an ecosystem and the presence of reef predators?

Several studies have documented negative behavioral effects on marine fishes in response to anthropogenic noise (Sarà et al., 2007; Popper and Hastings, 2009; Holles et al., 2013; Voellmy et al., 2014). However, these studies have primarily been conducted on less mobile juvenile fishes or in caged environments, while field experiments in natural settings are deficient. Furthermore, published field research on this subject suffers from the inability to precisely measure human activities at the study sites and often relies on environmental variables that correlate with human activities, such as wind speed to measure the intensity of anthropogenic use in an ecosystem (Chateau and Wantiez, 2008). Direct measures of human activities such as vessel abundance and noise can provide a more accurate reflection of human disturbance on animals. In this study, we examined vessel noise and commercial tour boat logbooks (two measurements of human activities) to relate the presence of humans to the behavior and movement of predatory fishes inside the Molokini MLCD, based on observations from an acoustic telemetry array. Our objectives were to: (1) determine the species of predators that overlap with human use in the MLCD, (2) examine commercial tour operator logbook data to determine if vessel activity patterns correlate with anthropogenic noise in the MLCD, and (3) determine whether predators are displaced from important habitats in the MLCD at varying intensities of anthropogenic use.

2. Methods

2.1. Study site

Molokini is a small (31 ha) crescent shaped volcanic islet located in the Alalakeiki Channel between the islands of Maui and Kahoolawe (Friedlander et al., 2006). The inside of Molokini's crater is characterized by a shallow coral reef (< 30 m) protected from major ocean swells, while the backside of the islet forms a steep vertical wall that descends to approximately 100 m. The Molokini MLCD is comprised of two management zones, subzone A and subzone B (Fig. 1). Subzone A includes the inside of the crater bounded by a line extending from the end of the submerged coral ridge on the west side of the crater to the east side of the crater. The harvest of marine life is prohibited in subzone A, with most of the boating and recreational activities occurring in this subzone. To accommodate visitation of the MLCD, the State of Hawaii maintains 26 day use mooring buoys inside subzone A that are used by commercial tour vessels on a daily basis. Subzone B extends ~91 m (100 yards) seaward of subzone A and encompasses the entire perimeter of the islet, and only fishing using trolling gear is allowed in subzone B (DAR, 1981).

2.2. Acoustic array design

A VR2W passive acoustic monitoring array was used to track the movements of tagged predators at the Molokini MLCD from November 14th, 2013 to August 28th, 2015. Seven VR2W acoustic receivers (308 mm long × 73 mm diameter, Vemco, Halifax, Nova Scotia) were deployed in strategic locations that enabled the observation of fish movements within the MLCD. In locations with sandy substrate, the VR2W receivers were secured to the bottom with sand screws (2 m long × 10 cm diameter) and attached to a 2-m section of 2 cm diameter polypropylene rope suspended by a small crab float (35 cm long × 15 cm diameter). At receiver sites where the substrate consisted of hard rock, the moorings were secured to the bottom by passing a section of 6 mm stainless steel wire rope covered by hydraulic hose, through a natural benthic feature and fastened with two stainless steel wire crimps. Three receivers were stationed inside subzone A and four receivers were stationed along the back side of Molokini crater in subzone B. The arrays design, management subzones, location of the Ecological Acoustic Recorder (EAR, see description below), and estimates of VR2W detection ranges are depicted in Fig. 1.

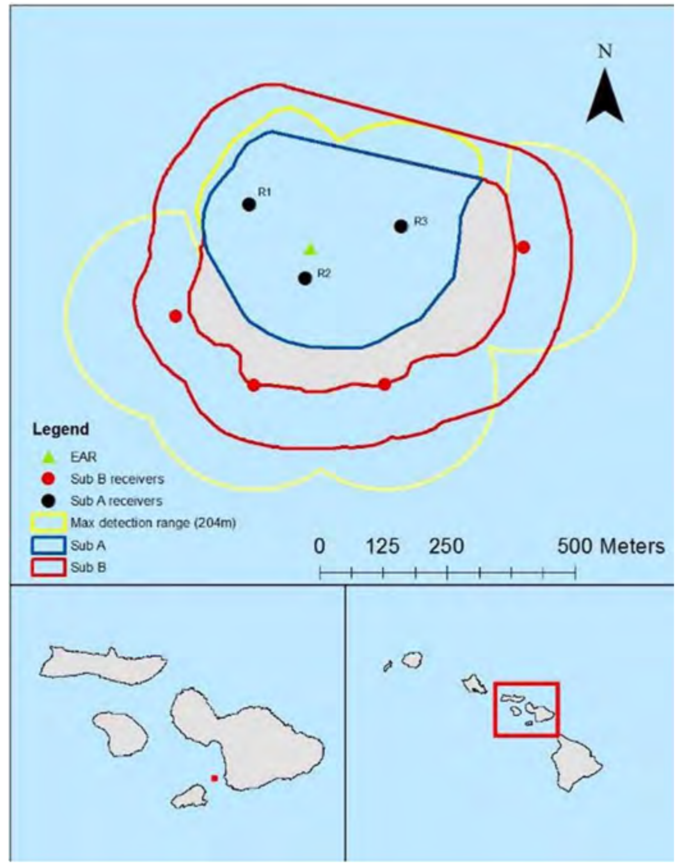

Fig. 1. The location of the Molokini MLCD and acoustic array. Red lines indicate subzone demarcation. Black dots indicate locations of subzone A receivers, red dots represent subzone B receivers, green triangle indicates the location of the ecological acoustic recorder (EAR) and yellow bands represent the 204 m theoretical maximum detection range of the receivers in the acoustic array. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

2.3. Fish capture and transmitter deployment

Five species of reef-associated predators including, whitetip reef shark (*Triaenodon obesus*, n = 13), grey reef shark (*Carcharhinus amblyrhynchos*, n = 5), giant trevally (*Caranx ignobilis*, n = 16), bluefin trevally (*Caranx melampygus*, n = 15) and green jobfish (*Aprion virscens*, n = 10) were captured with hook and line inside the MLCD. The captured sharks were tail roped and restrained alongside the research vessel where they were induced into tonic immobility (Henningsen, 1994). Teleost fishes were brought onboard the research vessel, inverted, and placed into a padded V board with a hose circulating sea water over the gills. Once catalepsy was achieved, the specimens were measured, sexed (sharks only), and tagged with Vemco V-13 coded transmitters (13 mm diameter, 45 mm long, Vemco, Halifax, Nova Scotia) programmed to transmit an individual identification number via a 69-kHz pulse, every 80 to 160 s for up to 1019 days. The transmitters were surgically implanted into the body cavity of each animal through a 2 cm incision in the abdominal wall and closed with an interrupted nylon suture (Holland et al., 1999; Meyer and Honebrink, 2005). After surgery, all specimens were externally tagged with a conventional ID tag (either an M-type tag (sharks and large teleost fish), or 10 cm plastic dart tag (Hallprint, South Australia) before being released. These methods were reviewed and approved by the University of Hawaii's Institutional Animal Care and Use Committee, IACUC protocol number 13-1712 and all fishing activities in the MLCD were conducted under a Special Activity Permit number 2014-23 issued by the State of Hawaii.

2.4. Analysis of commercial vessel use of subzone A of the Molokini Shoals MLCD

The Maui Division of Aquatic Resources requires that all permitted commercial tour operators in the Molokini MLCD submit vessel log book data on a monthly basis. These data include the time of day (i.e., start and stop time), mooring buoy ID, and number of users (i.e., SCUBA divers and snorkelers) from every tour operator in the Molokini MLCD. Vessel log book data were obtained from November 14th, 2013 to August 28th, 2015, and analyzed to determine the total number of commercial vessels present inside subzone A of the MLCD for every hour of the study. Finally, peak hours in vessel activity were determined by taking the mean of the total number of vessels present during each hour of the diel cycle over the duration of the study. All values presented from these analyses are means and one standard deviation of the mean unless otherwise stated.

To determine if the number of commercial vessels was significantly related to anthropogenic noise in the crater, an Ecological Acoustic Recorder (EAR, (Lammers et al., 2008)) was deployed inside subzone A of the MLCD. This device records ambient acoustic noise and was programmed to record on a duty cycle of 30 s ‘on’ every 5 min at a sampling rate of 25 kHz, providing an effective recording bandwidth of 12.5 kHz. The root-mean-square (RMS) sound pressure level of each acoustic file was determined in five one-octave bands, and the RMS sound pressure level of the 0–0.78125 kHz bandwidth corresponds with the dominant noise generated from vessels and anthropogenic activity (Lammers and Howe, 2014). With these data, we calculated the mean RMS sound pressure level for the 0–0.78125 kHz bandwidth for every hr. of the study. We then performed a least-squares linear regression between the number of boats present per hr. and the mean sound pressure level of the corresponding hr., during the peak hrs in human use of subzone A.

2.5. Range testing of the acoustic array

Range testing of the acoustic array was conducted throughout the MLCD by towing a V13 range test tag with 10 s fixed delay from a vessel, and simultaneously tracking the GPS location with a VR-100 acoustic receiver. The timing of tag detections by VR2W acoustic receivers was linked to the timing of tag detections by the VR-100 and the corresponding GPS coordinates. The location of each tag detection was plotted in ArcGIS to generate a map of tag detections in the array. The maximum possible detection ranges of each VR2W were determined by measuring the straight-line distance from a given receiver to the farthest point of tag detection.

To evaluate potential biases in fish detection patterns in our VR2W array from both natural and human acoustic interference (Payne et al., 2010), we conducted 48 h range tests across the diel cycle by placing four V13 range test tags 4 m from the bottom at staggered intervals from the VR2Ws located in subzone A. This enabled us to test receiver performance at a range of distances from 0 to 280 m for receivers located in subzone A. This design allowed us to calculate the percentage of detections successfully decoded at different distances by dividing the total number of detections per hr. received by VR2Ws at a given distance by the total number of signals transmitted by a test tag during that hr.

Because we were interested in detection ranges of our VR2Ws during daylight hours, these data were filtered to only include detections between 7:00 and 19:00. A binomial general additive model was fitted to these data to determine the distances at which a minimum of 5% of detections transmitted by stationary test tags were decoded. This distance represented the average maximum receiver detection range in our study. Finally, to investigate receiver performance over extended periods of time, a V13 sentinel tag with a 580–620 s duty cycle was deployed at receiver R2 (Fig. 1). This VR2W was selected to investigate acoustic detection performance because it is the shallowest receiver (10 m) in the array, and is located at the center of Molokini crater, where the majority of boating and wave action occurs. The presence of this test tag allowed us to investigate the performance of receivers R2 and R1, at two distances (0 m and 176 m) in the presence and absence of boats. We tested for a correlation between the presence of the test tag and the number of boats in subzone A during the peak hrs 8, 9, and 10 am HST using a Spearman's rank-order correlation test.

2.6. Analysis of vessel intensity in the MLCD and the movements of reef predators

To investigate the relationship between human use at the MLCD and movements of reef-associated predators in subzone A, we first generated individual diel scatter plots of detections for all the species tagged in the study, and examined patterns in habitat use within subzone A that coincided with peak hrs in human use at the MLCD. We then pooled fish detections from the three receivers located inside subzone A and examined the presence and absence of each fish during a given hr. based on the criteria that it was detected at least once by any of the three receivers. To obtain the response variable of the proportion of the species present in subzone A for every hr. of the study, we calculated the total number of individuals from a given species present in subzone A within each 24 h period and divided the number of a species present in subzone A at each hr. by the total number present each day. To determine if a correlation existed between anthropogenic use of the MLCD and predator abundance, we filtered our data to include only daylight hrs (7:00–17:00) and performed a Spearman's rank-order correlation test between the mean proportion of the species present and the number of vessels in subzone A for all five species.

2.7. Relationship between vessel intensity and of presence of bluefin trevally (Caranx melampygus) in the MLCD

In order to describe the relationship between the presence of bluefin trevally and the intensity of vessels in subzone A, we calculated the mean proportion of bluefin trevally present in subzone A at a given number of vessels (0–25) following the same procedure described above and excluded non-peak hours to eliminate the potential for bias of crepuscular behavior. We then plotted the mean proportion of bluefin trevally present against the number of commercial vessels present in subzone A. To determine if these two variables were significantly related, we performed a least-squares linear regression between the square root transformed mean proportion of bluefin trevally present in subzone A and the number of vessels during the corresponding hour. Finally, we used the regression equation to predict the point at which the mean proportion of bluefin trevally present in subzone A declined to 50% of the maximum value observed in our study.

3. Results

3.1. Commercial vessel use of subzone A of the Molokini Shoals MLCD

Between November 14th, 2013 and August 28th, 2015, 599,440 people visited the Molokini MLCD, with a mean of 23 (± 8) vessels and 924 (± 411) people per day. During this time period, the peak hrs in

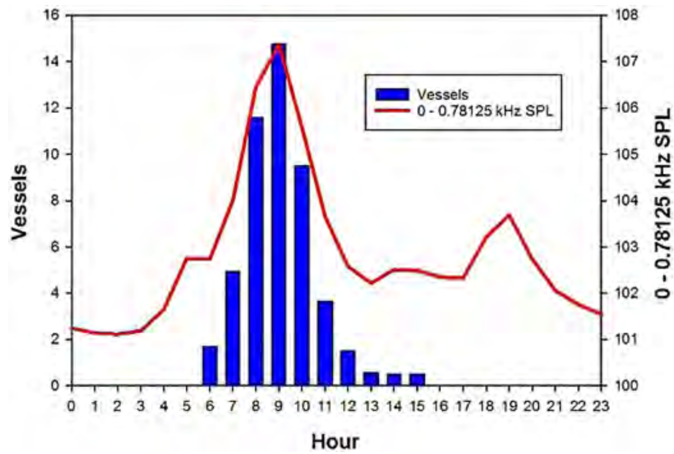

Fig. 2. The average number of vessels per hour in subzone A (left y axis) plotted against the average sound pressure level (SPL) of the 0–0.78 kHz bandwidth (second y axis), during the corresponding hour.

human use were 8, 9, and 10 am HST, with the corresponding mean number of commercial vessels in subzone A being 12, 15, and 10, respectively (Fig. 2). During peak hrs in anthropogenic use of the MLCD, the mean RMS sound pressure level of the 0–0.7815 kHz band width recorded by the EAR was significantly related to the mean number of vessels in subzone A ($Y = -0.21x + 104.05$, $R^2 = 0.95$, $P < 0.001$, SOM1).

3.2. Range testing

Maximum instantaneous detection ranges in the acoustic array ranged from 160 to 270 m, with a mean of 227 ± 39 m. The binomial general additive model of detection efficiency during daylight hours, generated from the results of the 48 h range test was significant ($R^2 = 0.93$, $P < 0.0001$, SOM2). The predictions estimated from these models indicated that the maximum range (the distance at which 5% of the detection efficiency is reached) during the day was 203 m. The test for correlation between the presence of the sentinel tag at receivers R1 and R2 indicates that at 0 m (R2) there is no influence in the number of boats and the chance of detecting the tag ($\rho = 0$). At distances nearing the maximum detection range (~176 m), there was a slightly significant correlation between the presence of boats and the probability of R1 detecting the sentinel tag ($\rho = -0.50$, $P = 0.03$). This suggests that the detection range of our receivers was only marginally reduced during high levels of vessel activity. Owing to the detection range and degree of overlap among receivers, the array design is effective in distinguishing fish movements between the management zones of the MLCD.

3.3. Reef predator use of subzone A and interaction with commercial vessels

Over the course of the study, the seven receivers detected 58 of the 59 predators with detection spans ranging from 2 to 542 days (SOM3). Bluefin trevally were the most common species present in subzone A during daylight hours (Fig. 3) and this species presence was negatively correlated with the number of vessels in subzone A ($\rho = -0.77$, $P \leq 0.001$). None of the other four species showed a strong correlation between vessel activity and habitat use of subzone A (Table 1), however our results for grey reef sharks and green jobfish were suggestive. We focused our further analysis, exclusively on bluefin trevally due to its daytime activity pattern in subzone A, high site fidelity to the MLCD and sample size. The combination of these factors provided a sufficient number of movement observations in subzone A to investigate this relationship during the peak hrs in human use (8, 9, and 10). During this time, we found a decrease in the mean proportion of bluefin trevally present in the MLCD across a gradient of increasing vessel intensity (Fig. 4). This reduction in habitat use is described by a negative linear relationship between the square root transformed mean proportion of bluefin trevally present in subzone A and the number of vessels ($R^2 = 0.73$, $P < 0.001$). Our estimate of the number of vessels, at which the mean proportion of bluefin trevally present in subzone A is reduced to 50% of the maximum observed abundance is 12, with 95% CI [3%, 2%] (SOM4).

4. Discussion

As the demand for recreational activities in MPAs increases, the study of the interactions between predators and humans in the marine environment is becoming an important topic in the management of these protected areas. The results of this study are some of the first to empirically document the displacement of a predator in response to non-extractive human activity in an MPA, and can be used to inform the management of recreational activities in MPAs in Hawaii and other locations around the world. To date, the majority of the research on the effects of humans on predators has focused on the impact of provisioning in shark feeding ecotourism (Hammerschlag et al., 2012). Several of these studies have shown that the natural behavior and movement patterns of wild animals can be influenced by human activities (Laroche et al., 2007; Bruce and Bradford, 2013; Brunnschweiler and Barnett, 2013). However, few field studies have addressed the impact of vessel activity on the natural behavior of marine fishes in MPAs.

Previous studies have suggested that with an increase in ambient noise generated by vessels, the detection range of acoustic receivers can be affected (Heupel et al., 2006). The acoustic receivers we used in this study to monitor fish movements detect a sound frequency of 69 kHz. The acoustic noise that was significantly related to the presence of commercial vessels was between 0 and 0.78 kHz, which suggests that overlap between these two bandwidths is minimal. However, we noted a marginal decrease in the detection efficiency of our receivers at the maximum extent of their detection ranges (~176 m), during extremely high levels of vessel activity. Fluctuations in detection ranges in response to environmental noise are real constraints in any acoustic monitoring study, and likely introduce a source of error in making conclusions about animal movements (Payne et al., 2010; Kessel et al., 2013).

Despite this limitation, we are confident that the results of this study represent the displacement of bluefin trevally from subzone A of the MLCD for several reasons. Firstly, the maximum detection ranges of our receivers are overlapping, and reductions in detection ranges at the scale we observed do not create gaps in our array. Nonetheless, should minor gaps in the array occur, in contrast to a fixed sentinel tag, bluefin trevally are highly mobile predators, and over the course of an hr., their position inside the crater changes; therefore, their chance of detection is not static. Furthermore, our response variable is conservative and the presence of an individual fish in subzone A during a given hr. is based on a single detection, across three pooled receivers. Therefore, fish presence is weighted equally regardless of the total number of detections. The evidence presented above leads us to conclude that the trends we observed are not an artifact of minor reductions in the ranges of VR2Ws in our acoustic array.

The presence of environmental covariates such a weather provides another potential limitation to this study's ability to determine whether human disturbance is responsible for the relationship between the displacement of bluefin trevally and commercial vessel use at the MLCD. Nevertheless, we are confident in our results as this study covers a time span of 1.8 yrs, which dampens the short-term effects of weather. The number of vessels in the MLCD is influenced by multiple factors other than bad weather. Anecdotal information from commercial tour operators suggests that the number of vessels at the Molokini MLCD on a given day could be attributed to several non-mutually exclusive

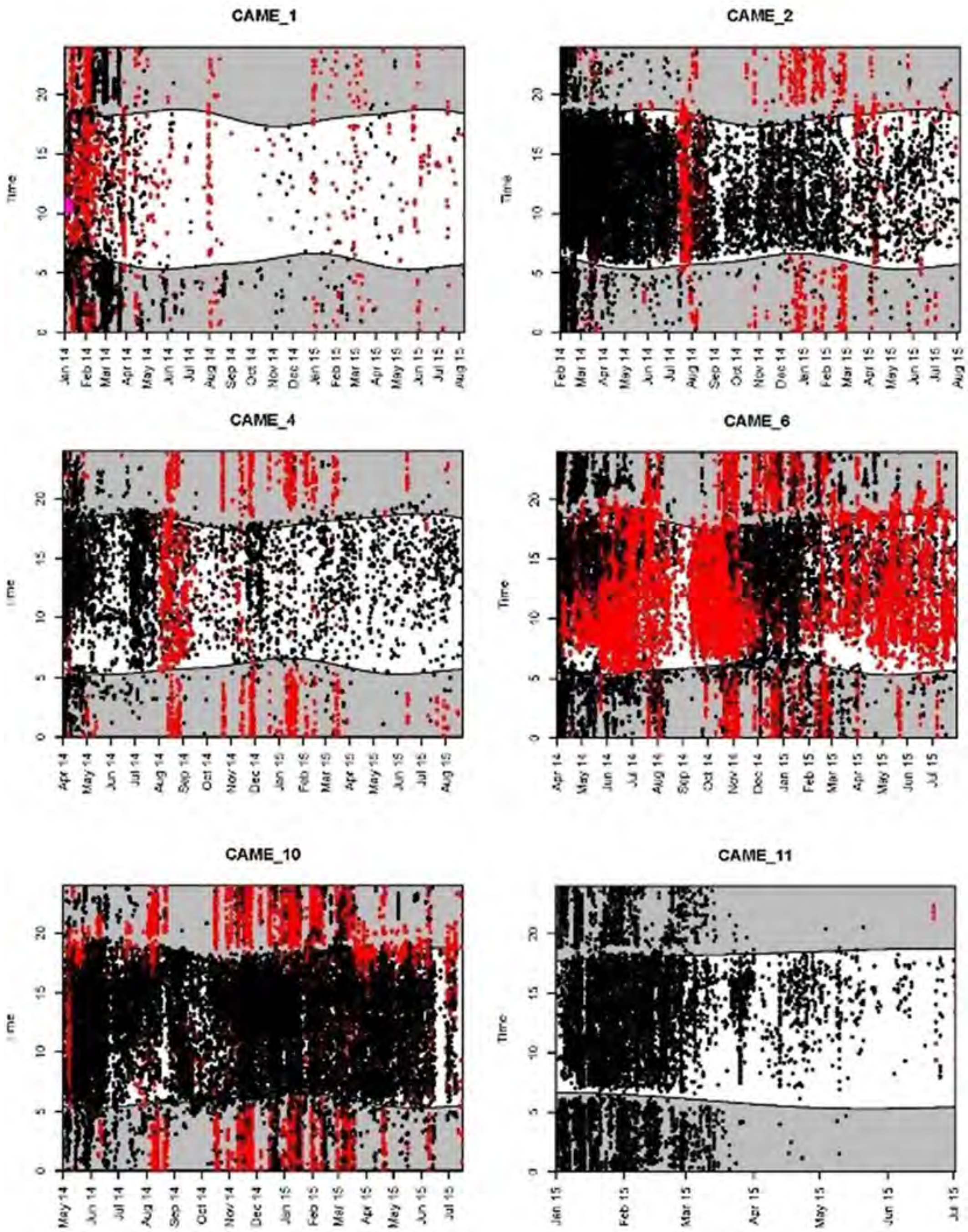

Fig. 3. The diel scatter plots of 6 bluefin trevally at the Molokini MLCD with day (white) and night (grey) shading over the course of their monitoring periods. Black dots indicate detections in subzone A, red dots indicate detections in subzone B (note differing scales on the x-axis). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Table 1
Summary of detections for 59 predators in subzone A of the Molokini Marine Life Conservation District (MLCD). Values for fork length are means and standard deviation in parentheses. With ρ and significance of Spearman's rank-order correlation between the mean proportion of the species present and number of vessels in subzone A during daylight hours (CAME = bluefin trevally, CAIG = giant trevally, TROB = whitetip reef shark, APVI = green jobfish, CAAM = grey reef shark).

Species	N	Mean fork length (± sd)	Median days detected	Median total detections	ρ	P-value
CAME	15	54 ± 13	115	3150	− 0.77	< 0.001
APVI	10	67 ± 11	18	75.5	− 0.45	0.02
CAAM	5	116 ± 25	97	625	− 0.43	0.03
TROB	13	87 ± 14	117	384	− 0.33	0.11
CAIG	16	92 ± 18	76.5	574.5	− 0.3	0.14

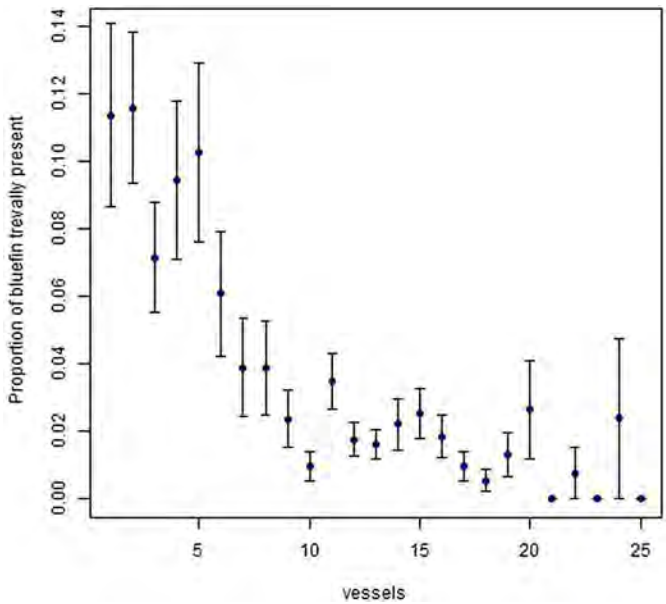

Fig. 4. The proportion of bluefin trevally present in subzone A, at a given number of vessels during the peak hours (8–10 am HST) in human use. Values are means with error bars equal to the standard error of the mean.

factors: including extremely poor weather, extremely good weather, and or an absence of sufficient tourists to make the excursion profitable. As such, we suggest that the steep decline in the presence of bluefin trevally that we observed with increasing vessels across this wide range of covariates is a result of human activities.

None of the other four species we tagged in this study showed strong evidence for a relationship between habitat use of subzone A and the intensity of human activities. The lack of this relationship could be attributed to natural differences in the spatial and temporal habitat use for each species that result in a limited overlap with humans. Detections from giant trevally and grey reef sharks primarily occurred at receivers located in close proximity to deep water along the back wall of the MLCD in subzone B and although whitetip reef sharks were active in subzone A, the majority of these detections occurred during nocturnal hrs (SOM1). Alternatively, the overall absence of these predators from subzone A during daylight hours may be attributed to anthropogenic displacement, but this conclusion is beyond the scope of the data obtained here. Green jobfish were the only other species that exhibited spatial and temporal overlap with humans at the MLCD (SOM1), but the majority (80%) of the individuals we tagged were detected infrequently and as a result, we were unable to obtain a sufficient sample of days with varying levels of human use to confidently determine if a relationship exists for this species.

The exact mechanism driving the displacement of bluefin trevally from subzone A of the MLCD during peak hours is uncertain. However, one possible driver is acoustic noise generated by motor vessels. Over 800 species of fishes are known to produce sound (Radford et al., 2014), and sound production and cognition is thought to play a critical role in predator-prey interactions, schooling behavior, reproduction, and territoriality in coral reef associated fishes (Lobel et al., 2010). High levels of acoustic noise could negatively affect fishes by masking biologically important sounds and reducing sensory abilities, which in turn could affect their ability to forage, find mates, and avoid predators (Amoser et al., 2004; Popper and Hastings, 2009; Radford et al., 2014). Bluefin trevally and other jacks are known to produce a croaking noise and although the social and biological function of this sound production is unknown, acoustic noise could interfere with this form of communication (Taylor and Mansueti, 1960). With an increase in the number of commercial vessels present in the MLCD, the RMS sound pressure level increased significantly and during the peak in human activity at the MLCD the average sound pressure levels can be over 5 dB higher than when humans are absent. Although the auditory thresholds of fishes are likely species-specific, the majority of fishes are believed to be able to detect sound levels between 50 and 500–1500 Hz (Popper and Fay, 1999; Radford et al., 2014) This suggests that the increasing 0–0.78 kHz sound levels generated by commercial vessels in subzone A overlaps with the hearing range of fishes and a potential for interference exists.

The physiological effect of intense anthropogenic noise on fishes is poorly understood, but previous studies have shown that vessel noise can alter the behavior of fishes. Sarà et al. (2007) observed the schooling behavior of Atlantic bluefin tuna (*Thunnus thunnus*) in net pens exposed to the acoustic noise of transiting hydrofoils, ferries, and small motor vessels. In the presence of larger vessels, such as hydrofoils and ferries, the tuna school structure changed from coordinated and uniform swimming to uncoordinated diving movements that suggests avoidance as vessels approached the pen (Sarà et al., 2007). This pattern of vessel avoidance has also been documented in Atlantic herring (*Clupea harengus*), with dramatic reductions in the abundance of acoustically monitored herring observed at the closest point of vessel approach (Vabø et al., 2002). Voellmy et al. (2014) documented reduced foraging efficiency and increased startle response in two species of closely related fishes (three-spined stickleback - *Gasterosteus aculeatus*, and common minnow - *Phoxinus phoxinus*) when exposed to intense boat noise.

In addition to noise, the physical presence of human's may be another factor influencing the displacement of bluefin trevally from the study area. Many species of marine fishes exhibit a “flight response” in the presence of humans and the severity of this flight response is most often associated with the intensity of fishing pressure at a given location (Feary et al., 2010; Januchowski-Hartley et al., 2011; Usseglio, 2015). Although the recreational activities in the Molokini MLCD are non-extractive, the number of users can be up to 1702 people a day and the presence of humans at this magnitude may be contributing to the relationship we observed in this study.

The consequences of the displacement of bluefin trevally from the shallow waters of Molokini crater during peak hours in human use are unknown. On the individual level, physical displacement from optimal habitats may lead to reduced fitness as a result of several non-exclusive factors including: 1) lost foraging opportunities, 2) reduced reproductive success, and 3) increased competition for resources in refuge areas (Codarin et al., 2009; Popper and Hastings, 2009; Jacobsen et al., 2014; Radford et al., 2014). Furthermore, on the ecosystem level, reef predators play a critical role in maintaining the balance of marine environment by regulating the abundance of mid-level predators and imposing a top down effect on lower trophic groups (Baum and Worm, 2009; Ritchie and Johnson, 2009). Therefore, the natural ecosystem function that a reserve is established to protect may be compromised by the absence of these predators during these times.

4.1. Conclusions and implications for management

Marine ecotourism is a growing industry and an important component of the economy, as well as public education (Cesar and Van Beukering, 2004; Zeppel, 2008; Needham et al., 2011). Overall, ecotourism in places like the Molokini MLCD provides a net benefit to society and ultimately the environment, through increasing support for MPAs and the conservation of marine resources. Nevertheless, this study does indicate that in extreme circumstances, fish species that overlap with heavy human use can be displaced from their preferred habitats, and could be negatively impacted by non-consumptive human activities. The perception of overcrowding at the Molokini MLCD has been investigated from the human perspective (Bell et al., 2011; Needham et al., 2011; Needham and Szuster, 2011). Surveys of marine park users indicated that 67% of individuals felt overcrowded during their experience at Molokini and this perception led 66–79% of users to support restrictions on use of the MLCD. The maximum number of vessels that was perceived to be acceptable from the human perspective was determined to be 15–16 at any given time (Bell et al., 2011). Further research is needed to determine whether reducing the noise generated by commercial vessels would be an effective mitigation strategy or if reducing the total number of users is necessary to prevent the displacement of bluefin trevally and potentially other species from the MLCD. However, the combination of both ecological and social evidence suggests that the issue of overcrowding may warrant regulation in the management of Hawaii's MLCDs and other locations, worldwide.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.marpolbul.2017.06.032.

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ITEM F-4 - EXHIBIT 3

PLOS ONE

RESEARCH ARTICLE

Decreased tourism during the COVID-19 pandemic positively affects reef fish in a high use marine protected area

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Abstract

Humans alter ecosystems through both consumptive and non-consumptive effects. Consumptive effects occur through hunting, fishing and collecting, while non-consumptive effects occur due to the responses of wildlife to human presence. While marine conservation efforts have focused on reducing consumptive effects, managing human presence is also necessary to maintain and restore healthy ecosystems. Area closures and the tourism freeze related to the COVID-19 pandemic provided a unique natural experiment to measure the effects of decreased tourism on fish behavior in a high use no-take marine protected area (MPA) in Hawaiʻi. We found that when tourism shut down due to COVID restrictions in 2020, fish biomass increased and predatory species increased usage of shallow habitats, where tourists typically concentrate. When tourism resumed, fish biomass and habitat use returned to pre-pandemic levels. These displacement effects change fish community composition and biomass, which could affect key processes such as spawning, foraging and resting, and have knock-on effects that compromise ecosystem function and resilience. Managing non-consumptive uses, especially in heavily-visited MPAs, should be considered for sustainability of these ecosystems.

Introduction

Non-consumptive effects of humans are well documented in both terrestrial [1], and marine systems [2]. Non-consumptive effects are generated through either avoidance of or attraction to human activities and can induce behavioral change, displacement, habituation, crowding, and dietary impacts [3], and disruptions in foraging, reproduction [4], and resting [5, 6]. Tourism impacts in marine systems have been researched extensively with respect to shark and fish provisioning [7]. Effects of human presence have been assessed for marine mammals, sharks, birds, turtles [2] and in freshwater systems [8]. Boat noise is known to impact fish stress and communication [9], predation mortality [10] and larval settlement [11].

datadryad. Fish occupancy data will be deposited in the PIRAT node of the Ocean Tracking Network. https://piratnetwork.org Fish tagging was conducted under an animal care protocol (IACUC-2020-10-05-14561-kcweng) approved by the William & Mary Animal Care and Use Committee (IACUC), USDA 52-R-0002, OLAW D16-00419 #A3713-01, and a Special Activity Permit from the State of Hawai'i (2021-28)."

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Less research has been conducted to understand human presence effects on marine fishes [8]. In marine systems, fishes often perceive humans as predators and avoid them, so the resulting alterations in fish distribution are non-consumptive effects [12], in contrast to the consumptive effect of fishing. In prior studies, fish diversity and biomass declined temporarily in the presence of snorkelers [13], and the long-term disturbance effects of ongoing human presence [12, 14–16] caused habitat shifts at the cost of reduced access to resources [17]. Fish community structure was altered at intensive tourism sites [14, 15] and increased when human activities were reduced [18].

Non-consumptive effects can be direct, when human presence displaces a fish from a habitat, or indirect, when human presence displaces a predatory fish, thus releasing prey species from risk [12, 19]. Since herbivores avoid high-risk foraging locations when predators are abundant, indirect effects can alter community composition and abundance of primary producers [20]. Snorkeling and diving are concentrated in shallower waters [19] so these non-consumptive effects are strongest near shore [21, 22].

Tourism is the main driver of non-consumptive human effects in protected areas and is one of the largest and fastest-growing sectors of the global economy. This growth comes with both positive and negative ecological impacts [23]. Tourism in protected areas generates large economic benefits, contributing to the management of the protected areas as well as local and travel economies [24, 25]. While tourism can facilitate the preservation of natural resources by increasing the economic value of living animals and intact habitats [26], it can lead to degradation of the resources that tourists are paying to see [27]. Different levels of protection in marine protected areas (MPAs) lead to divergent conservation outcomes, and even non-extractive uses such as tourism can have profound impacts [28].

Since tourism can have negative impacts [28], large reductions in human activity are expected to allow wildlife to reestablish optimal habitat use [17], resulting in higher biomass particularly at higher trophic levels. The COVID-19 pandemic caused a substantial decline in tourism [29]. Global economic losses in the travel and tourism sector are in the range of USD 4 to 12 trillion in gross domestic product, 164 to 514 million jobs, and USD 363 to 1134 billion in capital investment [30]. In French Polynesia, the absence of tourism during a 45 day lockdown resulted in a short term increase in fish biomass [31]. In Hawai'i the pandemic caused a 71% decrease in visitors, with 2.7 million in 2020, as compared to 10.4 million in 2019 [32], so a resurgence of wildlife at tourist sites was possible.

In response to ongoing environmental degradation, the State of Hawai'i is developing a marine resource management initiative (https://dlnr.hawaii.gov/holomua/), in the context of the United Nations Convention on Biological Diversity. Hawai'i receives approximately 10 million tourists annually, many of whom participate in marine tourism [33], so management of tourism impacts is a priority [22]. Managers must set ecological performance targets and then achieve them by controlling impacts. At a given level of economic benefit, ecological impacts are likely to be lower when tourism focuses on premium experiences with fewer visitors, each spending more money, instead of minimizing costs to maximize visitor numbers [34]. By shifting towards higher margin tourism, economic benefits are maintained while decreasing the number of visitors [2, 35].

In Hawai'i, the State designated Marine Life Conservation Districts (MLCDs) as no-take MPAs to conserve and replenish marine resources [36], but these MPAs are frequently visited by a high number of tourists, and non-consumptive effects remain to be quantified. One of these highly visited MPAs is the Molokini Shoal MLCD. Despite its small size (0.36 km^2), Molokini received an average of >1,000 visitors per day over the past two decades [37]. In the 1970s, tour operators became concerned about fishing impacts at Molokini Crater and advocated for the creation of an MPA, which was officially designated in 1977 (Hawai'i

Administrative Rules 13–31). The Molokini Shoal MLCD created a two-zone management system that prohibited all fishing inside the crater, and allowed only trolling in the zone outside of the crater. As the number of tours increased, operators voiced concern about the impacts of tourism volume at the MLCD, as well as damage to corals caused by tour boat anchors. In 1987, a limited-entry permit system was established, allowing 42 tour vessels to visit the MLCD, and in 1995 anchoring was prohibited and moorings were installed for both commercial and private users [37]. In 2014 a conservation action plan was created, highlighting four priorities: the coral reef ecosystem, apex predators, seabirds, and place-based nature experiences for visitors [37].

To make informed decisions, managers require data on the effects of human activity on wildlife and the ecosystem as a whole. For Molokini, the tour operator permit system includes mandatory reporting of vessels, passenger numbers, and activities to the Maui Division of Aquatic Resources (DAR). The State of Hawaiʻi conducts regular monitoring of fishes and benthic resources within the MLCD, while other scientists have conducted in-depth studies of the area [38, 39]. Friedlander et al. quantified the 'reserve effect' of Hawaiʻi's MPAs by examining fish biomass inside these MPAs compared to adjacent areas and found that Molokini had among the highest reserve effects in the state, with biomass more than six times greater inside the MLCD compared to adjacent areas [22]. Filous et al. [40] studied predator movement patterns and found that *Caranx melampygus*, a prized sportfish species, was displaced from inside the MLCD crater during periods of high human and vessel abundance.

In this study, we build on prior research by using the COVID pandemic as a perturbation in human abundance in a high-use MPA. We hypothesize that fish biomass and habitat use are negatively correlated with human abundance. The number of visitors to Molokini before and after the COVID-19 pandemic was quantified using data from mandatory vessel logbooks, and was examined in relation to the biomass of reef fishes within the MLCD and the movement patterns of predatory fishes. Insights gained from this study will inform management planning and are relevant to three of the four priorities in the Molokini conservation action plan (preserve the coral reef ecosystem and predators, and provide place-based nature experiences). The study sheds light on the non-consumptive effects of tourism on marine wildlife.

Materials and methods

Study area

Molokini is a small, crescent-shaped islet located in the ʻAlalākeiki Channel, 4.2 km off the south coast of Maui (Hawaiʻi, U.S.). It is the remnant of the rim of a basalt tuff crater, located between Maui and Kahoʻolawe [41]. Due to its distance from the coast of Maui it does not receive runoff and sedimentation from land. The interior of the crater is managed as a no-take zone (0.16 km^2), while the water surrounding the outside of the crater (0.19 km^2) is managed as a trolling-only zone, where other fishing methods are prohibited. The majority of tourists who visit the MLCD use the interior zone, with snorkeling being the primary activity, while use of the outside zone is much lower, primarily by scuba divers (DAR logbook data).

Visitor abundance

Detailed reporting by permitted tour operators was initiated in 2012 and is maintained in a vessel logbook dataset by DAR. This dataset does not cover private vessels, which are usually small boats carrying four or fewer persons, and account for a small minority of people visiting the MLCD. Reporting in the vessel log book includes the vessel name, permit number, date, arrival and departure times, location and number of mooring buoy(s) visited, and the numbers of participants in each underwater activity(scuba, snuba, snorkel, and other). In downstream analyses, we used the maximum number of participants from all activities in each vessel for each day and each month as our proxy of monthly human abundance for the period of 2013–2021.

In situ fish surveys

Diver surveys measured fishes at all trophic levels within the MLCD using two methods. The Fish Habitat Utilization Surveys (FHUS) method was initially conducted in 2004 by the Fisheries Ecology Laboratory from the Hawai'i Institute of Marine Biology as part of an evaluation of MPAs across the State. This method was repeated in 2020 and 2021 to assess the impacts of COVID on fishes in the MLCD. he Fish and Habitat Utilization Survey (FAHU) method started in 2018 and is part of the marine monitoring program of State of Hawai'i (DAR). The FAHU method is conducted every year in August/September but additional surveys were done in April 2020, September 2020, and April 2021 for this study.

The FHUS and FAHU methods follow a similar procedure. A scuba diver swam a 25 x 5 m transect at a constant speed, identified all fishes visible within 2.5 m to either side of the centerline (125 m^2 transect area) to the lowest possible taxon, and estimated the total length (TL) of fishes to the nearest centimeter. Swimming duration varied from 10–15 min, depending on habitat complexity and fish abundance. FAHU and FHUS differ in the site selection and number of transects. The FHUS method consists of 23 transects that are selected using a spatially explicit stratified random sampling design [38], whereas the FAHU method includes 40 randomly selected transects over contiguous, complex shallow (≤8 m deep) and deep (≥9–16 m deep) aggregate reefs with relatively high coral cover. To ensure consistency within surveys, FHUS dives were conducted by AMF and WG, while FAHU surveys were conducted by the DAR survey team directed by RTS.

Length estimates of fishes from visual censuses were converted to weight using the following length-weight relationship: $W = aSL^b$ where the parameters a and b are constants for the allometric growth equation and SL is standard length in mm and W is weight in grams. Total length was converted to standard length (SL) by multiplying standard length to total length-fitting parameters obtained from FishBase [42].

Fish habitat use and occupancy

We used acoustic telemetry to follow the movements of fishes within the Molokini MLCD, keeping consistent with the methodology of a previous study [40]. Given finite resources, we tagged only predatory species since these are involved in both direct and indirect effects. We placed seven passive acoustic monitoring devices (VR2W receiver, Vemco Ltd., Halifax, Nova Scotia) around the outside and inside of Molokini Crater (Fig 1). The monitoring array allowed us to measure presence-absence in the MPA and determine if a fish was inside or outside of the crater. Acoustic monitoring receivers were attached to the benthos using a line, held vertically by a float. Lines were tied around boulders in hard substrate areas and attached to ~ 27 kg cement blocks in sand substrate areas. Receivers were downloaded at approximately 6-month intervals covering May 2020 through May 2021.

Predatory fishes were captured with standard rod and reel fishing gear and tagged with Vemco v13 and v16 coded acoustic tags. Methods are described in detail in Filous et al. [40]. Tags were surgically implanted into the peritoneum of the fish and the incision closed with surgical sutures. Surgical tools and tags were stored in Chlorhexidine prior to the procedure. Fishes were held supine in a padded cradle with saltwater flowing over the gills. Immediately following the surgery each animal was gently returned to the water and released. Fish tagging was conducted under an animal care protocol (IACUC-2020-10-05-14561-kcweng) approved by the William & Mary Animal Care and Use Committee (IACUC, USDA 52-R-0002, OLAW D16-00419 #A3713-01), and a Special Activity Permit from the State of Hawai'i (2021–28).

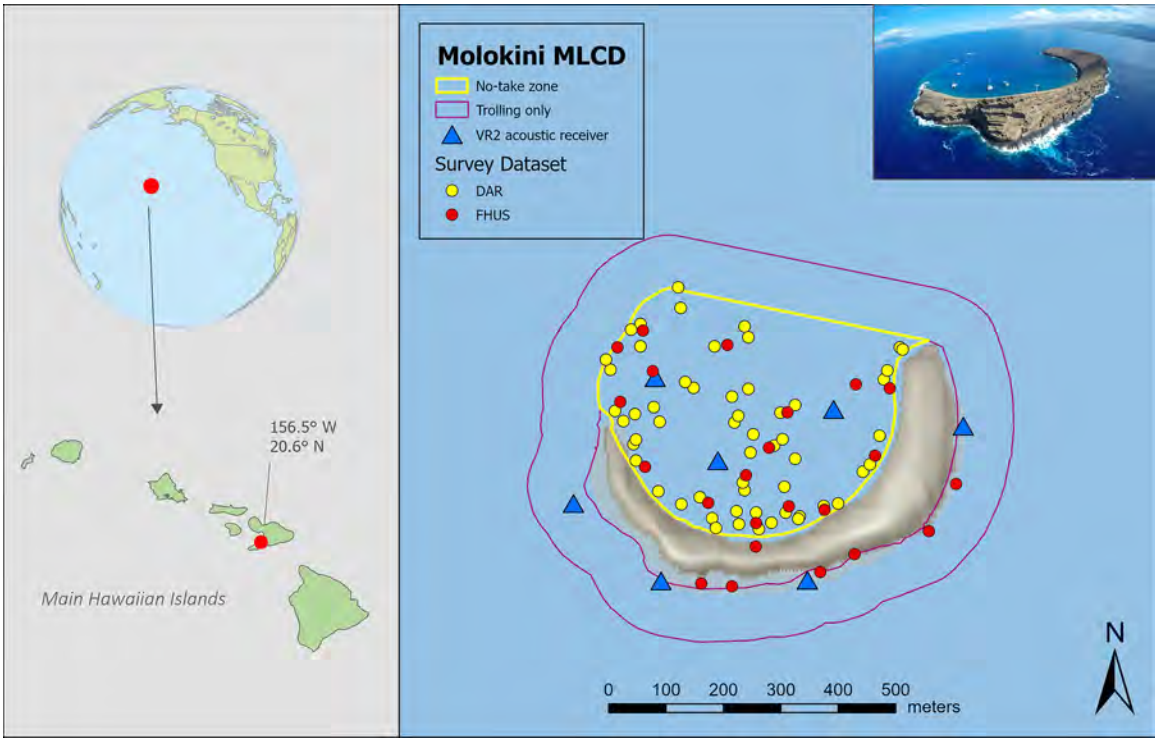

Fig 1. Map of the study site, Molokini Shoal Marine Life Conservation District, located in Maui, Hawaii, USA. Blue triangles show locations of acoustic tracking receivers, yellow and red dots show locations of fish surveys, yellow line shows the boundary of the no-fishing zone inside the crater, and red line shows the boundary of the trolling-only zone around the outside of the crater. Hillshade basemap derived from USGS Digital Elevation Model (DEM) [43]. The partially submerged volcanic crater that forms a wall around the interior is shown in the aerial photo ('Molokini Crater' by Bossfrog from Wikimedia Commons under the Creative Commons Attribution-Share Alike 4.0 International license).

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Analysis

Visitor abundance. To explore the variation in human abundance in Molokini across time and detect potential effects of the COVID-19 pandemic, we used generalized additive (GAM) models and generalized additive mixed models (GAMM) with the R-package mgcv [44]. These types of model were selected to allow the detection of non-linear patterns [45], which are often present in time-series datasets [46]. We aggregated our human abundance data by month (covering nine years from 2013 to 2021) and the COVID-19 pandemic was defined as lasting from March 2020 (start of lockdowns) to May 2021 (relaxing of passenger restrictions for commercial boats).

We started with the most complex model (i.e., adding COVID as a factor and varying the slope of the models pre- and post-pandemic) and reduced complexity in a stepwise fashion. Smoother functions for the continuous time covariates (i.e., months and times) were fitted with cyclic cubic splines and cubic regression splines, respectively. The number of knots (k) were determined by comparing the estimated degree of freedom to k. The optimal number of knots for months was seven and 12 for times. Number of visitors had a Gaussian distributed error term after trialing different distribution families (e.g., Poisson, quasi-Poisson).

Additionally, we added an autoregressive-moving-average (ARMA) residual autocorrelation structure to account for any dependence in our data. However, neither the autocorrelation function (ACF) and partial autocorrelation function (pACF) plots nor the auto.arima function from the R-package forecast confirmed the need to add an ARMA. The model with the best fit was selected using Akaike Information Criterion (AIC). When models did not differ by more than 2 AIC, the simplest model was selected. Model assumptions were checked by plotting model residuals against fitted values with the R-package gratia. All analyses were conducted in R [47].

***In situ* fish surveys.** Fish biomass (i.e., g m^{-2}) from both the FHUS and FAHU surveys were compared among sampling periods using a general linear model with a normal distribution and log-link function based on AIC_c. Contrasts using -loglikelihoods estimates were used to compare individual sampling periods from one another (2004, 2021, 2022).

Comparisons of fish assemblage structure among sampling periods based on biomass were investigated for both FHUS and FAHU surveys using permutation-based multivariate analysis of variance (PERMANOVA). Bray–Curtis similarity matrices were created from biomass of fish taxa. Prior to analyses, fish biomass was square root transformed. Interpretation of PERMANOVA results was aided using individual analysis of similarities (ANOSIM).

Principal Coordinate Analysis (PCO) examines fish assemblage structures among years. Eigenvectors were superimposed on the PCO plots to displace the relative contribution and direction of influence of taxa to the observed variation among years (Pearson product-moment correlations ≥ 0.5). Analysis was conducted in R 4.1.1 [47].

Principal Coordinate Analysis (PCO) was used to display fish assemblage structure among sampling periods. The primary taxa vectors driving the ordination (Pearson correlation Product movement correlations > 0.5) were overlaid on the PCO plots to visualize the major taxa that explained the spatial distribution patterns observed.

Fish habitat use and occupancy. Fish tracking data were downloaded from the passive acoustic monitoring array, processed in the manufacturer supplied software (Vue, Vemco Ltd.) and exported to csv. The fish detection data were used as the response variable. Vessel and human abundance data from the DAR database were used as the explanatory variables. Fish habitat utilization was represented by the daily count of detections on the monitoring array for all species, and was also subsetted to detections occurring for *C. melampygus* during morning hours (07:00–11:00) on the inside of the crater (yellow zone on Fig 1), where vessels moor and the majority of people are concentrated. Human abundance was represented by the daily counts of people, vessels, and people per boat. We used a GLM, and since our response and predictor variables were count data with overdispersion, we used the negative bionomial distribution with log link, with the R-package MASS. We assessed collinearity of predictor variables by calculating the variance inflation factors (VIF) with the R-package car. Predictors with VIF>10 were not used together in a model. When models did not differ by more than 2 AIC, the simplest model was selected (see supplement for model formulations). We determined if our selected model was different from the null model using a Chi-square test. Analysis was conducted in R4.1.1 [47].

Results

Visitor abundance

Human abundance at Molokini varied substantially over the course of the study with values ranging from zero to 43,511 people monthly (Fig 2). The number of people consistently peaked during the summer every year ($R^2 = 0.82$, EDF = 4.06, $p < 0.001$) until 2020 when the COVID-19 pandemic occurred (EDF = 4.78×10^{-07}, p = 0.7). From March to April 2020 the number of visitors declined to zero and remained low through June, July, and August 2020 before rising rapidly (EDF = 2.50, $p < 0.001$). By June 2021 the human abundance at Molokini reached 37,325 of visitors monthly (Fig 2), returning to pre-pandemic levels.

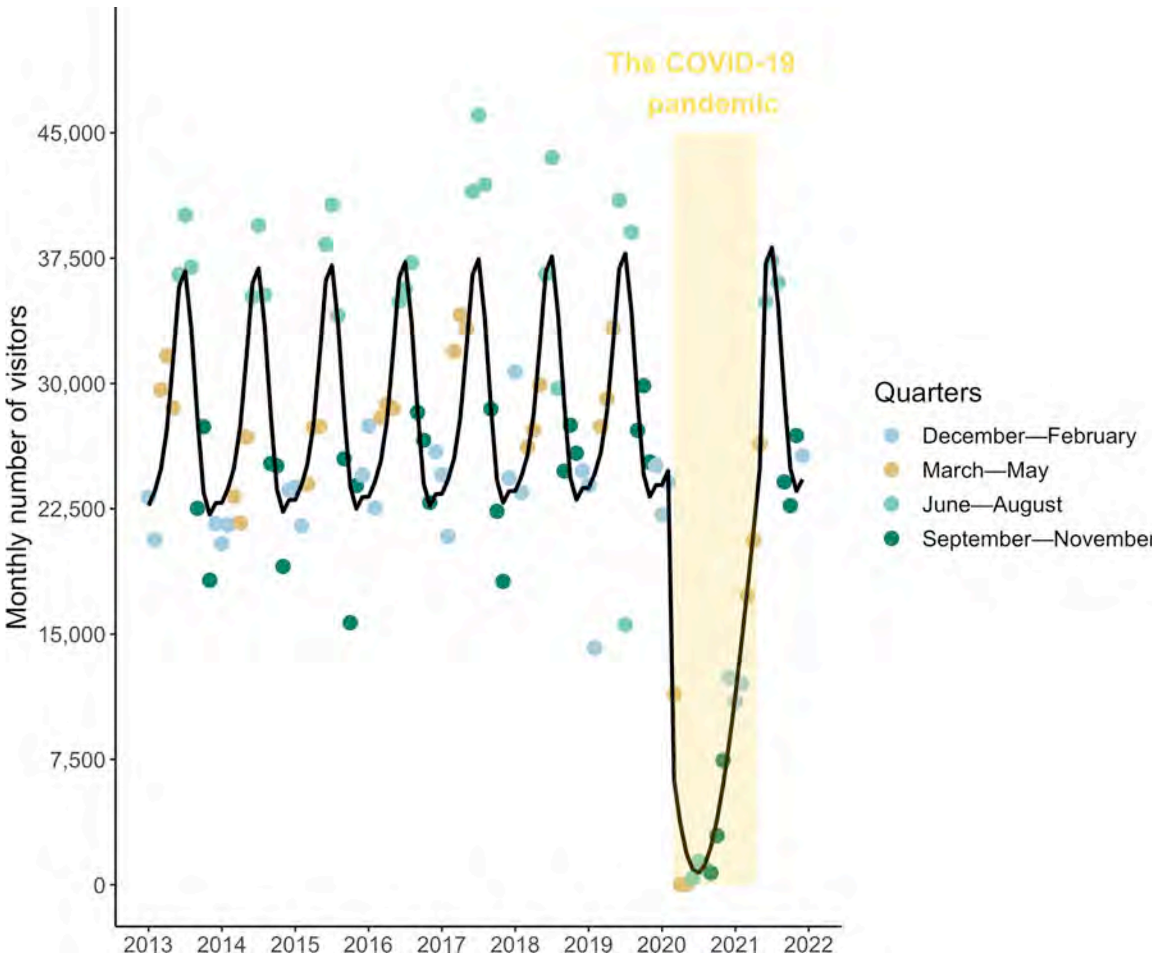

Fig 2. Monthly variation in the number of people visiting Molokini since 2013. Circles show monthly counts of people at Molokini and are colored by quarters (q) that each corresponds to a 3-month period. The black line is the result of the GAM model. The yellow box denotes the period of travel restrictions associated with the COVID-19 pandemic (from March 2020 to May 2021).

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In situ fish surveys

Based on the FHUS surveys, fish biomass in the Molokini MLCD has declined by 44% over two decades (Fig 3A), which was driven by decreases in predators including giant trevally (*Caranx ignobilis*) and white-tip reef shark *Triaenodon obesus* (Fig 3B). Fish biomass from the long-term surveys (2004, 2022, and 2021) was significantly different among years ($\chi^2 = 4.77$, $p = 0.029$), with 2021 significantly lower than 2004. Fish assemblage structure based on biomass was significantly different among years (PERMANOVA pseudo-$F_{2,68} = 2.395$, $p = 0.001$), with 2004 significantly different from 2022 (ANOSIM R = 0.142, p = 0.005) and 2021 (ANOSIM R = 0.159, p = 0.001). The years 2020 and 2021 were not significantly different from one another (ANOSIM R = 0.012, p = 0.304).

Fish biomass from the DAR surveys from January 2018 to April 2021 was significantly different among sampling periods ($\chi^2 = 19.18$, $p = 0.002$), with biomass during the April 2020 sampling period significantly different from all other sampling periods (Fig 3C). All other sampling periods were not significantly different from one another. Fish assemblage structure based on biomass was significantly different among years (PERMANOVA pseudo-$F_{5,236}$ = 2.37, p = 0.001). Most sampling periods were significantly different from one another (all

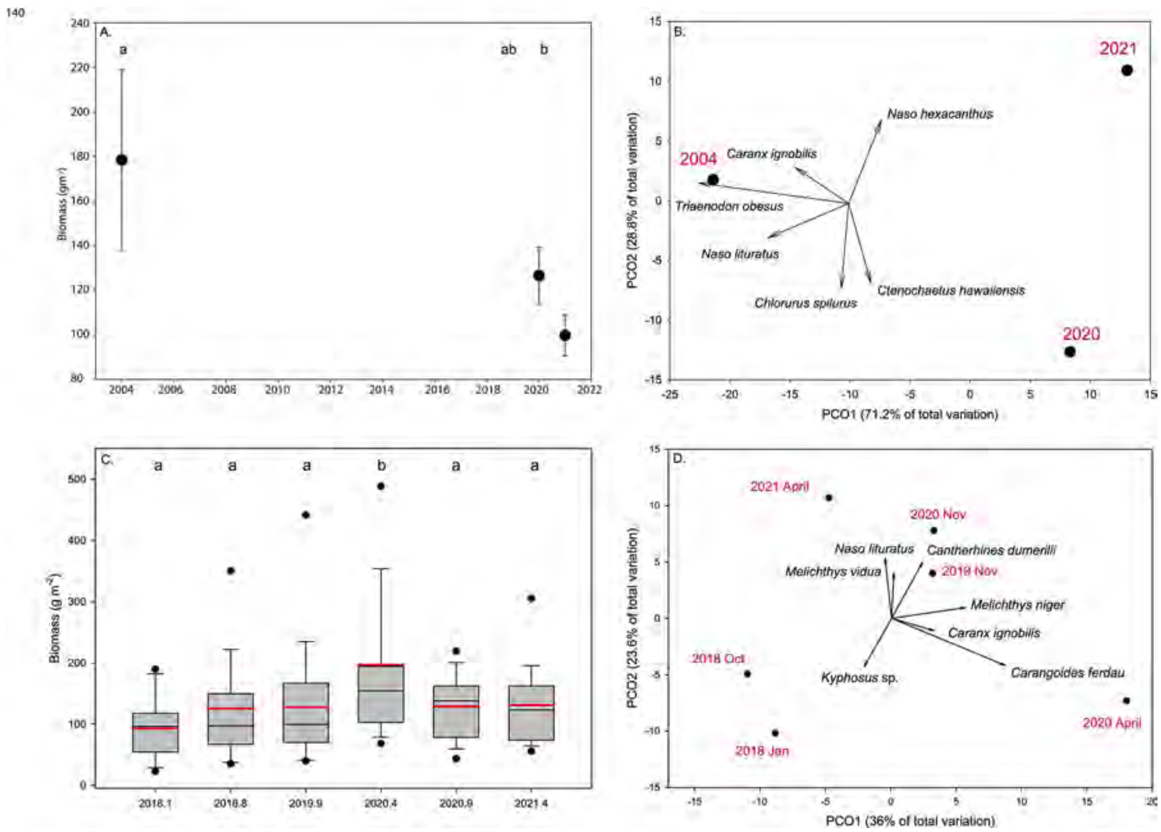

Fig 3. Changes in the fish community at Molokini. Comparisons of fish biomass at all trophic levels among sampling periods from (A) long-term surveys and (C) DAR surveys. Box plots showing median (black line), mean (red line), upper and lower quartiles, and 5th and 95th percentiles. Principal coordinates analysis of fish assemblage composition based on biomass (g m^{-2}) by sampling period for (B) long-term surveys and (D) DAR surveys. Data were ln(x+1)-transformed prior to analyses. Vectors are the relative contribution and direction of influence of fish taxa to the observed variation among sampling periods (Pearson Product movement > 0.5).

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$p < 0.001$) except for January and November 2018 ($R = 0.03$, $p = 0.06$), November 2019 and November 2020 ($R = 0.023$, $p = 0.077$), and November 2019 and April 2020 ($R = 0.017$, $p = 0.124$). However, these R values are all low and show limited differences in overall assemblage structure among time periods.

The April 2020 sampling period was well-separated in ordination space from the other sampling periods, with jacks (*Uraspis helvola* and *Caranx ignobilis*) most highly correlated with this sampling period (Fig 3D).

Fish habitat use and occupancy

The daily sum of detections for tagged fishes was negatively correlated with human abundance at Molokini, using data for all species from the whole MPA (both the inside and outside zones) and all hours of the diel cycle (AIC = 27667; Chi-square comparison with null model, DF = 8, LR = 1589, $p < 0.001$). The pattern was more pronounced when considering only *C. melampygus* from the inside zone during morning hours (Chi-square comparison with null model, DF = 6, LR = 1098, p = < 0.001 Fig 4A). *C. melampygus* showed high utilization of the sheltered interior of the MPA (yellow zone in Fig 1) during the lockdown, but the species was displaced from this habitat during times of high human abundance (morning) starting in December 2020 when tourism resumed (Fig 4B).

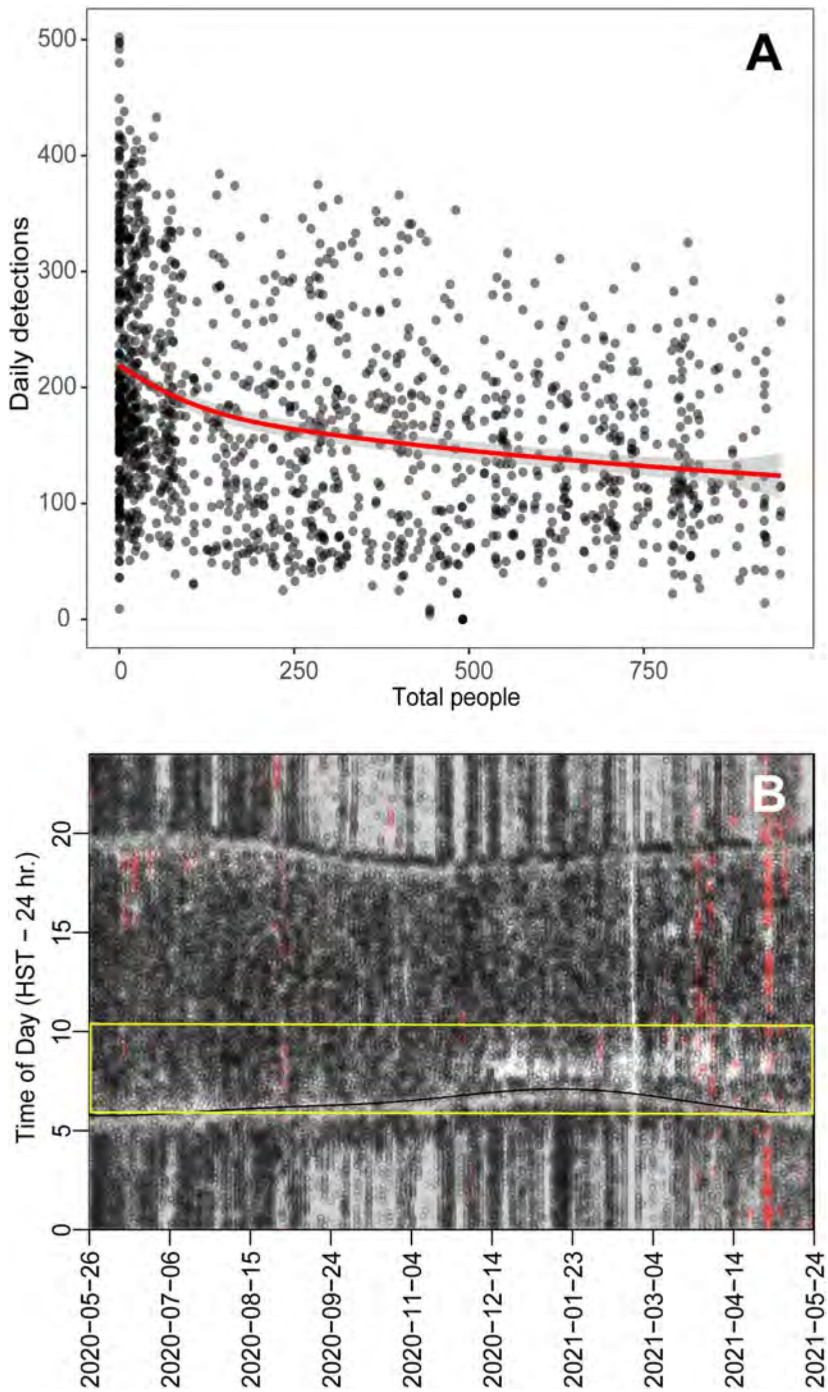

Fig 4. (A) Fish detections vs. presence of people at Molokini. Grey dots show detections per day for all *Caranx melampygus* vs. the daily count of people visiting the crater, with darker shade showing higher density. Red line shows GLM fit, grey envelope shows 95% confidence interval. (B) Diel behavior one *C. melampygus* (44 cm fork length) during 2020 and 2021. Y-axis shows diel cycle with time 00:00 (start of diel cycle) at bottom, noon at center and time 23:59 (end of diel cycle). Horizontal curves show dawn and dusk respectively. Dots show detections of *C. melampygus* with black representing inside the crater and red outside the crater. Yellow box indicates morning period of high human abundance. An interpretation guide for this figure is provided in the S1 Fig in S1 File.

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Discussion

Our results demonstrate that there has been a decadal-scale background decline in fish biomass at Molokini, but that some of these losses are driven by the displacement of fishes due to human presence (Fig 4). This suggests that these losses could be recovered with more effective management of tourism, which has been shown to ameliorate tourism impacts in other systems [48]. Multidecadal decreases in fish biomass likely reflect the long-term decrease in fish populations in the region due to fishing, benthic habitat loss, pollution, and other disturbance effects [22]. Since 2004 the fish biomass at Molokini has decreased, but the COVID lockdown and resulting cessation of tourism resulted in a significant rebound of biomass during that time (Fig 4). Given that the species driving this rebound have lifespans and ages at first reproduction of at least several years, the increase in observed biomass did not result from population growth.

Our acoustic tracking data reveal that the biomass recovery during the pandemic resulted from changes in movement patterns as predatory fishes returned to the much quieter and less disturbed MPA (Fig 4). The absence of human disturbance on a timescale of months resulted in fishes moving back into the sheltered interior of Molokini Shoal. The most important species driving these higher biomasses were jacks in the family Carangidae. These are edible and culturally important species that are targeted by fishers, and they are particularly sensitive to human presence. Thus, it is likely that the noise and physical disturbance of large groups of people and boats in shallow water has negative effects on this group of fishes [49].

Upper trophic level species are frequently the first to be removed from ecosystems as a result of human activity [50]. The giant trevally, *C. ignobilis*, is heavily targeted by spearfishers, shorecasters, and often taken in bottomfish and nearshore troll fisheries. *C. ignobilis* drove the changes in biomass during the lockdown (Fig 4). The closely related species *C. melampygus* had higher habitat use of the inside of the crater during the lockdown, and showed displacement behavior once tourism resumed (Fig 4). This displacement from shallow habitat is consistent with a prior study in Molokini Shoal [40], and suggests that high tourism levels may cause some fishes to leave shallow sheltering habitats, potentially exposing them to higher predation risk. Such displacement may also interfere with critical biological events such as spawning, foraging, and resting. *C. melampygus* and *C. ignobilis* are summer spawners [51], so the summertime peak in tourism visitation to Molokini could further reduce population viability for these species.

The displacement of predators in response to human presence altered fish community structure at Molokini in a manner akin to low intensity fishing that affects only the most aggressive and predatory species [52], in contrast to fishing that also degrades herbivory [53, 54]. Predators have diverse ecosystem roles including both consumptive and non-consumptive effects, and the loss of predators can reduce the resistance and resilience of ecosystems to perturbation [55]. In a terrestrial system, the presence of humans caused foraging activity to decrease for predators and increase for prey species [56]. Ongoing human presence can therefore result in long-term displacement of predators from a system, which could then lack the functions provided by this functional group, including mediation of landscape patchiness [57], shoaling of prey species [58] and herbivory [53, 54].

In addition to the impacts of human disturbance on fishes, the level of tourism at Molokini also appears to negatively affect the visitors themselves. A 2011 study [59] found that 67% of visitors felt crowded during their trip and wished to see no more than ~16 boats at one time at Molokini, but this number was exceeded on over 20% of trips to the MPA. Two-thirds of visitors surveyed supported actions that would reduce visitor numbers at Molokini (e.g., limit number of boats and/or people). Visitors expectations for interpretation (e.g., about reefs, history, culture) were not always met [60]. Overall, these findings suggest that Molokini is being used over its capacity, and management is needed to improve visitor experiences.

The impacts of tourism at Molokini are likely to apply to other locations, as MPAs often attract high levels of visitation. No-take MPAs make up <0.5% of nearshore waters in Hawaiʻi [22] but host a disproportionate tourist volume (e.g., Hanauma Bay hosts ~1,000,000/year, Molokini >300,000/year, Kealakekua ~ 36,000/year). As a result, these MPAs receive higher human presence impacts than other less-visited areas, despite the absence of fishing. Management of tourism should include relevant biological research, clear and well-enforced rules, adaptive management, and broad stakeholder involvement [2]. Successful management of tourism requires specific objectives with measurable indicators and outcomes, and identification of threats coupled with strategies to keep impacts below target levels. Strategies to manage the impacts of tourism include legal designation of sites as protected areas, prohibition or limitation of harmful activities, zoning for different levels of protection, permits for tour operators, and limits on visitation [35]. Hanauma Bay on Oʻahu is one of the most-visited MPAs in the world, and has undergone a series of management changes to address excessive visitor volume, including weekly rest days when the park is closed, a ban on fish feeding, a reservation system, mandatory visitor education, and an increase in fees. The series of management actions resulted in a reduction from >8,000 visitors per day in the 1980s to 1,000 per day in 2022 (https://www.honolulu.gov/parks-hbay/2016-09-01-18-10-39/history/timeline.html). Holistic tourism management is necessary throughout Hawaiʻi's waters, particularly in MPAs.

Achieving the goals of Hawaiʻi's Holomua Initiative will require further controls on human impacts, including controls on tourism impacts. Understanding the impacts of non-consumptive uses such as tourism is critical to statewide marine spatial planning, improving effectiveness of existing MPAs, and implementing a statewide network of MPAs. As part of this process, it is necessary to think strategically about the scale and configuration of tourism in Hawaiʻi to optimize earnings and employment without damaging the ecosystem. While staying below a target level of impact, economic benefit can be maximized when focusing on higher margins and lower volumes of tourism [34]. The number of people and the capacity of vessels were both significant predictors of fish displacement from the inside of Molokini Crater. Therefore, managers should consider the total number of visitors as well as the size and capacity of tour boats.

The COVID pandemic caused a strong negative perturbation in human presence at one of the most densely visited tourist sites in Hawaiʻi. We were able to use this natural experiment to demonstrate significant increases in fish biomass and habitat use during the period of human absence, indicating that the business-as-usual conditions of high tourism alter community structure by displacing predatory fishes to deeper environments. As Hawaiʻi formulates marine management plans and undertakes the Sustainable Hawaiʻi Initiative, lessons from Molokini can inform managers and facilitate effective plans.

Supporting information

S1 File.
(DOCX)

S2 File.
(JPG)

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ITEM F-4 - EXHIBIT 4

March 21, 2019
Molokini MLCD Public Scoping Meeting
Summary of Public Comments

BACKGROUND

On March 21, 2019, the Department of Land and Natural Resources (DLNR) held a public informational and scoping meeting regarding concerns with the current use of the Molokini MLCD. The meeting was well attended with 127 people signing up on the attendance sheets, and probably a few more who did not sign up (maybe about 150 total in attendance). The majority of those in attendance were affiliated in some way with the marine tour business (either owners, managers, or staff on tour vessels), and therefore, many of the comments reflect the viewpoints of those in the industry. Other stakeholders in attendance included some native Hawaiian residents with ancestral and generational ties to the moku of Honuaʻula (The area including Mākena, Molokini, and Kahoʻolawe), non-commercial recreational boaters concerned about public access to the Molokini MLCD, and other concerned members of the public.

The meeting was broken up into two parts. The first part of the meeting was the informational portion in which the DLNR presented background on the MLCD and the recent studies that provide some guidance and concern relating to excessive crowding in the reserve. This was followed up by smaller group facilitated discussions designed to encourage open dialog and to help gather specific comments to guide the DLNR's administrative rule amendment process. No specific rule suggestions were discussed at this point, but rather broad concepts regarding issues such as; concerns with crowding and the impacts on user experience and the health of the ecosystem, concerns relating to free and open access by non-commercial and cultural users, and thoughts on management priorities for the DLNR to look at funding through an updated permit fee structure.

KEY COMMENTS ARGUING AGAINST THE DLNR CONCERNS

- Many felt that anything reducing the number of vessels allowed and/or moorings in the MLCD would increase conflict between the companies using the area and/or between commercial and non-commercial users.
- The current number of day-use moorings (26) was felt to be adequate for current use of both commercial and non-commercial users, with some even suggesting more moorings were needed.
- Some pointed out that the state has not adequately managed the area in the past and is not needed now. The industry has stepped up to manage issues like moorings and they can continue to manage the area without the DLNR.
- Many questioned the validity and/or appropriateness of the scientific studies that are being used to help guide the DLNR's management efforts.
    - They felt the social carrying capacity work was misleading and disregarded the general level of satisfaction that they their customers express on surveys like trip advisor, etc.
    - They also felt that the predator movement work did not adequately correct for natural daily movement pattern of these predators and/or they questioned the importance of one species of predator on the overall ecosystem health of the reef.

- Many felt that reducing the use at Molokini would increase the use at other locations around Maui.
- There were suggestions for a full Maui master plan to better understand and address the tour industry use patterns everywhere before any management actions were taken at just the Molokini MLCD.

KEY COMMENTS IN SUPPORT OF THE DLNR'S CONCERNS AND/OR SUGGESTING OTHER MANAGEMENT OPTIONS

- Many comments suggested more restrictive controls were needed (for example: a one-year full closure to allow for the area to rest and recover, efforts to control the number of boats and/or the number of people allowed at any time, controls over the number of companies allowed to operate in the MLCD, options to shut the MLCD down to allow for non-commercial only access 1 day a week, etc.).
- There was a lot of support for at least 2 dedicated non-commercial use only moorings to help make the area more accessible for all users.
- There was Hawaiian cultural concerns with the heavy use and many suggested some form of kapu be set up to close the entire MLCD down to all use for various ceremonies or events (Makahiki, etc.).
- Concerns were expressed about the lack of appropriate cultural education provided to the guests at Molokini. Suggestions were made for mandatory education to all commercial users about the importance of the Molokini marine ecosystem, as well as the cultural significance of the area.

GENERAL CONCERNS RELATING TO CROWDING, CULTURE, ETC.

Crowding concerns with current use levels:

- There is both support and opposition against limiting the # of moorings and size of boats.

Support for More Management:

- Close Molokini MLCD down for 1 year to give it a rest.
- Perhaps the number of people should be limited instead of the number of boats.
- Need more management and schedule cooperation between the vessel operators.
- Should reduce the number of boats and the number of people on each boat.
- Follow examples at Haleakala, and the road to Hana; limit the number of companies.
- Limit boats not moorings
- 16 boats could be a good compromise number between 12 and 20.
- Others studies, general user observations and the cultural importance does support the need for better management.

Not Supportive of More Restrictions:

- Reef is healthy, boats not there most of the time. What happens when the boats and people are not around?

- Tourist want to go to Molokini; Molokini sells, and limiting trips to Molokini will have financial impacts to the companies.
- Reducing moorings will cause more conflict between operators. No problem now, but if moorings are removed, there will be conflict.
- Reducing moorings could increase anchoring and result in more damage to the reefs
- Reducing moorings could reduce safety by pushing operations to go to less safe locations.
- Keep all 26 moorings

<u>Concerns with Scientific Studies:</u>

- Western science is not rigorous enough to support management decisions. More studies on more species would be required first. Specific suggestions to look into uhu movement.
- Questions relating to why if Molokini is currently doing well, with predator biomass equal to Kahoolawe, that any additional management is needed?
- Many questioned the scientific methodology that was used for both studies.
- Suggestions for more studies on the number of boats at Molokini.
- ʻŌmilu have always hunted the shallow reefs in the early morning and then moved out before the boats come in. Question if they are moving because of boats or as part of their normal behavior.
- More work on ʻōmilu use of areas outside of Molokini (comparisons for the what is found inside of Molokini).
- The noise portion of the study is not trusted.
- The social studies were set up with leading questions to prompt responses towards a feeling of crowding, and photos of number of boats were manipulated.
- The industry surveys (trip advisory, etc) get different answers (find high level of satisfaction). They say 99% of customers are happy with their experience.

<u>Concerns with Molokini Management Increasing Crowding at Other Locations Around Leeward Maui:</u>

- There is a need for an island wide plan to look into displacement of Molokini operations to other parts of Maui.
- Look at impacts from the Haleakala model of controlling crowds at sunrise pushing everyone to the sunset time instead.
- Reducing moorings at Molokini will result in more use at other places around Maui.

<u>Native Hawaiian Cultural Concerns:</u>

- The state has no authorization to give permits to run commercial activities at Molokini (comments from a Hawaiian Activist)
- Need to consider ancestral ties to the island/culture back before 1779.
- What level of boats would the ancestors support if any?
- Operators should be more culturally sensitive.
- Molokini should be "kapu" (closed down to all) during certain important cultural events (For example: The Kahoʻolawe makahiki ceremonies).

<u>Education:</u>

- Tour operators are helping teach (conservation and Protection) about the ecosystem/resources to the general public.
- There needs to be increased education regarding the ecosystem and the effects of things like sunscreen.
- Educate boaters to slow down, and reduce the noise they make while at Molokini.
- There should be more cultural education provided to guests to Molokini, and a better understanding of cultural impacts.

Other Concerns:

- Need to update the Molokini master plan.
- Concerns expressed about the safety of drift snorkeling operations.
- Ban non-reef friendly sunscreens
- Management by the state has been neglected and the industry has to rely on themselves to fix things.
- The DLNR boat needs to be out at Molokini more often. Become part of the Molokini community.

FAIR AND OPEN ACCESS (NON-COMMERCIAL AND COMMERCIAL VESSELS)

Moorings:

- More moorings are needed not less.
- 12 moorings is too low as it creates a fight over the moorings further dividing the user groups.
- 26 moorings is too low.
- Don't increase non-commercial or ancestral uses at the expense of the commercial operators.
- All the current moorings are needed if more non-commercial use can be accommodated.
- Non-commercial only moorings are widely supported
- There should be 3 non-commercial moorings not just 2.
- The moorings should be clearly defined, and labeled to avoid confusion by users.
- Suggestions to keep the Non-commercial moorings subsurface, but paint them a different color to distinguish them form commercial moorings.
- Need a two buoy system. Just using a surface float exposes them to surf conditions and will put too much wear on the mooring hardware. Maybe a small surface float can be attached to the attachment line, but the main mooring buoy should be subsurface.
- Keep non-commercial moorings in the center (away from the edges of the reef), as it is safer for non-experienced users.
- Not all non-commercial users are inexperienced.
- Non-commercial and commercial moorings are already available on a first come first serve basis. Suggesting that all moorings be kept the same and used on a first come first serve basis.

- There is not that much non-commercial use. Maybe there is some needs on weekends only.
- One day a week (no commercial use) allows for non-commercial use only on that day.

<u>Cultural Concerns:</u>

- Priority should be given to Hawaiians with ancestral and lineal ties to the area.

<u>Priority Time for Commercial Use of Most Moorings:</u>

- No opinions
- The suggested time change is inconsistent with the data (not sure what this data is that they are referring to).

<u>FUNDING NEEDS (COMMERCIAL USER FEES)</u>

- There could be a need for a non-biased boat traffic controller to control crowding and allow fair access.
- Fund technology for monitoring vessels and studying long-term use of the crater by all (vessel monitoring systems, remote cameras, web-cams inside the crater, etc)
- Better mooring maintenance
- Better Harbor Maintenance and other boating facilities.
- Research grant funding to better guide management at Molokini and at other marine reserves
- Better marine monitoring including traditional practice monitoring.
- Develop a cultural advisory group that can share knowledge with the general public and tour operators regarding the significance of Molokini.
- Better education (Molokini certification program for operators and their staff).
- Increased educational programs and materials to be used with the tourists.
- Develop educational videos for the airlines.
- Increased conservation enforcement at Molokini and elsewhere in Maui Nui.
- Pumping of wastewater needs to happen with all boats.
- Marine debris clean-ups for all of Maui County
- More moorings in areas outside of Molokini.
- Restoration of the resources.
- Develop Molokini master plan.
- Develop a full south Recreational Maui Master plan
- No body really disagrees with the need for a user fee, but they want to make sure they have input into how the money is used and assurances that it does not go into the general fund.
- Management of user fees would be better within a non-profit.
- Need a special fund to designate the funds for Molokini and/or parts of Maui County.
- Create a Molokini specific special fund. Money paid for Molokini should stay in Molokini.
- DAR doesn't need so much money. Where is the money going? (note-DAR currently gets $1,000 per year from Molokini permits)

- Don't fund additional DOCARE. A web-cam and tour operators can provide enforcement support.
- DLNR should not manage moorings. Response times need to be within 24 hours and DLNR is too slow. This will be even more problematic if the moorings are reduced to 12.

SUGGESTIONS FOR FUTURE MANAGEMENT NEEDS

- Technology to monitor the location of permitted commercial vessels.
- Live streaming web cameras on the island to help monitor use patterns and to allow for commercial operators and visitors to see real time conditions at Molokini.
- Improved maintenance of day-use moorings at Molokini and at other locations around Maui.
- Fund more research by offering competitive grants to address management concerns.
- Develop a cultural advisory group to Molokini to help guide future management and/or the development of educational material and/or training.
- Increase educational programs and materials.
- There was broad support for increased DLNR revenue through Molokini user fees, but there was concern that the money would go to the general fund and not be used for Molokini and/or Leeward Maui resource management needs.

NEXT STEPS

DLNR is continuing to review and consider the comments provided at this meeting along with the suggestions from other specific stakeholder meetings (Stakeholder groups include: marine tour companies, Native Hawaiian's with ancestral and generational ties to the moku of Honuaʻula, and non-commercial boaters). The plan is to finalize suggested administrative rule amendments by the end of April and begin the administrative review process. A thorough discussion with all the permitted commercial operators suggests that the DLNR may be able to achieve an appropriate reduction of crowding concerns through a voluntary process that better coordinates existing use schedules and offers incentives to change schedules as needed through waivers of permit fees, etc. Discussions on how this voluntary process will work have begun and will continue through the commercial operator stakeholder group. Rule changes will likely focus instead on necessary changes to the commercial operators permit fees and renewal period, and on the day-use mooring zoning rules that are currently outdated and not appropriate for the current mooring set-up and use patterns. We hope to move towards public hearing in mid to late summer of 2019.

ITEM F-4 - EXHIBIT 5

Amendment and Compilation of Chapter 13-31
Hawaii Administrative Rules

(Date adopted)

1. Chapter 13-31, Hawaii Administrative Rules, entitled "Molokini Shoal Marine Life Conservation District, Maui", is amended and compiled to read as follows:

"HAWAII ADMINISTRATIVE RULES

TITLE 13

DEPARTMENT OF LAND AND NATURAL RESOURCES

SUBTITLE 4 FISHERIES

PART 1 MARINE LIFE CONSERVATION DISTRICTS

CHAPTER 31

MOLOKINI SHOAL MARINE LIFE CONSERVATION DISTRICT, MAUI

Historical note: Chapter 31 of title 13 is based substantially upon regulation 42 of the division of fish and game, department of land and natural resources, State of Hawaii. [Eff 7/8/77; R 5/26/81]

§13-31-1 Definitions. As used in this chapter unless otherwise provided:

[~~"Trolling" means trailing a line attached to either a baited hook or artificial lure from a boat moving faster than slow-no-wake speed;~~

~~"Slow-no-wake" means as slow as possible without losing steerage way and so as to make the least possible wake. This would almost always mean speeds of less than five miles per hour;~~

~~"Demonstrate" as is used in section 13-31-5(3) means proof such as in any combination of documents including but not limited to copies of commercial licenses, excise tax reports, brochures, affidavits, etc. The burden of proof lies with the applicant.~~

~~"Active commercial vessel operation" as used in section 13-31-5(3) means use no less than two times every quarter over four quarters (12 months) and greater than eight times per year~~]

"Anchor" means to drop or deploy an anchor into the water. For the purposes of this section, "anchor" does not include attaching to a legal mooring.

"Finfish" means any of various species of marine life that uses fins to swim, not including marine mammals or sea turtles.

"Marine life" means any type or species of saltwater fish, shellfish, mollusks, crustaceans, coral, or other marine animals, including any part, product, egg, or offspring thereof; or seaweed or other marine plants, including any part, product, seed, or holdfast thereof.

"Slow-no-wake" means as slow as possible without losing steerage way and so as to make the least possible wake. This would almost always mean speeds of less than five miles per hour.

"Take" means to fish for, catch, capture, confine, or harvest, or to attempt to fish for, catch, capture, confine, or harvest, marine life. The use of any gear, equipment, tool, or any means to fish for, catch, capture, confine, or harvest, or to attempt to fish for, catch, capture, confine, or harvest, marine life by any person who is in the water, or in a vessel on the water, or on or about the shore where marine life can be fished for, caught, captured, confined, or harvested, shall be construed as taking. Any gear, equipment, or tool possessed in the water shall be construed as being in use for the purposes of taking marine life.

"Trolling" means trailing a line attached to either a baited hook or artificial lure from a boat moving faster than slow-no-wake speed. [Eff and comp 9/16/95; am and comp] (Auth: HRS §190-3) (Imp: §§190-3, 190-4.5)

§13-31-2 Boundaries. The Molokini shoal marine life conservation district shall include subzones A and B of that portion of the submerged lands and overlying waters surrounding Molokini islet, county of Maui, as follows:

(1) Subzone A is defined as that portion of submerged lands and overlying waters within the crater, beginning at a point at the highwater mark of Lalilali Point, then along the highwater mark of the northern shoreline eastward until Pahe‘e o Lono Point, then west along a straight line to the end of the submerged ridge (shoal) extending from Lalilali Point, then along the top of the shoal back to the point of beginning; and

(2) Subzone B is defined as that portion of submerged lands and overlying waters outside the crater, encircling the islet out to 100 yards, seaward of the point of beginning at the highwater mark of Lalilali Point then eastward along the highwater mark of the

southern shoreline of the islet to Paheʻe o Lono Point, then west along a straight line from Paheʻe o Lono Point to the end of the shoal extending from Lalilali Point, then along the top of the shoal back to the point of beginning.

Subzone areas A and B are illustrated in ["Map of Molokini Shoal Marine Life Conservation District, Maui 1/18/94" attached] Exhibit A entitled "Map of Molokini Shoal Marine Life Conservation District, Maui", dated June 24, 2019, located at the end of this chapter. [Eff 5/26/81; am, ren, and comp 9/16/95; am and comp] (Auth: HRS §190-3) (Imp: HRS §§190-1, 190-2, 190-3)

§13-31-3 Prohibited activities. [No person shall engage in the following activities in] Within the Molokini [shoal marine life conservation district] Shoal Marine Life Conservation District, county of Maui, no person shall:

(1) [Fish for, catch, take, injure, kill, possess, or remove any finfish, crustacean, mollusk including sea shell and opihi, live coral, algae or limu, or other marine life, or eggs thereof] Take marine life except as provided for in section 13-31-4(1);

(2) Have or possess in the water, any [spear, trap, net, crowbar,] gear, equipment, tool, or [any] other device that may be used for the taking or altering of [marine life,] any geological feature[,] or specimen;

(3) Take, alter, deface, destroy, possess, or remove any sand, coral, rock, or other geological feature[,] or specimen;

(4) Feed or deliberately introduce any food material, substance, or attractant, directly to or in the vicinity of any aquatic organism, by any means for any purpose except as provided in section 13-31-4(1);

(5) [~~Moor boats for commercial activities~~] Engage in any type of commercial activity involving ocean users getting in or on the water, including swimming, snorkeling, diving, kayaking, or paddling, except as provided for in section 13-31-5; or

(6) Anchor a boat [~~when a day use mooring system and management plan is established by this department~~]. [Eff 5/26/61; am, ren, and comp 9/16/95; am and comp] (Auth: §§190-3, 190-4.5) (Imp HRS §§190-1, 190-3, 190-4.5)

§13-31-4 Allowed activities. A person may:

(1) [~~Fish for, catch, take, possess, or remove~~] Take or possess any finfish by trolling in subzone B only;

(2) Possess in the water, any knife and any shark billy, bang stick, powerhead, or carbon dioxide (C02) injector for the sole purpose of personal safety. [Eff 5/26/81; am, ren, and comp 9/16/95; am and comp] (Auth: HRS §§190-3, 190-4.5) (Imp: HRS §§190-1, 190-3, 190-4.5)

§13-31-5 Exceptions; permits. (a) The department may issue [~~permits~~] special activity permits, not longer than one year in duration, to engage in activities otherwise prohibited by law [~~and section 13-31-3, under such terms and conditions it deems necessary to carry out the purpose of chapter 190, Hawaii Revised Statutes:~~

~~(1) To take~~] for scientific, educational, management, or propagation[~~, or other~~] purposes in conformance with chapter 190 and section 187A-6, Hawaii Revised Statutes[~~, any form of marine life or eggs thereof otherwise prohibited by law;~~].

[~~(2)~~] (b) Except as provided in chapter 13-257, subchapter 4, the department may issue marine life conservation district commercial use permits to engage in commercial activity, excluding the taking of marine life, with [~~a marine life conservation district use permit.~~] the following conditions:

(1) Each boat shall be required to obtain a separate permit[~~. An applicant for this permit shall pay a non-refundable permit fee of $50 valid for a two-year duration.~~];

(2) Upon adoption of this chapter, active permits with an expiration date of December 14, 2023 shall have a new expiration date of December 31, 2023. Thereafter, permits shall be valid for not longer than two years and shall expire on December 31 of each odd-numbered year;

(3) Each permittee shall pay a permit fee at the time of renewal. The fee shall be set based on three categories of passenger capacity: Category 1 for vessels with passenger capacities lower than 25; Category 2 for vessels with passenger capacities between 25 and 74; and Category 3 for vessels with passenger capacities equal to 75 or more;

(4) Permit renewal fees shall be set at the following: Category 1 = $1,500; Category 2= $3,000; and Category 3= $6,000;

(5) The department may establish permit terms and conditions that provide for the reduction or waiver of permit fees as the department deems appropriate;

(6) Prior to [~~its~~] the expiration of the permit, the permittee may apply for reissuance. Unless the permit is reissued, it shall automatically expire on the expiration [~~date. The permittee shall indemnify, defend, and hold harmless the State of Hawaii, its successors, assigns, officers, employees, contractors, and agents from and~~

against any loss, liability, claim or demand for property damage, personal injury and death arising from any act or omission related to this permit;] date;

[(3)] (7) An application for reissuance of this permit shall be accepted only from a commercial operator who [can demonstrate active commercial vessel operation within the Molokini shoal marine life conservation district] possesses a current permit within the twelve-month period immediately prior to the [effective date of these rules,] expiration date of their current permit and who possesses a commercial vessel use permit for the use of state boating facilities issued in accordance with section [13-231-57,] 13-231-57 or a commercial vessel registration issued in accordance with section 13-256-4. [No application for a permit shall be accepted after ninety days of the effective date of these rules;]

(8) The permittee shall indemnify, defend, and hold harmless the State of Hawaii, its successors, assigns, officers, employees, contractors, and agents from and against any loss, liability, claim or demand for property damage, personal injury and death arising from any act or omission related to this permit;

[(4)] (9) The permit shall be incorporated as an addendum to the commercial vessel use permit for the use of state boating facilities issued in accordance with section 13-231-57, or a commercial vessel registration issued in accordance with section 13-256-4;

[(5)] (10) The permit shall be non-transferrable, except as provided by section 13-231-62; [and]

(11) The Department may establish additional permit terms and conditions deemed necessary to minimize any adverse effect within the conservation district; provided that the

department shall provide written notice of any change in permit conditions at least ninety calendar days prior to the effective date of the change, except, as determined by the department, when an immediate change in permit conditions is necessary to protect or preserve the conservation district or to protect the health and safety of the public; and

[~~(6)~~] (12) The board may revoke any permit for any infraction of the terms and conditions of the permit, and a person whose permit is revoked shall not be eligible to renew a permit until the expiration of one year from the date of revocation. [Eff 5/26/81; am 3/2/87; am, ren, and comp 9/16/95; am and comp] (Auth: §§187A-6, 190-3, 190-4.5) (Imp: HRS §§90-3(b), 187A-6, 190-4)

§13-31-6 Penalty. A person violating the provisions of this chapter or the terms and conditions of any permit issued as provided by this chapter, shall be punished as provided by law." [Eff 5/26/81; am, ren, and comp 9/16/95; comp] (Auth: HRS §§190-3, 190-4.5) (Imp: HRS §190-5)

2. Material, except source notes and other notes, to be repealed is bracketed and stricken. New material is underscored.

3. Additions to update source notes and other notes to reflect these amendments and compilation are not underscored.

4. These amendments to and compilation of chapter 13-31, Hawaii Administrative Rules, shall take

effect ten days after filing with the Office of the Lieutenant Governor.

I certify that the foregoing are copies of the rules drafted in the Ramseyer format pursuant to the requirements of section 91-4.1, Hawaii Revised Statutes, which were adopted on (date), and filed with the Office of the Lieutenant Governor.

____
DAWN N. S. CHANG
Chairperson, Board of Land
and Natural Resources

APPROVED AS TO FORM:

____
Deputy Attorney General

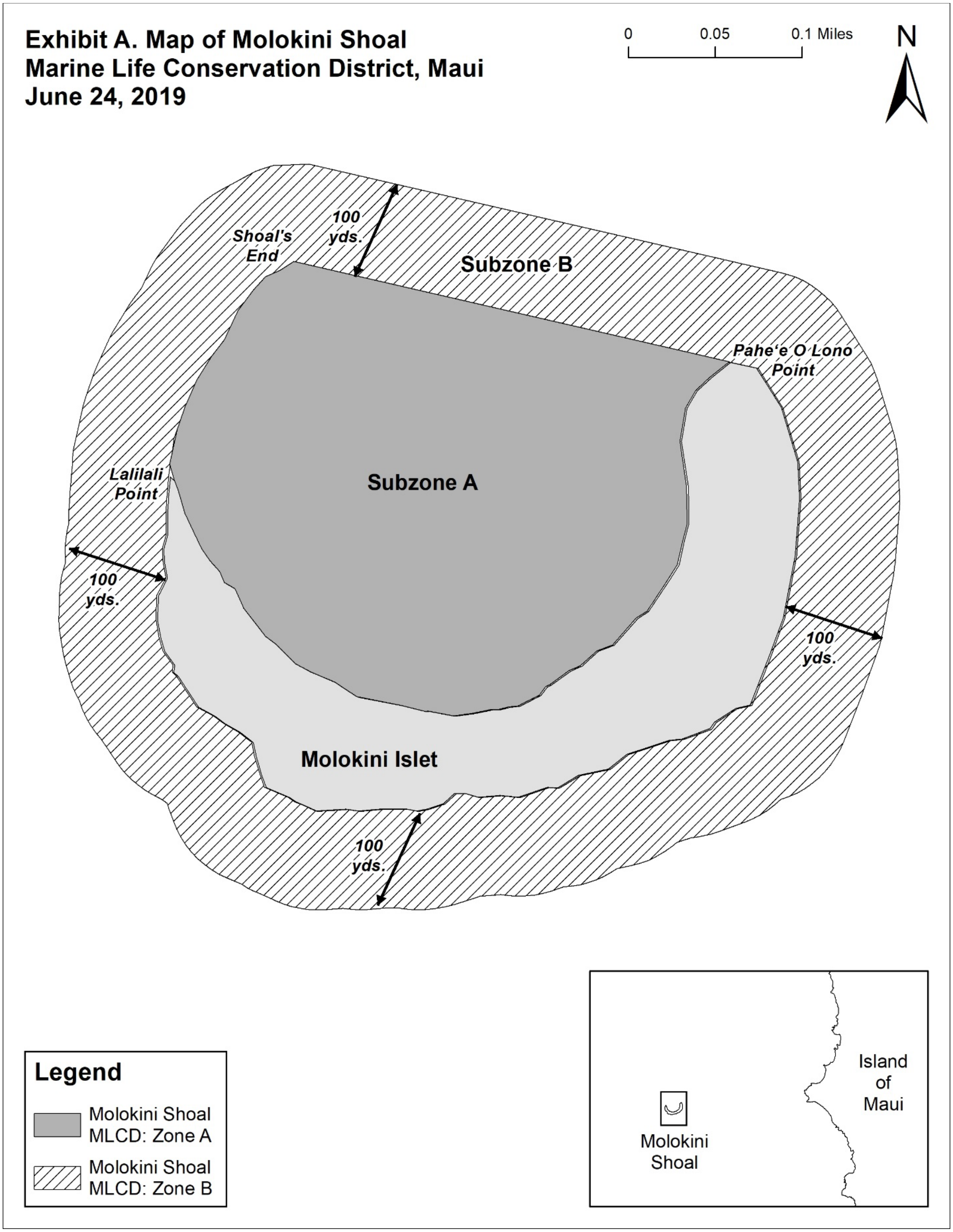
Exhibit A. Map of Molokini Shoal
Marine Life Conservation District, Maui
June 24, 2019
0
0.05
0.1 Miles
N
100 yds.
Shoal's End
Subzone B
Pahe'e O Lono Point
Subzone A
Lalilali Point
100 yds.
100 yds.
Molokini Islet
100 yds.
Legend
Molokini Shoal MLCD: Zone A
Molokini Shoal MLCD: Zone B
Island of Maui
Molokini Shoal

ITEM F-4 - EXHIBIT 6

Amendment and Compilation of Chapter 13-257
Hawaii Administrative Rules

INSERT DATE OF ADOPTION

1. Chapter 13-257, Hawaii Administrative Rules, entitled "Day-Use Mooring Rules", is amended and compiled to read as follows:

"HAWAII ADMINISTRATIVE RULES

TITLE 13

DEPARTMENT OF LAND AND NATURAL RESOURCES

SUBTITLE 11

OCEAN RECREATION AND COASTAL AREAS

PART 3

OCEAN WATERS, NAVIGABLE STREAMS AND BEACHES

CHAPTER 257

DAY-USE MOORING RULES

Subchapter 1 General Provisions

Subchapter 8 Day-Use Moorings, Island of Kauaʻi

§§13-257-91 to 13-257-120 (Reserved)

SUBCHAPTER 1

GENERAL PROVISIONS

§13-257-1 Purpose and scope. (a) The purpose of [~~the day use~~] day-use mooring rules and zones is to reduce damage to coral and other marine life as a result of continuous use of anchors by commercial and recreational vessels in zones of high dive and mooring activity statewide.

(b) [~~The rules describe the~~] This chapter contains provisions for mooring at state [~~day use~~] day-use mooring [~~buoys and the zones where the buoys are located.~~] buoys. [Eff 9/16/95; am and comp] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

§13-257-2 [~~Day use~~] Day-use mooring permit. An owner or operator of a vessel using a [~~day use~~] day-use mooring [~~established under~~] buoy installed pursuant to this chapter shall not be required to apply for a [~~day use~~] day-use mooring permit from the department, except as otherwise provided in this chapter. [~~Any use of a state day use mooring shall be at the sole risk of the owner or operator of the vessel using the mooring.~~] [Eff 9/16/95; am and comp] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

§13-257-3 [~~Time limit.~~] Day-use mooring buoy limitations. (a) [~~The time limit for use of a day~~

~~use mooring buoy by any one vessel~~] A vessel using a day-use mooring buoy shall not exceed two and one half hours [~~when another vessel is waiting for the use of that mooring buoy,~~] of use, except as provided by section 13—37-3 for the [~~old Kona airport marine life conservation district.~~] Old Kona Airport Marine Life Conservation District, Hawai‘i.

(b) Overnight mooring is [~~prohibited except in case of emergency or by enforcement or rescue craft.~~] prohibited. [Eff 9/16/95; am and comp] (Auth: HRS §§200—2, 200—3, 200—4, 200—10) (Imp: HRS §200-10)

§13-257-4 Anchoring restrictions. [~~Anchoring~~] Unless otherwise provided in this chapter, anchoring is allowed only in areas of sand, rock, or rubble bottom types where no live corals exist; provided further that anchoring is prohibited within one hundred yards of any [~~day use mooring buoy, except as otherwise provided in these rules. Anchoring elsewhere in a day use mooring zone is permitted in areas of sand, rock, or rubble bottom types where no live corals exist.~~] day-use mooring buoy. [Eff 9/16/95; am and comp] (Auth: HRS §§200—2, 200—3, 200—4, 200—10) (Imp: HRS §200—10)

§13-257-5 [~~Day use~~] Day-use mooring buoy installation. (a) Design guidelines for [~~a typical day use~~] day-use mooring buoy installation is as shown on Exhibits “DM—OO”, “DM—OO—A” and “DM—OO—B”, dated December 16, 1994, located at the end of this subchapter. The department shall adhere to the design guidelines specified in this subsection, and the Board shall have the discretion to approve mooring buoy designs that differ from the guidelines in this section if the Board finds that:

(1) A specific design offers environmental or structural advantages over those specified in the day-use mooring buoy guidelines; and

(2) Such environmental or structural advantages outweigh any negative impacts to aquatic resources.

(b) For each day-use mooring buoy site, the department shall develop a day-use mooring buoy site proposal, subject to approval and modification by the Board, which shall consider:

(1) Public input;

(2) Impact upon aquatic resources;

(3) Use patterns with respect to the proposed site; and

(4) Any other information relevant to site selection and mooring buoy installation.

[Eff 9/16/95; am and comp] (Auth: HRS §§200—2, 200—3, 200—4, 200—10) (Imp: HRS §200—10)

§13-257-6 Day-use mooring buoy locations. The department shall maintain a listing of sanctioned day-use mooring buoys installed in waters of the State. The listing shall be available on the division's website, may be maintained in print form, and shall provide GPS coordinates for the location of each mooring buoy. The department shall make a reasonable effort to ensure that the GPS coordinates on the listing provide an accurate location for each state-owned day-use mooring buoy. [Eff] (Auth: HRS §§200—2, 200—3, 200—4, 200—10) (Imp: HRS §200-10)

§13-257-7 Rafting prohibited. Rafting of vessels from any day-use mooring buoys is prohibited. [Eff] (Auth: HRS §§200—2, 200—3, 200—4, 200—10) (Imp: HRS §200—10)

§13-257-8 Liability. By using a state-owned day-use mooring buoy, a vessel owner or operator assumes the sole risk of using the mooring. The State assumes no liability or responsibility associated with the use of any day-use mooring buoys, except as otherwise provided in this chapter. [Eff] (Auth: HRS §§200—2, 200—3, 200—4, 200—10) (Imp: HRS §200—10)

§13-257-9 Safety and enforcement. The restrictions cited in this chapter do not apply to the following:

(1) Emergency situations;
(2) Law enforcement, patrol, or rescue craft;
(3) Department vessels and personnel performing official duties;
(4) Vessels and personnel performing authorized homeland security training operations; and
(5) The U.S. Coast Guard. [Eff] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §§200-2, 200-3, 200-10)

§§13-257-10 to 13-257-15 (Reserved)

SUBCHAPTER 2

[~~DAY-USE MOORING,~~] DAY-USE MOORINGS, ISLAND OF [~~HAWAII~~] HAWAI'I

[~~**§13-257-16 Kaiholena to Malae Point day use mooring zone.**~~ ~~(a)~~ ~~Kaiholena to Malae Point day use mooring zone is encompassed by the boundaries as shown~~

on Exhibit "DM-01" dated November 15, 1990, located at the end of this subchapter and described as follows:

Beginning at a point at the high water mark at the tip of Malae Point and measured by azimuth clockwise from True South; 050 degrees for a distance of four hundred seventy-five feet; 161 degrees for a distance of four thousand eight hundred fifty feet; 150 degrees for a distance of two thousand feet; 167.5 degrees for a distance of seven thousand three hundred thirty feet; 246.5 degrees to the high water mark at the shoreline; then along the shoreline to the point of beginning.

(b) The following buoys are within the mooring zone described in this section.

(1) Buoy "DM-01" located at a point on the water measured by azimuth clockwise from True South, 152.5 degrees for a distance of four thousand four hundred fifty feet from the southwest tip of Keaweula Bay.
(2) Buoy "DM-02" located at a point on the water measured by azimuth clockwise from True South, 143 degrees for a distance of two thousand eight hundred ten feet from the southwest tip of Keaweula Bay.
(3) Buoy "DM-03" located at a point on the water measured by azimuth clockwise from True South, 154 degrees for a distance of five hundred ninety feet from the southwest tip of Keaweula Bay.] [Eff 9/16/95; R] (Auth: HRS §§200– 2, 200–3, 200–4, 200–10) (Imp: HRS §200–10)

[**§13-257-17 Malae Point to Kaiopae Point day use mooring zone.** (a) Malae Point to Kaiopae Point day use mooring zone is encompassed by the boundaries as shown on Exhibit "DM-02" dated November 15, 1990, located at the end of this subchapter and described as follows:

~~Beginning at a point at the high water mark at the tip of Kaiopae Point and measured by azimuth clockwise from True South; 056 degrees for a distance of six hundred ten feet; 137 degrees for a distance of six thousand five hundred eighty feet; 151 degrees for a distance of forty thousand six hundred feet; 148 degrees for a distance of six thousand nine hundred ninety-five feet; then in a straight line to the high water mark at the Malae Point shoreline; then along the shoreline to the point of beginning.~~

~~(b) The following buoys are within the mooring zone described in this section.~~

~~(1) Buoy "DM-04" located at a point on the water measured by azimuth clockwise from True South, 354 degrees for a distance of one thousand feet from the northwest tip of Kalala Gulch Cove.~~

~~(2) Buoy "DM-05" located at a point on the water measured by azimuth clockwise from True South, 333 degrees for a distance of two thousand six hundred feet from the northwest tip of Kalala Gulch Cove.~~

~~(3) Buoy "DM-06" located at a point on the water measured by azimuth clockwise from True South, 113.5 degrees for a distance of one thousand one hundred feet from the southeast tip of Kamilo Gulch Cove.~~

~~(4) Buoy "DM-07" located at a point on the water measured by azimuth clockwise from True South, 001 degrees for a distance of one thousand one hundred feet from the southeast tip of Kamilo Gulch Cove.~~

~~(5) Buoy "DM-08" located at a point on the water measured by azimuth clockwise from True South, 314 degrees for a distance of two thousand six hundred fifty feet from the southeast tip of Kamilo Gulch Cove.~~

~~(6) Buoy "DM-09" located at a point on the water measured by azimuth clockwise from True South, 095 degrees for a distance of one~~

~~thousand one hundred ten feet from the northwest tip of Keawewai Gulch Cove.~~] [Eff 9/16/95; R] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

[**~~§13-257-18 Pauoa Bay to Honokaope Bay day use mooring zone.~~** ~~(a) Pauoa Bay to Honokaope Bay day use mooring zone is encompassed by the boundaries as shown on Exhibit "DM-03" dated November 15, 1990, located at the end of this subchapter and described as follows:~~

~~Beginning at a point at the high water mark at the tip of Lae o Panipou Point and measured by azimuth clockwise from True South; 124 degrees for a distance of one thousand two hundred feet; 060 degrees for a distance of two thousand nine hundred twenty feet; 044 degrees for a distance of seven thousand two hundred fifty feet; then in a straight line to the high water mark at the Anaehoomalu "trig" shoreline; then along the shoreline to the point of the beginning.~~

~~(b) The following buoys are within the mooring zone described in this section.~~

~~(1) Buoy "DM-10" located at a point on the water measured by azimuth clockwise from True South, 081.5 degrees for a distance of one thousand one hundred fifty feet from Keanapukalua Point.~~

~~(2) Buoy "DM-11" located at a point on the water measured by azimuth clockwise from True South, 057 degrees for a distance of two thousand feet from Keanapukalu Point.~~] [Eff 9/16/95; R] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

[**~~§13-257-19 Kaauau Point to Kapalaoa Point day use mooring zone.~~** ~~(a) Kaauau Point to Kapalaoa Point~~

day use mooring zone is encompassed by the boundaries as shown on Exhibit "DM-04" dated November 15, 1990, located at the end of this subchapter and described as follows:

Beginning at a point at the high water mark at the tip of Kaauau Point and measured by azimuth clockwise from True South; 053 degrees for a distance of four thousand one hundred eighty feet; then in a straight line to the high water mark at Kapalaoa Point shoreline; then along the shoreline to the point of beginning.

(b) The following buoy is within the mooring zone described in this section.

(1) Buoy "DM-12" located at a point on the water measured by azimuth clockwise from True South, 219 degrees for a distance of three thousand fifty feet from Kapalaoa Point.]
[Eff 9/16/95; R] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

[**§13-257-20 Makako Bay to Kalihi Point day use mooring zone.** (a) Makako Bay to Kalihi Point day use mooring zone is encompassed by the boundaries as shown on Exhibit "DM-O5" dated November 15, 1990, located at the end of this subchapter and described as follows:

Beginning at a point at the high water mark at the tip of Kalihi Point and measured by azimuth clockwise from True South; 062 degrees for a distance of five hundred fifty feet; 150 degrees for a distance of two thousand nine hundred seventy-five feet; 012.5 degrees for a distance of one thousand three hundred twenty-five feet; 040 degrees for a distance of three thousand four hundred feet; 270 degrees to the high water mark of the shoreline; then along the shoreline to the point of beginning.

(b) The following buoys are within the mooring zone described in this section.

(1) Buoy "DM-13" located at a point on the water measured by azimuth clockwise from True South, 214 degrees for a distance of three thousand two hundred fifty feet from Keahole Lighthouse.

(2) Buoy "DM-14" located at a point on the water measured by azimuth clockwise from True South, 178 degrees for a distance of one thousand three hundred forty feet from Keahole Lighthouse.] [Eff 9/16/95; R] (Auth HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200—10)

[**§13—257—21 Wawaloli Beach to Maliu Point day use mooring zone.** (a) Wawaloli Beach to Maliu Point day use mooring zone is encompassed by the boundaries as shown on Exhibit "DM—06" dated November 15, 1990, located at the end of this subchapter and described as follows:

Beginning at a point at the high water mark at the tip of Maliu Point and measured by azimuth clockwise from True South; 140 degrees for a distance of ten thousand five hundred feet; 158.5 degrees for a distance of four thousand five hundred forty feet; 180 degrees for a distance of two thousand two hundred fifty feet; 151 degrees for a distance of three thousand ninety feet; 242 degrees to the high water mark of the shoreline; then along the shoreline to the point of beginning.

(b) The following buoys are within the mooring zone described in this section.

(1) Buoy "DM-15" located at a point on the water measured by azimuth clockwise from True South, 172 degrees for a distance of four thousand three hundred seventy-five feet from Puhili Point.

(2) Buoy "DM-16" located at a point on the water measured by azimuth clockwise from True South, 170 degrees for a distance of two

~~thousand six hundred twenty-five feet from Puhili Point.~~

~~(3)~~ ~~Buoy "DM-17" located at a point on the water measured by azimuth clockwise from True South, 152 degrees for a distance of one thousand one hundred fifty feet from Puhili Point.~~

~~(4)~~ ~~Buoy "DM-18" located at a point on the water measured by azimuth clockwise from True South, 002 degrees for a distance of nine hundred eighty feet from Puhili Point.~~

~~(5)~~ ~~Buoy "DM-19" located at a point on the water measured by azimuth clockwise from True South, 121 degrees for a distance of one thousand six hundred feet from Wawahiwaa Point (Heiau).~~

~~(6)~~ ~~Buoy "DM-20" located at a point on the water measured by azimuth clockwise from True South, 073 degrees for a distance of seven hundred fifty feet from Wawahiwaa Point (Heiau).~~

~~(7)~~ ~~Buoy "DM-21" located at a point on the water measured by azimuth clockwise from True South, 005 degrees for a distance of seven hundred fifty feet from Wawahiwaa Point (Heiau).~~

~~(8)~~ ~~Buoy "DM-22" located at a point on the water measured by azimuth clockwise from True South, 312 degrees for a distance of one thousand four hundred fifty feet from Wawahiwaa Point (Heiau).~~

~~(9)~~ ~~Buoy "DM-23" located at a point on the water measured by azimuth clockwise from True South, 143 degrees for a distance of one thousand seven hundred feet from Kaloko Point.~~

~~(10)~~ ~~Buoy "DM-24" located at a point on the water measured by azimuth clockwise from True South, 069 degrees for a distance of one thousand one hundred twenty-five feet from Kaloko Point.~~] [Eff 9/16/95; R

] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

[**§13-257-22 Kaiwi Point to Kukailimoku Point day use mooring zone.** (a) Kaiwi Point to Kukailimoku Point day use mooring zone is encompassed by the boundaries as shown on Exhibit "DM-07" dated November 15, 1990, located at the end of this subchapter and described as follows:

Beginning at a point at the high water mark at the tip of Kukailimoku Point and measured by azimuth clockwise from True South; 000 degrees for a distance of nine hundred fifty feet; 117.5 degrees for a distance of seven thousand three hundred eighty feet; 099 degrees for a distance of two thousand five hundred feet; 140 degrees for a distance of three thousand eighty feet; 159 degrees for a distance of one thousand nine hundred feet; 270 degrees to the high water mark of the shoreline; then along the shoreline to the point of beginning.

(b) The following buoys are within the mooring zone described in this section.

(1) Buoy "DM-25" located at a point on the water measured by azimuth clockwise from True South,001 degrees for a distance of seven hundred feet from Kaiwi Point.
(2) Buoy "DM-26" located at a point on the water measured by azimuth clockwise from True South, 351 degrees for a distance of one thousand six hundred ninety feet from Kaiwi Point.
(3) Buoy "DM-27" located at a point on the water measured by azimuth clockwise from True South, 115 degrees for a distance of one thousand five hundred fifty feet from Keahuolu Point.
(4) Buoy "DM-28" located at a point on the water measured by azimuth clockwise from True

~~South, 010 degrees for a distance of five hundred feet from Keahuolu Point.~~

~~(5) Buoy "DM-29" located at a point on the water measured by azimuth clockwise from True south, 288 degrees for a distance of one thousand three hundred feet from Keahuolu Point.~~

~~(6) Buoy "DM-30" located at a point on the water measured by azimuth clockwise from True South, 293 degrees for a distance of three thousand three hundred eighty feet from Keahuolu Point.~~

~~(7) Buoy "DM-31" located at a point on the water measured by azimuth clockwise from True south, 113 degrees for a distance of four thousand three hundred ninety feet from Kukailimoku Point.~~

~~(8) Buoy "DM-32" located at a point on the water measured by azimuth clockwise from True South, 107 degrees for a distance of two thousand three hundred fifty feet from Kukailimoku Point.~~

~~(9) Buoy "DM-33" located at a point on the water measured by azimuth clockwise from True South, 039 degrees for a distance of six hundred feet from Kukailimoku Point.~~] [Eff 9/16/95; R] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

[**~~§13-257-23 Kuamoo Bay to Paaoao Bay day use mooring zone.~~** ~~(a) Kuamoo Bay to Paaoao Bay day use mooring zone is encompassed by the boundaries as shown on Exhibit "DM-08" dated November 15, 1990, located at the end of this subchapter and described as follows:~~

~~Beginning at a point at the high water mark at the Keauhou Coast "trig station" and measured by azimuth clockwise from True South; 090 degrees for a distance of eight hundred thirty feet; 335 degrees for a distance of eight thousand four~~

~~hundred feet; 270 degrees to the shoreline of the northwest tip of Paaoao Bay; then along the shoreline to the point of beginning.~~

~~(b) The following buoys are within the mooring zone described in this section.~~

~~(1) Buoy "DM-34" located at a point on the water measured by azimuth clockwise from True South, 025 degrees for a distance of eight hundred fifteen feet from the Keauhou Coast "trig station"~~

~~(2) Buoy "DM-35" located at a point on the water measured by azimuth clockwise from True South, 087 degrees for a distance of one thousand one hundred feet from Kalanui Point.~~

~~(3) Buoy "DM-36" located at a point on the water measured by azimuth clockwise from True South, 073 degrees for a distance of seven hundred feet from Kuamoo Point.~~

~~(4) Buoy "DM-37" located at a point on the water measured by azimuth clockwise from True South, 115 degrees for a distance of one thousand seventy-five feet from Leinokano Point.~~] [Eff 9/16/95; R] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

[**~~§13-257-24 Paaoao Bay to Cook Point day use mooring zone.~~** ~~(a) Paaoao Bay to Cook Point day use mooring zone is encompassed by the boundaries as shown on Exhibit "DM-09" dated November 15, 1990, located at the end of this subchapter and described as follows:~~

~~Beginning at a point at the high water mark at the northwest tip of Paaoao bay and measured by azimuth clockwise from True South; 090 degrees for a distance of one thousand seventy-five feet; 015.5 degrees for a distance of five thousand nine hundred fifty-five feet; 329 degrees for a distance of eight thousand five hundred fifty feet; 009 degrees for a distance of three~~

thousand three hundred feet; 335 degrees for a distance of one thousand nine hundred feet; 295 degrees for a distance of four thousand six hundred ninety feet; 213 degrees to the high water mark at Cook Point; then along the shoreline to the point of beginning.

(b) The following buoys are within the mooring zone described in this section.

(1) Buoy "DM-38" located at a point on the water measured by azimuth clockwise from True South, 156 degrees for a distance of nine hundred eighty feet from Paaoao Point.

(2) Buoy "DM-39" located at a point on the water measured by azimuth clockwise from True South, 090 degrees for a distance of eight hundred feet from Paaoao Point.

(3) Buoy "DM-40" located at a point on the water measured by azimuth clockwise from True South, 155 degrees for a distance of eight hundred feet from Kekeiwaha Point.

(4) Buoy "DM-41" located at a point on the water measured by azimuth clockwise from True South, 069 degrees for a distance of seven hundred fifty feet from Keikiwaha Point.

(5) Buoy "DM-42" located at a point on the water measured by azimuth clockwise from True South, 130 degrees for a distance of two thousand seven hundred ten feet from the Puu Ohau "trig station".

(6) Buoy "DM-43" located at a point on the water measured by azimuth clockwise from True South, 075 degrees for a distance of one thousand six hundred seventy-five feet from the Puu Ohau "trig station".

(7) Buoy "DM-44" located at a point on the water measured by azimuth clockwise from True South, 000 degrees for a distance of two thousand one hundred feet from the Keauhou Coast "trig station".

(8) Buoy "DM-45" located at a point on the water measured by azimuth clockwise from True South, 181 degrees for a distance of two

~~thousand nine hundred ninety feet from Keawekaheha Point.~~

~~(9) Buoy "DM-46" located at a point on the water measured by azimuth clockwise from True South, 168 degrees for a distance of one thousand three hundred fifty feet from Keawekaheha Point.~~] [Eff 9/16/95; R] (Auth: HRS §§200—2, 200—3, 200—4, 200—10) (Imp: HRS §200—10)

§§13-257-25 to 13-257-35 (Reserved)

SUBCHAPTER 3

[~~DAY USE~~] DAY-USE MOORINGS, ISLAND OF MAUI

§§13-257-36 to 13-257-50 (Reserved)

SUBCHAPTER 4

[~~DAY USE~~] DAY-USE MOORING AREA, MOLOKINI SHOAL MARINE LIFE CONSERVATION DISTRICT

§13—257—51 Molokini Island Day-Use Mooring Area. The boundary of the Molokini Island Day-Use Mooring Area is contiguous with the boundary of Subzone A of the Molokini Shoal Marine Life Conservation District, as described in section 13—31-2, and as shown on [~~Exhibit "DM—10",~~] Exhibit A, entitled "Map of Molokini Shoal Marine Life Conservation District, Maui", dated [~~March 3, 1994,~~] June 24, 2019, located at the end of this subchapter and described as follows:

Beginning at a point at the high water mark [~~at Pahe'e 0 Lono Point; then in a straight line to the end of the shoal at the northwest point of Molokini island; then in a counter-clockwise direction along the shoreline of Molokini island~~] of Lalilali Point, then along the high water mark of the northern shoreline eastward until Pahe'e o Lono Point, then west along a straight line to the end of the submerged ridge (shoal) extending from Lalilali Point, then along the top of the shoal back to the point of beginning. [Eff 9/16/95; am and comp] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

§13-257-52 Commercial use restrictions. (a) No vessel shall use a day-use mooring for commercial purposes unless the owner has been issued a marine life conservation district use permit by the department pursuant to section 13-31-5, as evidenced by its inclusion as an addendum to a commercial vessel use permit for the use of state boating facilities issued in accordance with section 13-231-57, or a commercial vessel registration issued in accordance with section 13-256-4 for that vessel.

(b) [~~Mooring zone "A" is designated for use by commercial vessels carrying twelve or more passengers. Mooring zone "B" is designated for use by commercial vessels carrying less than twelve passengers.~~] The use of any one particular mooring shall be on a first-come, first-served basis. [~~Mooring zones "A" and "B" as shown on exhibit "DM-10" located at the end of this subchapter are generalized locations intended to reflect current mooring practices and are subject to revision, pending development of a final mooring plan prior to installation of permanent moorings.~~

~~(c) The department may authorize the owner of a commercial vessel not having a marine life conservation district use permit occasional or infrequent use of the day use moorings, not to exceed eight times a year, when application is made and~~

~~approved not less than seven days in advance of the date of intended use.~~] [Eff 9/16/95; am and comp] (Auth: HRS §§200—2, 200—3, 200—4, 200—10) (Imp: HRS §200—10)

§13-257-53 Commercial day-use mooring [~~permit~~] fee. [~~The commercial day use mooring permit~~] <u>Beginning January 1, 2024, the</u> fee for [~~a~~] commercial <u>use of a</u> Molokini day-use mooring [~~shall be the greater of $100~~] <u>is $200</u> per month [~~or two per cent of gross receipts~~], provided that this fee [~~shall be~~] <u>is</u> waived for commercial operators who are presently paying [~~commercial vessel user fees for the use of state boating facilities in accordance with section 13-234-5.~~] <u>the ocean stewardship user fee required by section 187A-52, Hawaii Revised Statutes.</u> [~~This fee shall be in addition to the commercial use permit fee required under section 13-31-5.~~] <u>This fee is in addition to the commercial use permit fee required under section 13-31-5. and any commercial fees charged pursuant to chapter 13-234.</u> [Eff 9/16/95; am and comp] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

§13-257-54 Recreational vessel use of Molokini day use moorings. [~~Mooring zone "C" is designated for primary use by recreational vessels, and is shown on exhibit "DM-10" located at the end of this subchapter.~~] <u>Recreational vessels shall have exclusive use of designated recreational day-use moorings. All designated recreational day-use moorings shall be indicated with a surface float.</u> Recreational vessels may also use vacant <u>commercial day-use</u> moorings [~~located in zones "A" and "B"~~] except during the period from [~~8:30 a.m. to 11:30 a.m.~~] <u>7:30 a.m. to 9:30 a.m.</u> [Eff 9/16/95; am and comp] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

§13-257-55 Speed Restrictions. No vessel shall operate at a speed in excess of "slow-no wake" within the [~~Subzone A, as defined in section 13-257-51 and shown on exhibit "DM-10".~~] Molokini Island Day-Use Mooring Area. [Eff 9/16/95; am and comp] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

§13-257-56 Anchoring restrictions. [~~(a)~~] Anchoring is prohibited within the Molokini [~~island day-use mooring area, provided that anchoring is permitted within the designated area at locations of sand, rock, or rubble bottom types where no live corals exist until such time as new day use moorings are installed.~~

~~(b) Anchoring is prohibited within Subzone B of the Molokini shoal marine life conservation district.~~] Island Day-Use Mooring Area. [Eff 9/16/95; am and comp] (Auth: HRS §§200-2, 200-3, 200-4, 200-10) (Imp: HRS §200-10)

§§13-257-57 to 13-257-60 (Reserved)

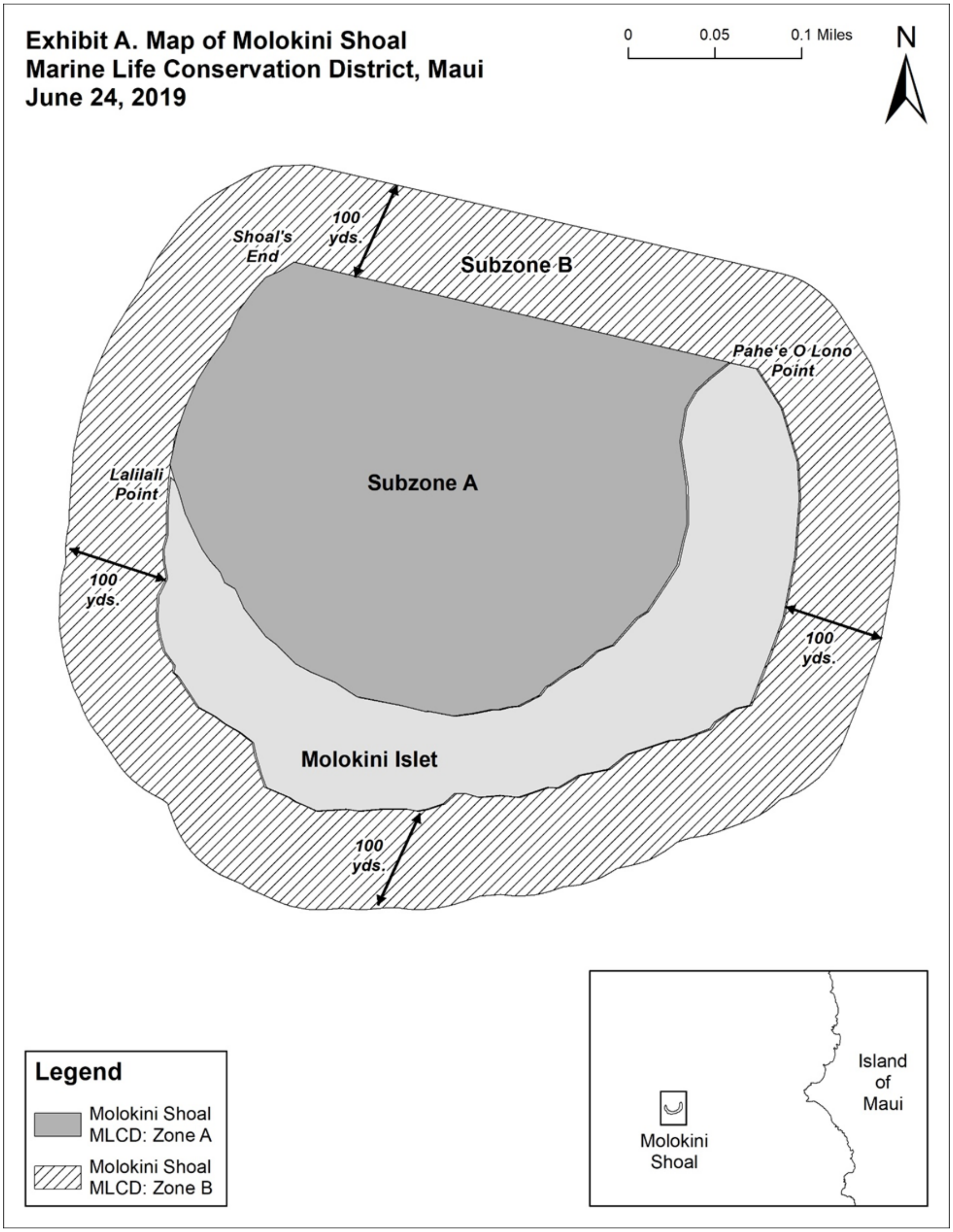
Exhibit A. Map of Molokini Shoal
Marine Life Conservation District, Maui
June 24, 2019
0
0.05
0.1 Miles
N
Shoal's End
100 yds.
Subzone B
Pahe'e O Lono Point
Lalilali Point
Subzone A
100 yds.
100 yds.
Molokini Islet
100 yds.
Legend
Molokini Shoal MLCD: Zone A
Molokini Shoal MLCD: Zone B
Island of Maui
Molokini Shoal

SUBCHAPTER 5

[~~DAY USE~~] DAY-USE MOORINGS, ISLAND OF [~~LANAI~~] LĀNA‘I

§§13-257-61 to 13-257-70 (Reserved)

SUBCHAPTER 6

[~~DAY USE~~] DAY-USE MOORINGS, ISLAND OF [~~MOLOKAI~~] MOLOKA‘I

§§13-257-71 to 13-257-80 (Reserved)

SUBCHAPTER 7

[~~DAY USE~~] DAY-USE MOORINGS, ISLAND OF [~~OAHU~~] O‘AHU

§§13-257-81 to 13-257-90 (Reserved)

SUBCHAPTER 8

[~~DAY USE~~] DAY-USE MOORINGS, ISLAND OF [~~KAUAI~~] KAUA‘I

§§13-257-91 to 13-257-120 (Reserved)"

2. Material, except source notes and other notes, to be repealed is bracketed and stricken. New material is underscored.

3. Additions to update source notes and other notes to reflect these amendments and compilation are not underscored.

4. The amendments to and compilation of chapter 13-257, Hawaii Administrative Rules, shall take effect ten days after filing with the Office of the Lieutenant Governor.

I certify that the foregoing are copies of the rules, drafted in the Ramseyer format pursuant to the requirements of section 91-4.1, Hawaii Revised Statutes, which were adopted on ________________ and filed with the Office of the Lieutenant Governor.

____
DAWN N. S. CHANG
Chairperson,
Board of Land and Natural Resources

APPROVED FOR PUBLIC HEARING:

____
Deputy Attorney General