Committee Staff Summary for November 6-7, 2024 MRC

2. Marine Protected Area (MPA) Regulation Change Petitions – Evaluation Process

Today's Item **Information ☐** **Action ☒**

(A) Receive and discuss Department evaluation and recommendations for MPA petitions in Bin 1 (petitions ready to be evaluated in the near-term) and develop potential committee recommendation

(B) Discuss sorting of MPA petitions in Bin 2 (petitions that require additional policy guidance, information and/or resources before evaluation), and next evaluation steps

(C) Receive general input on MPA petitions (*as time allows*)

Summary of Previous/Future Actions

• Received decadal management review (DMR) report and Department presentation	February 8-9, 2023
• Marine Resources Committee (MRC) and Commission discussed and prioritized adaptive management recommendations from DMR	2023; various
• Received 20 MPA regulation change petitions	December 13-14, 2023
• Referred 20 MPA petitions to Department for review and to MRC for discussion	February 14-15, 2024
• MRC received and discussed Department-proposed approach for reviewing and evaluating petitions for MPA regulation changes	March 19, 2024; MRC
• Department presented proposed Phase 1 "binning" of MPA petitions into bins 1 and 2, and MRC developed recommendation	July 17, 2024; MRC
• Approved MRC recommendation for Bin 1 and Bin 2 petitions; requested updates on process for Bin 2 petitions and proposed timeline	August 14-15, 2024
• Department provided update on developing Bin 1 recommendations and proposed next steps for evaluating Bin 2 petitions.	October 9-10, 2024
• **Today receive and discuss Department Bin 1 petitions evaluation and draft recommendations; discuss sorting of Bin 2 MPA petition actions and next evaluation steps**	**November 6, 2024; MRC**
• Commission considers MRC recommendations; receives Department annual MPA Management Program update	December 11-12, 2024; MRC

Background

Twenty public MPA regulation change petitions, containing over 80 individual petition actions, are currently under review by the Department for evaluation and recommendations following

Commission referral in February 2024. The Department is following the three-phase framework for evaluating MPA petition requests, which the Commission approved in April 2024 based on MRC recommendation, including four core petition evaluation considerations (see Exhibit 1, pages 3-4). The petition evaluation framework organizes further evaluation considerations into three MPA cornerstones: Governance, Management Program Activities, and Network Performance (See Exhibit 1, page 5).

Phase 1 Binning of Individual Petitions – July 2024 MRC

The Department presented draft binning of individual petitions into Bin 1 (near-term evaluation) and Bin 2 (longer-term evaluation) at the July MRC meeting. In August, the Commission supported the draft placement of petitions into the bins as proposed, initiating Department evaluation of the petitions in Bin 1. The Commission requested a process update in October.

Department Progress Update in October 2024

In October, the Department presented: (1) the status of Bin 1 petition evaluations under the approved MPA petition evaluation framework; (2) proposed next steps for the petition evaluation framework (for discussion at MRC in November 2024); (3) near-term milestones for MRC and Commission meetings (through early 2025); and (4) the Department's newly-launched MPA Petitions StoryMap. The agenda topic materials are in Exhibit 1. The Commission expressed strong interest in tracking the MPA petitions discussions as the evaluation process unfolds.

Following the October meeting, the Department submitted a report to the Pacific Fishery Management Council for the November Council meeting, to provide a high level overview of the process underway with the Commission (Exhibit 5).

Today's Meeting – November 6, 2024

The Department will give a presentation to serve as a roadmap for today's discussion about the Bin 1 evaluation and draft recommendations, and the next phases of the evaluation framework (Exhibit 2).

(A) *Bin 1 Petitions Evaluation and Draft Recommendations*

The Department has released its draft recommendations and rationale for all petitioned actions in the five petitions sorted into Bin 1 (exhibits 3 and 4). To clarify terminology used in the draft recommendations, "Support" is exclusively for non-regulatory actions, while "Grant" or "Deny" are formal terms used for regulatory actions, aligning with the Commission's authority under the State's Administrative Procedure Act.

Following its introductory presentation, the Department will then walk through the individual draft recommendations for each Bin 1 MPA petition action, categorized into four groups based on the type of action:

- *Non-regulatory*
- *Allowable uses*
- *Classification/take*
- *Boundaries*

Today, MRC will discuss the Department's draft recommendations and potentially develop an MRC recommendation for Commission consideration.

(B) *Next Steps for Bin 2 Petitions Sorting and Action Evaluation*

This item is to discuss next steps for sorting and evaluating individual actions within Bin 2 petitions (those requiring additional policy guidance, information, or resources) as well as other process considerations.

The Department has begun separating Bin 2 petitions into the individual actions for review. In October 2024, the Department proposed to further sort Bin 2 actions using the Phase 1 considerations to identify those actions ready for near-term evaluation versus those on a longer-term evaluation time scale (Exhibit 1). Based on the Bin 1 review and discussion, today is an opportunity to consider the potential effectiveness of the evaluation method for more involved or complex actions.

There are several sources of information and context to support discussion and potential MRC guidance on the Bin 2 sorting and evaluations:

- *Evaluation framework:* In addition to evaluation guidelines related to compatibility with MLPA and master plan, advancing MLPA goal(s), garnering community support, and advancing DMR adaptive management recommendations, the MPA petition evaluation framework organizes evaluation considerations into the three cornerstones: governance, management program activites, and network performance (found in Exhibit 1). There are multiple ways the sorted actions could be grouped for evaluation purposes, one of which is to use the framework categories to separate actions aimed at adaptive management of existing MPAs through management program changes versus those focused on expanding or adding MPAs to improve network performance. Such an approach is in contrast to, say, focusing discussions in specific regions, or grouping by action type. Each of the approaches may be reasonable, depending on the proposed actions.
- *Staff-proposed petition revision process*: In October, the Commission confirmed its willingness to receive requests from MPA petitioners to amend their original MPA petition. Staff has developed a proposed petition amendment process for MRC consideration (Exhibit 6).
- *Tools for evaluation* (design and scientific analysis): At the October Commission meeting, the California Ocean Protection Council shared its intent to invest in updating two existing tools with recent data: SeaSketch and the Connectivity Model. During today's meeting, Ocean Protection Council staff will provide an update on the tools, anticipated timing for when data updates will be complete, and clarify what the potential applications of each tool are for petition review and evaluation (Exhibit 7).
- *Design feasibility and science guidelines:* Staff and the Department have noted the potential application of existing design feasibility and science guidelines (found in the master plan for MPAs) in reviewing petitioned actions.

(C) *General Input on MPA Petitions (as time allows)*

Upon completion of 2(A) and 2(B), this section provides a place for comments related to specific MPA petitions or MPAs more broadly. A number of general comments were received by the public comment deadline.

Next Steps – December 11-12, 2024 Commission Meeting

At its December meeting, the Commission will receive any MRC recommendations related to: (1) actions on MPA petitions in Bin 1; (2) a potential petition revision process for Bin 2 petitions; and (3) potential sorting or evaluation guidance for individual actions in Bin 2 petitions, including the use of design and evaluation tools. Additionally, the Department will present its annual MPA Management Program update under the Department's Marine Region update.

Significant Public Comments

(A) Bin 1 Petitions – Department Evaluation and Recommendations

- *Petition 2023-26MPA (Swami's State Marine Conservation Area, SMCA)*

  Amend: The petitioner requests to withdraw the boundary change proposals, but retain proposed color changes for no-take SMCAs in outreach materials (Exhibit 8).

  Oppose: A recreational fishing and hunting organization and two recreational fishermen oppose the proposed boundary changes, citing concerns about scientific basis, fishing access, and enforcement challenges (exhibits 9 through 11).

- *Petition 2023-31MPA (Drakes Estero SMCA) or Petition 2023-30 (Big River SMCA)*

  Support 2023-31MPA: The petitioner provides additional support for the petition from various individuals and organizations (National Park Service, Marin County Supervisor Rodoni, scientists, non-governmental and community-based organizations, local individuals, and tribes) (Exhibit 12).

  Oppose 2023-31MPA and 2023-30MPA: A recreational fishing and hunting organization opposes both petitions due to potential impacts on recreational harvest and lack of clear scientific rationale (Exhibit 9).

- *Petition 2023-22MPA (several Orange County MPAs)*

  Support 2023-22MPA_7: Twenty-two individuals support adding language to Orange County MPAs stating that "Scientific research, monitoring, restoration, and education is allowed pursuant to any required federal, state, or local permits, or as otherwise authorized by the Department."

(B) Bin 2 Petitions – Sorting and Next Steps in Evaluation Process

- *MPA Petition Evaluation Process:* Four fishing organizations and three individual fishermen have raised concerns about the MPA petition evaluation process, especially for advancing large-scale MPA change petitions. They cite issues such as insufficient scientific support, inadequate stakeholder engagement, potential conflicts with the Commission's new Coastal Fishing Communities Policy, and coastal fishing communities facing multiple marine spatial developments (offshore wind, 30x30, quillback-driven area closures). Some commenters recommend prioritizing adaptive management adjustments actions, separating evaluations for network expansion, and

pausing the process for new MPA proposals to allow for a more thorough and inclusive approach (see examples in exhibits 13-18).

(C) General Comments

- *Disputing MPA Effectiveness:* Two recreational fishing organizations submitted documents as evidence from scientific sources challenging the effectiveness of MPAs in increasing fish abundance (Exhibit 19).
- *Amend: Petition 2023-15MPA (Channel Islands MPAs):* The petitioner requests to amend the petition with several options offered for take allowance, including full access and restrictions on gear types, and addresses potential impacts on nearshore areas. Also provides rationale to allow fishing for highly migratory species (HMS) in three Channel Islands MPAs (states HMS have minimal impact on MPA ecosystems; current regulations are overly restrictive due to unintentional gear movement and military closures; and the proposal aligns with adaptive management principles). (Exhibit 20)
- *Support, Oppose or Additional Information:* Over a dozen letters and emails in support of or opposition to specific Bin 2 petitions (Exhibit 21).
- *Petition 2023-23MPA:* Petitioner provides additional information about outreach and compromises made, responds to objections to petition, identifies where additional policy guidance is needed, and attaches a table with all MPA petitions with proposed actions and justifications, and other non-MPA related information (Exhibit 22).

Recommendation

Commission staff: (A) Review the Department's draft recommendations for Bin 1 petition actions and provide feedback. Develop an MRC recommendation for each Bin 1 action, considering public input and potential modifications to the Department's proposals, if any. (B) Discuss the categorization of Bin 2 petitions into individual actions. Provide guidance on the evaluation process, including any specific information or criteria that should be displayed.

Department: (A) Support the Department's draft Bin 1 actions recommendations as proposed. (B) Discuss potential next steps for Bin 2 petition evaluations and amendments.

Exhibits

1. Staff summary and exhibits from October 9-10, 2024 Commission meeting, Agenda Item 10(C), Marine Region Report, regarding MPA regulation change petitions (*for background purposes only*)
2. Department presentation
3. Department memo: MPA Regulations Change Petitions-Evaluation Process, received October 25, 2024
4. Department recommendations for Bin 1 petition actions, received October 25, 2024
5. Department report on the California MPA Petition Process, Agenda Item D.2.b Marine Planning, Pacific Fishery Management Council, November 2024
6. Staff-proposed process for revising MPA petitions, dated October 25, 2024
7. California Ocean Protection Council presentation – evaluation tools

(A) ***Comments on Bin 1 Petitions***

8. Letter from Katie O'Donnell, U.S. Ocean Conservation Manager, WILDCOAST, received October 10, 2024
9. Letter from Joel Weltzien, California Chapter Coordinator, Backcountry Hunters & Anglers, received October 23, 2024
10. Email from Volker Hoehne, received October 16, 2024
11. Letter from David Clutts, member, San Diego Freedivers, Norcal skindivers, and Richmond Pelican Skindivers, received October 21, 2024
12. Letter from Ashley Eagle-Gibbs, Executive Director, Environmental Action Committee of West Marin, received October 24, 2024

(B) ***Comments on Bin 2 Petition Evaluation Process***

13. Letter from Kim Selkoe, Executive Director, Chris Voss, President, and Ava Schulenberg, Assistant Director, Commercial Fishermen of Santa Barbara, received October 24, 2024
14. Letter from Kim Selkoe, Founder and CEO, and Victoria Voss, COO, Get Hooked Seafood, received October 24, 2024
15. Letter from Miles Wallace, Owner, Open Ocean Seafood, and Board Member, California Lobster and Trap Fishermen's Association, received October 24, 2024
16. Email from Matthew Bond, AllWaters PAC, received October 24, 2024
17. Letter from Ava Schulenberg, Executive Director, California Lobster and Trap Fishermen's Association, received October 24, 2024
18. Letter from Ava Schulenberg, commercial fisherman, received October 24, 2024

(C) ***Comments on Individual Petitions or MPAs Generally***

19. Emails and attachments from Chris Killen, AllWaters PAC, and Bill Shedd, Coastal Conservation Association California, received October 9 to October 23, 2024
20. Letter from Blake Hermann, petitioner for Petition 2023-15MPA, received October 15, 2024
21. Compilation of eleven letters and emails, received October 9 to October 24, 2024
22. Letter and attachments from Keith Rootsaert, Founder, Giant Giant Kelp Restoration, and petitioner for 2023-23MPA, received October 24, 2024

Committee Direction/Recommendation

The Marine Resources Committee recommends that the Commission support the Department draft recommendations for petitioned actions in Bin 1 MPA regulation change petitions; and schedule those petitions for action at the February 2024 Commission meeting.

OR

The Marine Resources Committee recommends that the Commission support the Department draft recommendations for petitioned actions in Bin 1 MPA regulation change petitions, except for: _____ for which the MRC recommends: _____, and schedule those petitions for action at the February 2024 Commission meeting.

10C. Department Marine Region Report

Today's Item **Information ☒** **Action ☐**

I. Update on developing recommendations for marine protected area (MPA) regulation changes for Bin 1 petitions (near-term) and proposed next steps for commencing Bin 2 (longer-term) petition evaluations.

Summary of Previous/Future Actions

• Received MPA Decadal Management Review (DMR) report and recommendations	February 8-9, 2023
• Received 20 MPA regulation change petitions	December 13-14, 2023
• Referred 20 MPA petitions to Department for review and to the Commission Marine Resources Committee (MRC) for discussion	February 14-15, 2024
• MRC received and discussed Department-proposed approach for reviewing and evaluating petitions for MPA regulation changes	March 19, 2024; MRC
• Requested Department update on status of adaptive management actions	June 19-20, 2024
• Department presented proposed Phase 1 "binning" of MPA petitions into bin 1 and 2, and MRC developed recommendation	July 17 2024; MRC
• Approved MRC recommendation for bin 1 and bin 2 petitions; requested update on process for bin 2 petitions and proposed timeline	August 14-15, 2024
• **Today's update**	**October 9-10, 2024**

Background

MPA Regulation Change Petitions Review and Evaluation Process Update

In February 2024, the Commission referred 20 MPA regulation change petitions, submitted by the public in December 2023, to the Department for review, evaluation, and recommendation. The Department developed a 3-phased evaluation framework (Exhibit 1) with specific evaluation criteria to begin sorting petitions, which the Commission concurred with in April 2024 based on an MRC recommendation.

The Department subsequently completed Phase 1 of the evaluation process and presented results to MRC in July 2024. In August 2024, the Commission approved the Phase 1 binning as proposed and recommended by MRC (Exhibit 2). The Department highlighted mapping visualization tools — under development in partnership with the California Ocean Protection Council — to assist with understanding and evaluating petitions. The Commission requested that the Department provide a progress update in October 2024 (this meeting) on the evaluation process and timeline.

As requested, for today's meeting the Department has prepared an update on the MPA petition evaluation process and timeline (Exhibit 3) that includes a presentation focused on orienting the full Commission to the work underway through MRC as directed by the Commission. The presentation includes the status of petition evaluation efforts under the approved MPA petition evaluation framework, proposed next steps for pursuing phases 2 and 3 of the petition evaluation framework, and a look ahead at near-term milestones for MRC and Commission meetings in late 2024 to early 2025.

Finally, the Department has just launched a new Marine Protected Area (MPA) Petitions StoryMap. The web-based StoryMap provides information for anyone interested and with internet access to view maps and details for the submitted MPA petitions and view updates on the petition evaluation process. See Exhibit 4 for the Department blog post announcing the site's availability.

Significant Public Comments (N/A)

Recommendation (N/A)

Exhibits

1. Department memo with proposed three-phase MPA petition evaluation process and timeline, dated April 2, 2024 (*for background purposes only*)
2. Department document, "Phase 1 Categorization of MPA Petitions," dated June 20, 2024 *(for background purposes only)*
3. Department presentation, "MPA Petition Evaluation Process Status and Timeline," received October 2, 2024
4. Department Marine Management News blog post: *New Web Page Provides Information on Proposed Changes to the California Marine Protected Area Network*, posted September 30, 2024

Motion (N/A)

State of California
Department of Fish and Wildlife

Received April 4, 2024;
Original signed copy on file

Memorandum

Date: April 2, 2024

To: Melissa Miller-Henson
Executive Director
Fish and Game Commission

From: Charlton H. Bonham
Director

Subject: **Proposed Marine Protected Area Petition Evaluation Process and Timeline**

At their February 14-15, 2024, meeting, the California Fish and Game Commission (CFGC) referred 20 Marine Protected Area (MPA) regulation change petitions to the California Department of Fish and Wildlife (CDFW) for review, evaluation, and recommendation. In addition, the CFGC requested CDFW develop a proposed approach to evaluate the petitions to discuss at the Marine Resources Committee (MRC) meeting on March 19, 2024. After discussion and input from interested stakeholders, the MRC recommended approval of CDFW's proposed 3-phase approach to evaluate MPA petitions. The proposed approach is briefly described below and in the enclosed presentation that was provided to the MRC on March 19, 2024.

Proposed 3-Phase Approach to MPA Petition Evaluation

Phase 1: Petitions will be categorized into two bins using the criteria outlined below to determine which petitions can be evaluated in the near-term and which petitions will require additional policy guidance, information, and/or resources prior to evaluation.

- **Bin 1 petitions:** Petitions that can be evaluated in the ***near-term*** must meet all the following criteria:
  - Policy direction not needed for next phases.
  - Within CFGC authority.
  - Immediate evaluation possible.
  - Limited clarification needed from petitioner.
  - Limited controversy anticipated.

- **Bin 2 petitions:** Petitions that do not meet all the above criteria will be categorized into Bin 2. The analysis of these petitions will be more complex as they will require additional policy guidance, information, and/or resources before they can be evaluated. Due to the complexity of these petitions, these will be evaluated in the ***longer term***.

Phase 2: Separate all Bin 1 petitions into individual actions and proceed to phase 3. Separate Bin 2 petitions into individual actions and identify additional policy guidance, information, and/or resources that are necessary to advance individual actions to phase 3.

Phase 3: Adaptive management evaluation and recommendations. Apply the evaluation framework approved by the CFGC to each petition action. The process will identify which petitions, and/or actions within each petition, would be recommended to be granted, denied, or considered through an alternative pathway.

Proposed MPA Petition Evaluation Anticipated Timeline

- **March-April 2024: Development of Evaluation Framework**
  - Receive and discuss proposed 3-phase evaluation process at the March 19 MRC and April 17 CFGC meetings.
- **April-August 2024: Phase 1— CDFW Sort Petitions into 2 Bins**
  - Discuss proposed bins at the July 18 MRC and August 14 CFGC meetings.
- **August 2024 and beyond: Phases 2 and 3—Separate petitions into individual actions**
  - Receive guidance on Bin 2 actions as needed.
  - Move forward with evaluation on both Bin 1 and 2 actions. Evaluation timelines for Bin 1 and Bin 2 actions will vary.

If you have any questions or need more information, please contact Dr. Craig Shuman, Marine Regional Manager, at (805) 568-1246.

Attachment 1: Proposed Marine Protected Area Petition Evaluation presentation.
Attachment 2: Evaluation Framework

ec: Jenn Eckerle, Deputy Secretary for Ocean and Coastal Policy
Natural Resources Agency

Craig Shuman, D. Env., Region Manager
Marine Region

Becky Ota, Environmental Program Manager
Marine Region

Stephen Wertz, Senior Environmental Scientist
Marine Region

Sara Worden, Environmental Scientist
Marine Region

Department of Fish and Wildlife: Summary of Marine Protected Area (MPA) Regulation Change Petition Framework Discussion

(07/27/23) Revised 08/10/23; Revised 8/17/23

At the California Fish and Game Commission's (CFGC) July 20, 2023 Marine Resources Committee (MRC) meeting, MRC, CFGC staff, California Department of Fish and Wildlife (CDFW) staff, and stakeholders discussed potential next steps in pursuing the MPA Decadal Management Review (DMR) report recommendations and goals. The discussion included a potential framework to assist in evaluation of petitions the CFGC may receive related to changes to the MPA network and management program. At the request of MRC, staff from CDFW summarized the input received at the July 20, 2023 MRC meeting regarding these MPA petition framework considerations.

Broadly, petitions submitted to the CFGC are evaluated on a case by case by basis. To help guide petition development and subsequent review by CDFW, the MRC received the following input for evaluating petitions related to MPAs:

- Compatible with the goals and guidelines of the Marine Life Protection Act (MLPA);
- Help advance one or more of the six goals of the MLPA;
- Garner strong community support; and/or
- Advance adaptive management recommendations under the cornerstones of MPA governance, MPA Management Program activities, and MPA Network Performance outlined in DMR Table 6.1 to ensure that petitions meet MPA management priorities.

The MRC also received input organized by cornerstone as follows:

- MPA Governance:
    - Simplifies regulatory language or enhances public understanding
    - Addresses inaccuracies or discrepancies in regulations
    - Accounts for regional stakeholder group intent identified during the regional MLPA planning process (including MPA-specific goals/objectives and design considerations)
    - Accounts for CDFW's MPA design and management feasibility guidelines
    - Advances tribal stewardship and co-management, consistent with the CFGC Co-Management Vision Statement and Definition
    - Improves access for traditionally underserved or marginalized communities, consistent with the CFGC Policy on Justice Equity, Diversity and Inclusion
    - Acknowledges socio-economic implications, such as access for consumptive or non-consumptive users
- MPA Management Program Activities:
    - Clearly addresses or identifies scientific need for MPA Network based on best available science and scientific advancement since Network completion
    - Improves compliance and/or enforceability
- MPA Network Performance:
    - Maintains or enhances the protections and integrity of the MPA Network
    - Maintains or enhances habitat and species connectivity
    - Adheres to science guidelines, such as maintaining minimum size and spacing, and protection of diverse habitats
    - Enhances climate resilience and/or helps mitigate climate impacts

State of California
Department of Fish and Wildlife

Memorandum

Date: June 27, 2024

To: Melissa Miller-Henson
Executive Director
Fish and Game Commission

From: Craig Shuman, D. Env.
Marine Regional Manager

Subject: **Draft Proposed Phase 1 Categorization of Marine Protected Area Petitions**

At their February 14-15, 2024 meeting, the California Fish and Game Commission (CFGC) referred 20 MPA petitions received to the California Department of Fish and Wildlife (CDFW) for review, evaluation, and recommendation. In addition, they requested CDFW provide an administrative update at their March 19 Marine Resources Committee (MRC) meeting on the approach to evaluate the petitions. After discussion and input from interested stakeholders, the MRC recommended approval of CDFW's proposed 3-phase approach to evaluate petitions, and the CFGC approved the approach at their April 17 meeting. CDFW has completed Phase 1 of the 3-phase approach and will present the proposed draft binning at the July 17, 2024, MRC meeting.

Phase 1 petitions are categorized into two bins using the criteria outlined in the 3-phase approach to determine which petitions can be evaluated in the near-term (Bin 1) and which petitions will require additional policy guidance, information, and/or resources prior to evaluation (Bin 2). CDFW released the draft Phase 1 outcomes to California Native American tribes and the public on May 31, which includes tables that outline the proposed Bin 1 and Bin 2 petitions with brief justifications that describe why petitions are categorized into each bin.

If you have any questions or need more information, please contact Dr. Craig Shuman, Marine Regional Manager, at (805) 568-1246.

Attachment 1: 3-phase approach for MPA Petition review and evaluation

Attachment 2: Draft Proposed Phase 1 Categorization of Marine Protected Area Petition background, Bin 1 and Bin 2 tables, and brief justifications

Attachment 3: Power Point presentation outlining process, proposed binning, and next steps

ec: Jenn Eckerle, Deputy Secretary for Ocean and Coastal Policy
Natural Resources Agency

Stephen Wertz, Senior Environmental Scientist Supervisor
Marine Region

Draft Proposed Phase 1 Categorization of Marine Protected Area Petitions

In 2023, the California Department of Fish and Wildlife (CDFW) publicly released the first 10-year comprehensive review of California's Marine Protected Area (MPA) Network that included 28 adaptive management recommendations prioritizing strategies for the next decade of MPA management. One of the near-term priority recommendations called for applying what was learned from the comprehensive management review to support proposed changes to the MPA Network and Management Program. To advance this recommendation, the California Fish and Game Commission (CFGC) requested that MPA regulation change petitions be submitted for their December 2023 meeting. CFGC received 20 petitions with over 80 unique requests for changes to the MPA Network.

At their February 14-15, 2024 meeting, CFGC referred the 20 MPA petitions received to CDFW for review, evaluation, and recommendation. In addition, they requested CDFW provide an administrative update at their March 19 Marine Resources Committee (MRC) meeting on the approach they would take to evaluate the petitions. After discussion and input from interested stakeholders, the MRC recommended approval of CDFW's proposed 3-phase approach to evaluate MPA petitions, and the CFGC approved the approach at their April 17 meeting. CDFW has completed Phase 1 of the 3-phase approach and will present the proposed binning of petitions for discussion and consideration at the July MRC meeting. In addition to the MRC's regularly scheduled July 18 meeting, the CFGC approved a separate day on July 17 be added to the meeting for this discussion. There will be an update about the outcomes from this meeting at the August 14-15 CFGC meeting.

Petitions are categorized into two bins (Tables 1 and 2) using the criteria outlined below to determine which petitions can be evaluated in the near-term (Bin 1) and which petitions will require additional policy guidance, information, and/or resources prior to evaluation (Bin 2). The proposed binning of petitions by CDFW are recommendations for the MRC to consider at their July 17 meeting. It is anticipated the MRC will make a recommendation on the binning of petitions for the CFGC to consider at their August meeting. ***Inclusion in Bin 1 does not automatically mean the requests in any given petition will be granted.*** Following approval of the binning of petitions by CFGC, CDFW will move forward with the evaluation of Bin 1 petitions for subsequent discussion and consideration by the MRC and CFGC.

Bin 1: Petitions that can be evaluated in the ***near-term*** must meet all the following criteria:

- Policy direction not needed for next phases: The requested changes are consistent with existing policies regarding the MPA Network.
- Within CFGC authority: CFGC has clear regulatory authority over the changes requested in the MPA petitions.
- Immediate evaluation possible: Information and resources are available to evaluate petitions in the near-term
- Limited clarification needed from petitioner: The changes requested in the petitions are clear and understandable.
- Limited controversy anticipated: Changes that have limited impact on human uses and network design, such as minor boundary changes and/or updating regulatory language, are expected to cause limited controversy.

Bin 2: Petitions that do not meet all the above criteria are categorized into Bin 2. The analysis of these petitions will be more complex as they will likely require additional policy guidance, information, and/or resources *before* they move forward into the evaluation phase. Bin 2 petitions that could move forward based on CFGC guidance will be evaluated in the ***longer-term***. In addition, due to the larger breadth and scope of these petitions, they will likely require more extensive coordination with California Native American Tribes, other government agencies, partners, and stakeholders.

The tables below outline the proposed Bin 1 and Bin 2 petitions. There are brief justifications following each table that describe why a metric was met or not, and why petitions are categorized into Bin 1 or Bin 2. CFGC is seeking feedback on the draft proposed binning of petitions into either Bin 1 or Bin 2. Comments should be sent directly to CFGC to inform the discussions scheduled for July 17, 2024 at the MRC meeting. Written comments must be received by CFGC by July 5 to be included in the July MRC meeting materials. The CFGC website includes instructions for how to submit written comments and a schedule of upcoming Commission meetings.

Table 1: Proposed Bin 1 Petitions. N=No, Y=Yes. Y/N in the "Within CFGC Authority?" column indicates that some of the actions proposed in the petition do fall within the regulatory authority of the CFGC, while others are non-regulatory requests. MPA designations state marine reserve (SMR), state marine conservation area (SMCA).

CFGC Tracking No.	Name of Petitioner	Short Description	Policy guidance needed?	Within CFGC Authority?	Evaluate in the near-term?	Clarification needed from petitioner?	Limited controversy anticipated?
2023-22MPA	Wendy Berube, Orange County Coast Keeper	Change color coding on outreach maps, add language to tidepool take prohibitions, modify definition of tidepools, and allow research, monitoring, restoration, and education in Orange County MPAs, with the exception of Upper Newport Bay (Bolsa Chica, Laguna Beach, Crystal Cove, and Dana Point)	N	Y/N	Y	N	Y
2023-25MPA	Burton Miller	Change color designation of Blue Cavern Onshore and Casino Point SMCAs, change boundary of Long Point SMR, and remove allowance for feeding fish and Lover's Cove and Casino Point SMCAs.	N	Y/N	Y	N	Y
2023-26MPA	Lisa Gilfilan, WILDCOAST	Shift Swami's SMCA south from the lifeguard tower to the State/Solana Beach line to cover tidepools on the south side and change map color of no-take SMCAs at Batiquitos Lagoon, San Elijo Lagoon, and Famosa Slough from purple to red.	N	Y/N	Y	N	Y
2023-30MPA_1	Robert Jamgochian	Change gear restrictions within Big River SMCA to only allow Type A hoop nets that are compatible and eliminate the hoop net Type B option (rigid frame) from general provisions, reduce the number of set traps allowed from 10 to 5, and reduce the bag and possession limit for recreational take of crabs from 10 to 5.	N	Y	Y	N	Y
2023-31MPA_1	Ashley Eagle-Gibbs, Environmental Action Committee of West Marin	Subsume Drake's Estero SMCA into Estero de Limantour SMR to create a single SMR.	N	Y	Y	N	Y

Justifications for Proposed Bin 1 Petitions

Proposed Bin 1 petitions do not need policy direction from the CFGC to move forward with evaluation, are within CFGC regulatory authority, can be evaluated in the near-term, require minimal follow-up with the petitioner, and limited controversy is anticipated regarding petition requests. Justifications for each criterion are outlined below.

Petition Number: 2023-22MPA

Petitioner: Wendy Berube, Orange County Coastkeeper

- **Is policy guidance needed for the next phase of evaluation? (N):** Changes requested do not require policy guidance from CFGC.
- **Does the petition fall within CFGC regulatory authority? (Y/N):**
    - Modifying the descriptions of specific MPAs and updating regulatory language are within CFGC authority.
    - Changing the color of a purple no-take SMCA to red *on outreach materials only* is a non-regulatory request. However, alternative pathways for this and other similar non-regulatory requests may be explored as a part of the 3-phase approach to evaluate petitions.
- **Is immediate evaluation possible? (Y):** Related information and data needed to evaluate petition are currently available.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (Y):** Limited controversy anticipated because the requested changes are to simplify and clarify regulatory language.

Petition Number: 2023-25MPA

Petitioner: Burton Miller

- **Is policy guidance needed for the next phase of evaluation? (N):** Changes requested do not require policy guidance from CFGC.
- **Does the petition fall within CFGC regulatory authority? (Y/N):**
    - Boundary clarification at Long Point SMR, and the proposed removal of fish feeding from the regulations all fall within the CFGC's authority.
    - Changing the color of a purple no-take SMCA to red *on outreach materials only* is a non-regulatory request. However, alternative pathways for this and other similar non-regulatory requests may be explored as a part of the 3-phase approach to evaluate petitions.
- **Is immediate evaluation possible? (Y):** Related information and data needed to evaluate petition are currently available.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (Y):** Limited local controversy is anticipated regarding the request to end fish feeding within the Lover's Cove and Casino Point SMCAs.

Petition Number: 2023-26MPA
Petitioner: Lisa Gilfillan, WILDCOAST

- **Is policy guidance needed for the next phase of evaluation? (N):** Changes requested do not require policy guidance from CFGC.
- **Does the petition fall within CFGC regulatory authority? (Y/N):**
    - Changing the boundaries of an MPA is within CFGC authority.
    - Changing the color of a purple no-take SMCA to red *on outreach materials only* is a non-regulatory request. However, alternative pathways for this and other similar non-regulatory requests may be explored as a part of the 3-phase approach to evaluate petitions.
- **Is immediate evaluation possible? (Y):** Related information and data needed to evaluate petition are currently available.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (Y):** Limited local controversy is anticipated regarding the proposed boundary shift.

Petition Number: 2023-30MPA
Petitioner: Robert Jamgochian

- **Is policy guidance needed for the next phase of evaluation? (N):** Changes requested do not require policy guidance from CFGC.
- **Does the petition fall within CFGC regulatory authority? (Y):** The proposed amendments to the allowed take and gear type are within CFGC authority.
- **Is immediate evaluation possible? (Y):** Related information and data needed to evaluate petition are currently available.
- **Is clarification needed from the petitioner? (N):** Limited clarification with the petitioner may be necessary to determine the request for Type A hoop nets only.
- **Is limited controversy anticipated? (Y):** Limited local controversy is anticipated regarding proposed change in Dungeness crab take regulations.

Petition Number: 2023-31MPA
Petitioner: Ashley-Eagle Gibbs, Environmental Action Committee of West Marin

- **Is policy guidance needed for the next phase of evaluation? (N):** Changes requested do not require policy guidance from the CFGC. The requested redesignation aligns with the intent of this MPA identified during the north central coast marine life protection act (MLPA) Initiative design and siting process to redesignate as an SMR once the pre-existing aquaculture lease was terminated.
- **Does the petition fall within CFGC regulatory authority? (Y):** The proposed amendments to the allowed take and gear type are within CFGC authority.
- **Is immediate evaluation possible? (Y):** Related information and data needed to evaluate petition are currently available.

- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (Y):** Limited local controversy regarding ending recreational clamming. This petition is consistent with the recommendation of the northcentral coast MLPA regional stakeholder group at the end of the MLPA Initiative design and siting process.

Table 2: Proposed Bin 2 Petitions. N=No, Y=Yes. Y/N in the "Within CFGC Authority?" column indicates that some of the actions proposed in the petition do fall within the regulatory authority of the CFGC, while others are non-regulatory requests. MPA designations state marine reserve (SMR), state marine conservation area (SMCA).

CFGC Tracking No.	Name of Petitioner	Short Description	Policy guidance needed?	Within FGC Authority?	Evaluate in the near-term?	Clarification needed from petitioner?	Limited controversy anticipated?
2023-14MPA	David Goldberg, California Sea Urchin Commission	Allow commercial take of sea urchins in 9 SMCAs.	Y	Y	N	N	N
2023-15MPA	Blake Hermann	Reclassify three SMRs in the northern Channel Islands, Santa Barbara County, as SMCAs and allow either the limited take of highly migratory species and possession of coastal pelagic species, or allow the take of pelagic finfish.	Y	Y	N	N	N
2023-16MPA	Richard Ogg	Reclassify Stewarts Point and Bodega Head SMRs and SMCAs to allow commercial take of salmon by trolling.	Y	Y	N	N	N
2023-18MPA	Greg Helms	Create small SMCA within Vandenberg SMR; modify multiple MPAs within the Santa Barbara Channel to allow range of activities, from changes to take of natural resources restrictions to vessel landing requirements.	Y	Y/N	N	N	N
2023-19MPA	Sam Cohen, Santa Ynez Band of Chumash Mission Indians	Designate new Chitaqwi SMCA with a tribal take-exemption for the Santa Ynez Band of Chumash Indians along the central coast.	Y	Y	N	Y	N
2023-20MPA	Sam Cohen, Santa Ynez Band of Chumash Mission Indians	Add a tribal take exemption to Point Buchon SMCA for co-management with Santa Ynez Band of Chumash Indians, and modify northern boundary of the Point Buchon SMR.	Y	Y	N	Y	N
2023-21MPA	Rosa Laucci, Tolowa Dee-ni' Nation	Modify take allowances in Pyramid Point SMCA to no-take with tribal exemption and change northern boundary to align with California/Oregon border.	Y	Y	N	Y	N

CFGC Tracking No.	Name of Petitioner	Short Description	Policy guidance needed?	Within FGC Authority?	Evaluate in the near-term?	Clarification needed from petitioner?	Limited controversy anticipated?
2023-23MPA	Keith Rootsaert, Giant Giant Kelp	Reclassify three SMCAs as SMRs, designate Tanker's Reef as an SMR, allow kelp restoration in these four MPAs as follows: allow unlimited urchin take, allow outplanting of kelp, kelp spore dispersal, and kelp canopy pruning without a DFW scientific collecting permit (SCP). Proposes several actions to support kelp restoration such as placement of buoys at restoration sites, establishing a new process for restoration permits in DFW SCP program, designating "adopted reefs," and others.	**Y**	**Y/N**	**N**	**Y**	**N**
2023-24MPA	Mike Beanan, Laguna Bluebelt Coalition	Extend Laguna no-take SMCA southern boundary to the southern border of City of Laguna Beach, which will require modification of northern boundary of Dana Point SMCA.	**N**	**Y**	**N**	**N**	**N**
2023-27MPA	Azsha Hudson, Environmental Defense Center	Reclassify Anacapa SMCA as an SMR or reclassify the portion of the SMCA from shore to at least 30 meters deep.	**Y**	**Y**	**N**	**N**	**N**
2023-28MPA	Lisa Suatoni, Natural Resources Defense Council	Designate a new SMR around Point Sal in central California and consult with tribes first to determine whether an SMCA with exemptions for cultural and subsistence purposes.	**Y**	**Y**	**N**	**N**	**N**
2023-29MPA_1	Lisa Suatoni, Natural Resources Defense Council	Designate Mishopshno SMCA, a California-Chumash co-management MPA that allows take by members of Santa Ynez Band of Chumash Indians for traditional, ceremonial, cultural, and subsistence purposes.	**Y**	**Y**	**N**	**Y**	**N**
2023-32MPA_1	Ashley Eagle-Gibbs, Environmental Action Committee of West Marin	Change Duxbury Reef SMCA to an SMR, extend the southern boundary further south, and extend the northern boundary to the Double Point Special Closure.	**Y**	**Y**	**N**	**N**	**N**
2023-33MPA_1	Laura Deehan, Environmental California Research and Policy Center and Azul	Expand boundaries of SMCAs and SMRs, and designate new MPA.	**Y**	**Y**	**N**	**N**	**N**

CFGC Tracking No.	Name of Petitioner	Short Description	Policy guidance needed?	Within FGC Authority?	Evaluate in the near-term?	Clarification needed from petitioner?	Limited controversy anticipated?
2023-34MPA_1	Laura Deehan, Environmental California Research and Policy Center and Azul	Reclassify Point Buchon SMCA as an SMR, and modify regulations of Farnsworth Onshore and Offshore SMCAs to allow only recreational spearfishing.	**Y**	**Y**	**N**	**N**	**N**

Justifications for Proposed Bin 2 Petitions

Petitions that do not meet the above criteria for Bin 1 petitions are categorized into Bin 2. The analysis of these petitions will be more complex as they will likely require additional policy guidance, information, and/or resources, before they can be evaluated. Below are brief justifications that describe why a metric was met or not.

Petition Number: 2023-14MPA
Petitioner: David Goldenberg, California Sea Urchin Commission

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance regarding changing take regulations in SMCAs over a large geographic scale.
- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.
- **Is immediate evaluation possible? (N):**
    - Requested changes will require coordination with other management priorities such as the Kelp Restoration, Recovery, and Management Plan (KRMP) and updates to invertebrate take regulations.
    - A more in-depth examination of the original MPA design guidance will be needed for this petition before staff can analyze the proposed change.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (N):** Changing take regulations in several MPAs statewide is likely to be controversial.

Petition Number: 2023-15MPA
Petitioner: Blake Hermann

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance regarding re-designation of entire SMRs into SMCAs.
- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.
- **Is immediate evaluation possible? (N):** Requested changes will require in-depth analysis of many resources and extensive coordination with external partners, including but not limited to the Channel Islands National Marine Sanctuaries, National Parks Service, and National Marine Fisheries Service.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (N):** Redesignating SMRs to SMCAs is likely to be controversial.

Petition Number: 2023-16MPA
Petitioner: Richard Ogg

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance regarding re-designation of entire SMRs to SMCAs.
- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.

- **Is immediate evaluation possible? (N):** Requested changes will require coordination with other management efforts regarding the ocean salmon fishery.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (N):** Redesignating SMRs to SMCAs is likely to be controversial.

Petition Number: 2023-18MPA

Petitioner: Greg Helms

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance regarding partial designation change of an SMR to an SMCA and modifications to special closures.
- **Does the petition fall within CFGC regulatory authority? (Y/N):**
    - Creation of an SMCA and modifications to, or removal of, an existing state MPA or special closure are within CFGC authority.
    - Continued support of M2 radar is a non-regulatory request. Changing the color of a purple, no-take SMCAs to red *on outreach materials only* is a non-regulatory request. However, alternative pathways for this and other similar non-regulatory requests may be explored as a part of the 3-phase approach to evaluate petitions.
- **Is immediate evaluation possible? (N):** Evaluation of this petition will require coordination with many external partners including National Marine Sanctuaries and the National Park Service. A more in-depth examination of the original MPA design guidance will also be needed to analyze the proposed changes.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (N):** The partial redesignation and changes to special closures around the Channel Islands are likely to be controversial.

Petition Number: 2023-19MPA

Petitioner: Sam Cohen, Santa Ynez Band of Chumash Mission Indians

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance regarding approach to co-management of MPAs with California Native American Tribes and creation of new MPAs.
- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.
- **Is immediate evaluation possible? (N**): Requested changes will require coordination with the California Natural Resources Agency, other state and federal agencies, local jurisdictions, and other partners regarding policies for co-management of the state's natural resources with California Native American Tribes.
- **Is clarification needed from the petitioner? (Y):** Additional clarification needed from the petitioner regarding the definition of tribal co-management in the context of this petition and proposed regulation changes.
- **Is limited controversy anticipated? (N):** Establishing a new MPA is likely to be controversial.

Petition Number: 2023-20MPA

Petitioner: Sam Cohen, Santa Ynez Band of Chumash Mission Indians

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance on approach to co-management of MPAs with California Native American Tribes and changes in take regulations of an SMCA.
- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.
- **Is immediate evaluation possible? (N):** Requested changes will require coordination with the California Natural Resources Agency, other state and federal agencies, local jurisdictions, and other partners regarding policies for co-management of the state's natural resources with California Native American Tribes.
- **Is clarification needed from the petitioner? (Y):** Significant clarification is needed from the petitioner regarding the definition of tribal co-management in the context of this petition.
- **Is limited controversy anticipated? (N):** Decreasing the level of protection of an SMCA and proposed differences in take allowances by diverse sectors are likely to be controversial.

Petition Number: 2023-21MPA

Petitioner: Rosa Laucci, Tolowa Dee-ni' Nation

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance on approach to co-management of MPAs with California Native American Tribes and the creation of a tribal take-only MPA.
- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.
- **Is immediate evaluation possible? (N):** Requested changes will require coordination with the California Natural Resources Agency, other state and federal agencies, local jurisdictions, and other partners regarding policies for co-management of the state's natural resources with California Native American Tribes.
- **Is clarification needed from the petitioner? (Y):** Clarification is needed from the petitioner about the tribal take exemption.
- **Is limited controversy anticipated? (N):** Creating a tribal-take only MPA and proposed differences in take allowances by diverse sectors are likely to be controversial.

Petition Number: 2023-23MPA

Petitioner: Keith Rootsaert, Giant Giant Kelp Restoration

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance regarding redesignation of entire MPAs and creation of new MPAs.
- **Does the petition fall within CFGC regulatory authority? (Y/N):** Several requested changes are within CFGC authority, while many are non-regulatory requests.
- **Is immediate evaluation possible? (N):** Several requested changes will require coordination with other management priorities such as the KRMP and updates to statewide invertebrate take regulations. Evaluation of the requested changes will require in-depth analysis and coordination with many partners including National Marine Sanctuaries and several other state agencies.
- **Is clarification needed from the petitioner? (Y):** The scope of changes requested in this petition are extensive and complex and will require extensive coordination with the petitioner.

- **Is limited controversy anticipated? (N):** Establishment of new MPAs is likely to be controversial. Stakeholders in the Monterey area have consistently provided public comments on prior CFGC actions like those proposed within the petition, indicating a high degree of anticipated controversy on other petition components.

Petition Number: 2023-24MPA

Petitioner: Mike Beanan, Laguna Bluebelt Coalition

- **Is policy guidance needed for the next phase of evaluation? (N):** Changes requested do not require policy guidance from the CFGC.
- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.
- **Is immediate evaluation possible? (N):** A more in-depth examination of the original MPA design guidance will be needed for this petition to analyze the proposed change.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (N):** Public comments/letters have already been received by CDFW and CFGC about this petition, indicating a high degree of anticipated controversy.

Petition Number: 2023-27MPA

Petitioner: Azsha Hudson, Environmental Defense Center

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance regarding re-designation of SMCA to SMR. The requested change does not align with the intent of this MPA identified during the Channel Islands planning process and would affect current tribal take allowances.
- **Does the petition fall within CFGC regulatory Authority? (Y):** All requested regulatory changes are within CFGC authority.
- **Is immediate evaluation possible? (N):** Evaluation of this petition will require coordination with the Santa Ynez Band of Chumash Mission Indians and many external partners including National Marine Sanctuaries, National Marine Fisheries Service, and the National Park Service. A more in-depth examination of the original MPA design guidance will also be needed to analyze the proposed changes.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (N):** Re-designation of entire MPA, effects on tribal take exemptions, and effects of proposed changes to the commercial and recreational lobster fisheries are likely to be controversial.

Petition Number: 2023-28MPA

Petitioner: Lisa Suatoni, Natural Resources Defense Council

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance regarding the creation of new MPAs.
- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.

- **Is immediate evaluation possible? (N):** Requested changes will require coordination with the California Natural Resources Agency, other state and federal agencies, local jurisdictions, and other partners regarding policies for co-management of the state's natural resources with California Native American Tribes.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (N):** Establishment of a new MPA is likely to be controversial.

Petition Number: 2023-29MPA

Petitioner: Lisa Suatoni, Natural Resources Defense Council

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance regarding the creation of new MPAs.
- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.
- **Is immediate evaluation possible? (N):** Requested changes will require coordination with the California Natural Resources Agency, other state and federal agencies, local jurisdictions, and other partners regarding policies for co-management of the state's natural resources with California Native American Tribes. A more in-depth examination of the original MPA design guidance will be needed for this petition before staff can analyze the proposed change.
- **Is clarification needed from the petitioner? (Y):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (N):** Establishment of a new MPA is likely to be controversial.

Petition Number: 2023-32MPA

Petitioner: Ashley Eagle-Gibbs, Environmental Action Committee of West Marin

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance regarding the redesignation of an SMCA to an SMR that does not align with MLPA design process intent of the MPA and expansion of the existing MPA.
- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.
- **Is immediate evaluation possible? (N):** A more in-depth examination of the original MPA science design guidance will be needed to analyze the proposed change.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (N):** Due to this site being a popular area for human use, a designation change and boundary expansion are likely to be controversial.

Petition Number: 2023-33MPA

Petitioner: Laura Deehan, Environment California Research and Policy Center and Azul

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance regarding the redesignations of SMCAs to an SMRs that do not align with MLPA design process intent of the MPA, creation of a new MPA, and expansion of existing MPAs.

- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.
- **Is immediate evaluation possible? (N):** Because this petition's stated intent is to assist in kelp forest recovery, this petition will need to be evaluated in concert with the KRMP, which is not yet complete.
- **Is clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (N)** Creation of a new MPA and large expansion of existing MPAs are likely to be controversial. There has already been significant local stakeholder discussion regarding the proposed Pleasure Point MPA in Santa Cruz County.

Petition Number: 2023-34MPA

Petitioner: Laura Deehan, Environment California Research and Policy Center and Azul

- **Is policy guidance needed for the next phase of evaluation? (Y):** Requires guidance on the redesignation of the SMCA to an SMR that does not align with MLPA design process intent of the MPA.
- **Does the petition fall within CFGC regulatory authority? (Y):** All requested regulatory changes are within CFGC authority.
- **Is immediate evaluation possible? (N):** Analysis will require a more in-depth examination of the original MPA design guidance regarding the proposed changes.
- **Is Clarification needed from the petitioner? (N):** Changes requested are straightforward and do not require detailed clarification from petitioner.
- **Is limited controversy anticipated? (N):** Anticipated to be highly controversial with the recreational and commercial fishing communities in the areas of the proposed changes.

Draft Phase 1 Proposed Marine Protected Area Petition Bins

17 July 2024

Presented to:

Marine Resources Committee

California Fish and Game Commission

Presented by:

Dr. Craig Shuman

Marine Regional Manager

How We Got Here: DMR Report and Petition Timeline

2023 Jan-Feb

Public release
CFGC receives DMR report

2023 Mar-Aug

Public meetings:
Discuss DMR results and recommendations

2023 Nov-Dec

MPA Petitions submitted to CFGC

2024 and beyond

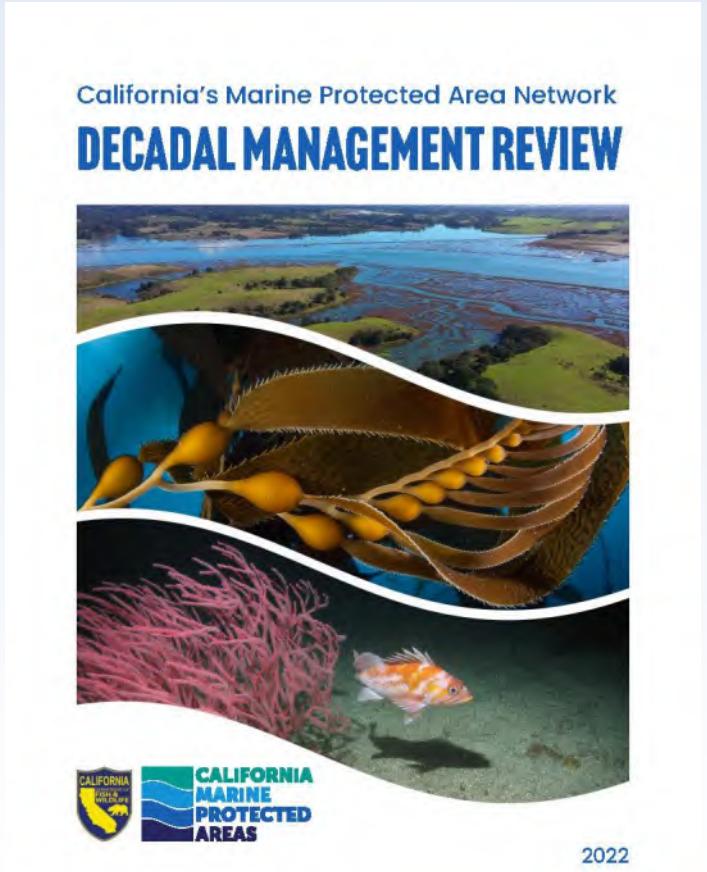
Policy guidance on petitions and evaluation

CFGC=California Fish and Game Commission
CDFW=California Department of Fish and Wildlife
DMR=Decadal Management Review

CALIFORNIA MARINE PROTECTED AREAS

Petitions for Proposed MPA Network Changes

- CFGC received **20 petitions** to change MPAs at the December 2023 meeting
- **16 individual organizations** submitted petitions
- Petitions include **80+ proposed petition actions**
- **49+ MPAs and special closures affected** by proposals



Where We Are: MPA Petition Process 2024

2024 and beyond

Policy guidance on petitions and evaluation

- **February 2024 -** CFGC referred all petitions to CDFW for evaluation
- **March 2024 –** CDFW proposed 3-phased approach to petition evaluation process
- **April 2024 –** CFGC accepted CDFW's approach
- **May 2024 –** CDFW released a blog with the draft petition binning for public review
- **July 2024 -** Marine Resources Committee discussion

Petition Evaluation Framework: 3-phase Approach

Phase 1: Bin whole petitions

→

Phase 2: Separate petitions into individual actions to determine evaluation pathway

→

Phase 3: Adaptive management evaluation and recommendations

Phase 1: Bin Whole Petitions

Phase 1:
Bin whole petitions

Bin 1

- Policy direction not needed for next phases
- Within CFGC authority
- Immediate evaluation possible
- Limited clarification needed from petitioner
- Limited controversy anticipated

Bin 2

Do not meet criteria for Bin 1

Draft Proposed Bin 1 Petitions

CFGC Tracking No.	Brief description	Policy guidance needed?	Within CFGC authority?	Evaluate in the near-term?	Clarification needed from petitioner?	Limited controversy anticipated?
2023-22MPA	Orange County MPAs; change color coding on outreach maps, update regulatory language	**N**	**Y/N**	**Y**	**N**	**Y**
2023-25MPA	Catalina Island MPAs; change color coding on outreach maps, remove fish feeding; boundary update	**N**	**Y/N**	**Y**	**N**	**Y**
2023-26MPA	San Diego County MPAs; change color coding on outreach maps; Swami's SMCA boundary shift	**N**	**Y/N**	**Y**	**N**	**Y**
2023-30MPA_1	Big River SMCA; change Dungeness crab gear and take limits	**N**	**Y**	**Y**	**N**	**Y**
2023-31MPA_1	Drake's Estero SMCA; subsume into Estero de Limantour SMR	**N**	**Y**	**Y**	**N**	**Y**

Draft Proposed Bin 2 Petitions (1 of 3)

CFGC Tracking No.	Brief description	Policy guidance needed?	Within CFGC authority?	Evaluate in the near-term?	Clarification needed from petitioner?	Limited controversy anticipated?
2023-14MPA	Allow commercial take of sea urchins in 9 SMCAs	**Y**	**Y**	**N**	**N**	**N**
2023-15MPA	Northern Channel Island MPAs; allow take of highly migratory species; pelagic finfish	**Y**	**Y**	**N**	**N**	**N**
2023-16MPA	Bodega Head and Stewarts Point SMRs; redesignate to SMCAs to allow commercial salmon trolling	**Y**	**Y**	**N**	**N**	**N**
2023-18MPA	Santa Barbara County MPAs; modify take allowances; modify special closures; create small SMCA within Vandenberg SMR	**Y**	**Y/N**	**N**	**N**	**N**
2023-19MPA	Designate new tribal SMCA with take exemption for the Santa Ynez Band of Chumash Mission Indians	**Y**	**Y**	**N**	**Y**	**N**

Draft Proposed Bin 2 Petitions (2 of 3)

CFGC Tracking No.	Brief description	Policy guidance needed?	Within CFGC authority?	Evaluate in the near-term?	Clarification needed from petitioner?	Limited controversy anticipated?
2023-20MPA	Point Buchon MPAs; tribal take exemption for Santa Ynez Band of Chumash Mission Indians, boundary shift	**Y**	**Y**	**N**	**Y**	**N**
2023-21MPA	Pyramid Point SMCA; tribal take only for Tolowa Dee-ni' Nation, boundary adjustment	**Y**	**Y**	**N**	**Y**	**N**
2023-23MPA	Monterey County MPAs; designation changes, new permitting process, various other activities	**Y**	**Y/N**	**N**	**Y**	**N**
2023-24MPA	Laguna Beach no-take SMCA boundary shift	**N**	**Y**	**N**	**N**	**N**
2023-27MPA	Anacapa SMCA; redesignation to SMR, or partial redesignation	**Y**	**Y**	**N**	**N**	**N**

Draft Proposed Bin 2 Petitions (3 of 3)

CFGC Tracking No.	Brief description	Policy guidance needed?	Within CFGC authority?	Evaluate in the near-term?	Clarification needed from petitioner?	Limited controversy anticipated?
2023-28MPA	San Luis Obispo County; new MPA near Point Sal	**Y**	**Y**	**N**	**N**	**N**
2023-29MPA_1	Santa Barbara County; new tribal co-management MPA with Santa Ynez Band of Mission Indians	**Y**	**Y**	**N**	**Y**	**N**
2023-32MPA_1	Duxbury Reef SMCA; redesignate to SMR and expand boundaries	**Y**	**Y**	**N**	**N**	**N**
2023 33MPA_1	Expand boundaries of multiple SMCAs and SMRs; designate new MPA	**Y**	**Y**	**N**	**N**	**N**
2023-34MPA_1	Redesignate Point Buchon SMCA to SMR; modify take allowances in Farnsworth SMCAs	**Y**	**Y**	**N**	**N**	**N**

Next Steps: Implement DMR Recommendations

Near-Term (ongoing – 2 years)

- Rec 1: Improve state agencies tribal engagement
- Rec 4: Apply Review knowledge to Network/Management changes ★
- Rec 7: Expand outreach and education materials
- Rec 9: Continue OPC coordination
- Rec 10: Improve coordination across Management Program pillars
- Rec 11: Update Action Plan
- Rec 16: More targeted outreach to specific audiences
- Rec 17: Improve SCP process
- Rec 18: Use policy to review MPA restoration/mitigation efforts
- Rec 20: Increase enforcement capacity
- Rec 21: Enhance citation record keeping and management
- Rec 25: Implement MPA climate change research
- Rec 27: Improve understanding of MPA effects on fisheries

Mid-Term (2 – 5 years)

- Rec 2: Create pathway to tribal MPA management
- Rec 3: Build tribal capacity to participate in MPA management
- Rec 6: Include and fund more diverse researchers and stakeholders
- Rec 8: Evaluate MPA accessibility
- Rec 12: Improve understanding of human dimensions
- Rec 13: Explore innovative technologies
- Rec 14: Develop MPA community science strategy
- Rec 15: Evaluate Outreach needs and resource effectiveness
- Rec 22: Increase knowledge on MPA judicial outcomes
- Rec 23: Examine MPA Network design attribute more effectively
- Rec 26: Consider climate change in human dimensions monitoring
- Rec 28: Integrate influencing factors into MPA performance evaluations

Long-Term (5- 10 years)

- Rec 5: Establish targets to meet MLPA goals
- Rec 19: Create MPA Enforcement Plan
- Rec 24: Better incorporate marine cultural heritage into MPA Network

Roadmap for Today's Discussion

- **Draft bins and justifications**
  - Move petitions?
  - Change criteria outcomes and justifications?
- **Evaluation process and timeline**
  - Phase 2: Individual actions
  - Policy guidance
  - Extent of evaluations and trade-offs
- **Next steps and MRC recommendations for August CFGC meeting**

Scan for draft bins and justifications

A. Van Diggelen

Marine Protected Area Petition Evaluation Process Status and Timeline

9 October 2024

Presented to:

California Fish and Game Commission

Presented by:

Dr. Craig Shuman

Marine Regional Manager

Recap: Decadal Management Review and Petition Timeline

2023 Jan-Feb

Public release CFGC receives DMR report

2023 Mar-Aug

Public meetings: Discuss DMR results and recommendations

2023 Nov-Dec

MPA Petitions submitted to CFGC

2024 and beyond

Petition evaluation framework

Common acronyms:
CFGC=California Fish and Game Commission
CDFW=California Department of Fish and Wildlife
DMR=Decadal Management Review

CALIFORNIA MARINE PROTECTED AREAS

Where We Are: MPA Petition Process

2024 to date

Petition evaluation framework

- **February:** CFGC referred all 20 received petitions to CDFW for evaluation.
- **March – May:** CFGC approval of CDFW's proposed 3 phase evaluation approach; CDFW completes phase 1.
- **June:** CFGC requested an update on the other DMR recommendations.
- **July:** Marine Resource Committee (MRC) approved phase 1 outcomes.
- **August:** CFGC approved phase 1 outcomes, requests update in Oct. meeting and draft recommendations for Bin 1 petitions at Nov. MRC.

Petition Evaluation Framework: Status

Proposed Next Steps For Bin 2 Petitions: Phases 2 and 3

Bin 2 Petition Actions

Do they meet Bin 1 criteria?

- Policy direction not needed for next phases
- Within CFGC authority
- Immediate evaluation possible
- Limited clarification needed from petitioner
- Limited controversy anticipated

YES → **Move forward to Phase 3 evaluation**

NO → **Policy guidance, information, resources**

Approved MPA Petition Evaluation Framework

- Compatible with the goals and guidelines of the Marine Life Protection Act (MLPA);
- Help advance one or more of the six goals of the MLPA;
- Garner community support; and/or
- Advance DMR adaptive management recommendations.

Petition Evaluation Framework Example Considerations

Compatible with MLPA goals and MPA Master Plan Guidelines, e.g.

- Maintains or enhances the protections, resiliency, connectivity, of the MPA Network
- Adheres to science design and CDFW management feasibility guidelines
- Accounts for the regional stakeholder group intent
- Improves enforceability and compliance

Advances DMR Recommendations, e.g.

- Advances tribal stewardship and co-management
- Improves access for traditionally underserved communities
- Acknowledges socioeconomic implications
- Clearly addresses scientific need based on DMR results
- Simplifies/clarifies regulatory language

Garners Community Support

- Commission Guidance needed to define "community support“
- Example: Aligns with management priorities of other agencies with overlapping jurisdictions

Looking Ahead: MPA Petition Evaluation Process

2024 and beyond

Petition evaluation framework

- **November Marine Resources Committee:**
  - Draft Bin 1 actions and CDFW recommendations
  - Draft sorting of Bin 2 actions and next steps
- **December CFGC:**
  - Final CDFW Bin 1 recommendations and next steps
  - MPA Management Program annual report
- **March 2025 Marine Resources Committee:**
  - Draft CDFW recommendations on Bin 2 actions

CALIFORNIA MARINE PROTECTED AREAS

Next Steps: Implement DMR Recommendations

Near-Term (ongoing – 2 years)

- Rec 1: Improve state agencies tribal engagement
- Rec 4: Apply Review knowledge to Network/Management changes ★
- Rec 7: Expand outreach and education materials
- Rec 9: Continue OPC coordination
- Rec 10: Improve coordination across Management Program pillars
- Rec 11: Update Action Plan
- Rec 16: More targeted outreach to specific audiences
- Rec 17: Improve SCP process
- Rec 18: Use policy to review MPA restoration/mitigation efforts
- Rec 20: Increase enforcement capacity
- Rec 21: Enhance citation record keeping and management
- Rec 25: Implement MPA climate change research
- Rec 27: Improve understanding of MPA effects on fisheries

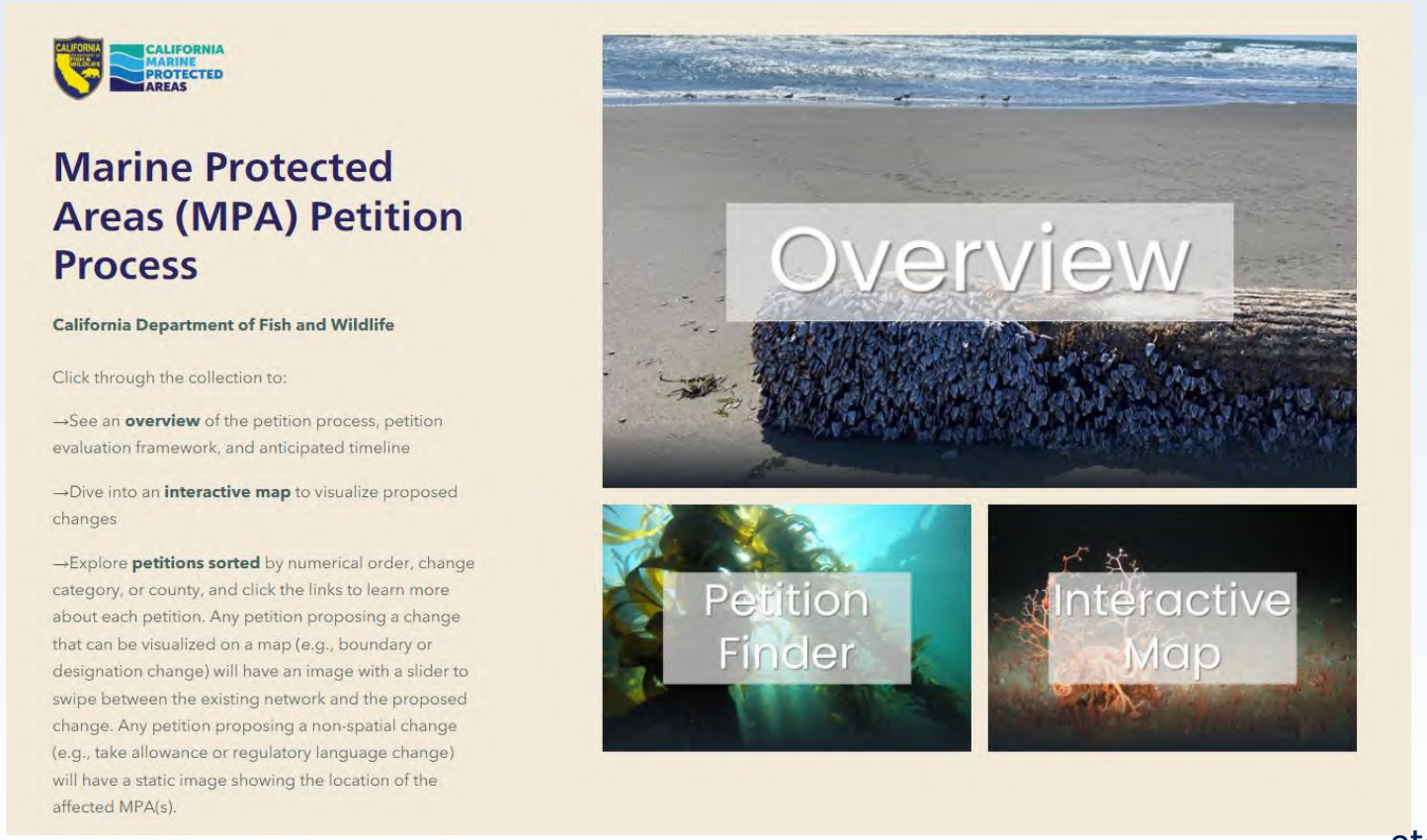
Mid-Term (2 – 5 years)

- Rec 2: Create pathway to tribal MPA management
- Rec 3: Build tribal capacity to participate in MPA management
- Rec 6: Include and fund more diverse researchers and stakeholders
- Rec 8: Evaluate MPA accessibility
- Rec 12: Improve understanding of human dimensions
- Rec 13: Explore innovative technologies
- Rec 14: Develop MPA community science strategy
- Rec 15: Evaluate Outreach needs and resource effectiveness
- Rec 22: Increase knowledge on MPA judicial outcomes
- Rec 23: Examine MPA Network design attribute more effectively
- Rec 26: Consider climate change in human dimensions monitoring
- Rec 28: Integrate influencing factors into MPA performance evaluations

Long-Term (5- 10 years)

- Rec 5: Establish targets to meet MLPA goals
- Rec 19: Create MPA Enforcement Plan
- Rec 24: Better incorporate marine cultural heritage into MPA Network

MPA Petition Updates: StoryMap



Explore and stay up-to-date!

storymaps.arcgis.com/collections/27e78c677dca484ebfb37120abc59d10

Thank You

Questions?

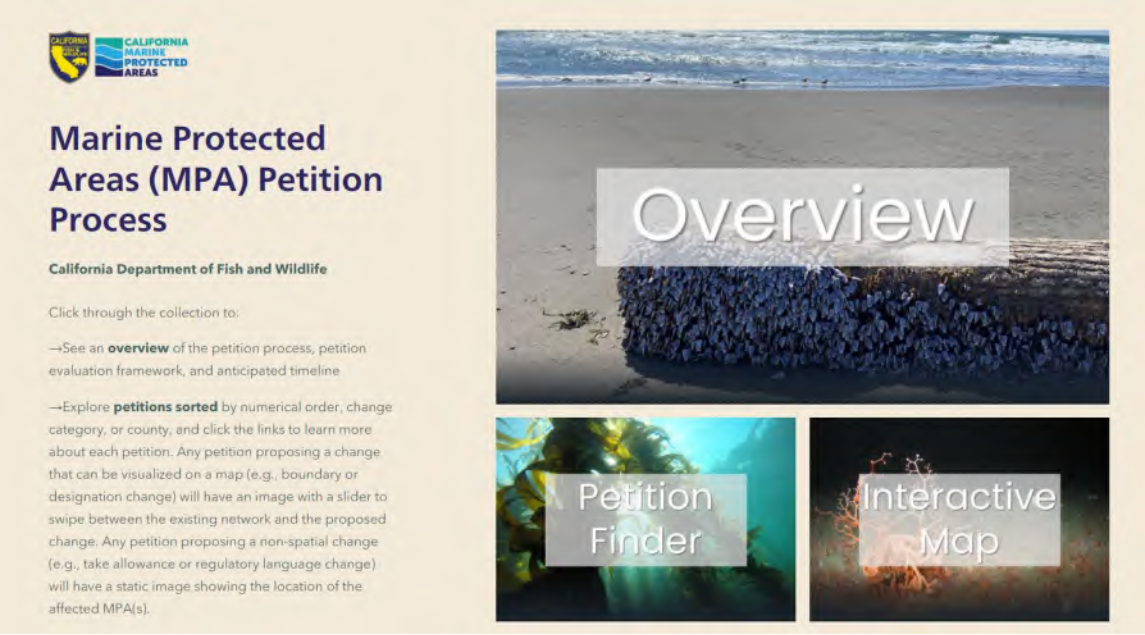
fgc@fgc.ca.gov

mpamanagementreview@wildlife.ca.gov

Marine Management News

New Web Page Provides Information on Proposed Changes to California Marine Protected Area Network

September 30, 2024



Landing page for CDFW's new MPA StoryMap, which describes petitions for changes to California MPAs

The California Department of Fish and Wildlife is happy to announce the launch of a new Marine Protected Area (MPA) Petitions StoryMap to help provide information about 20 petitions for changes to the California MPA Network. These petitions collectively propose more than 80 individual changes to California MPAs.

Each of these proposed changes can be visualized on maps housed in the MPA Petitions StoryMap. Visitors may browse among individual web pages that provide maps and details on each petition.

The MPA Petitions StoryMap overview page includes:

Up-to-date information on the individual petitions

An overview of the petition process and timeline

Status updates on the individual petitions

Instructions for how to engage in the public process through the California Fish and Game Commission as they consider the petitions

You can easily find petitions proposing changes in certain counties or proposing specific types of change to help pinpoint the petitions most important or relevant to you.
An interactive map also allows you to see the locations of key marine habitats in relation to both existing MPAs and proposed changes.

The California Fish and Game Commission received the petitions from Tribes and the public in December 2023, and referred the petitions to CDFW for evaluation in February 2024 as part of the MPA adaptive management process.

MPA Decadal Management Review cover

The new, publicly available MPA Petitions StoryMap aims to provide information to anyone interested in the MPA petitions and facilitate a transparent petition evaluation process. We invite you to bookmark the landing page and check back regularly for updates!

Questions or comments about the new MPA Petitions StoryMap? Contact the MPA team!

post by Kara Gonzales, CDFW Environmental Scientist

Marine Protected Area Petition Evaluation Status and Next Steps

6 November 2024

Presented to:

Marine Resources Committee

California Fish and Game Commission

Presented by:

Dr. Craig Shuman

Marine Regional Manager

Road Map for Today's Discussion

- Brief history and status updates
- Walk through DRAFT Bin 1 recommendations
- Status and next steps for Bin 2 petition evaluation and amendments
- December Commission meeting discussion and MRC recommendations

A. Van Diggelen

MPA Petition Updates: StoryMap

CALIFORNIA MARINE PROTECTED AREAS

Marine Protected Areas (MPA) Petition Process

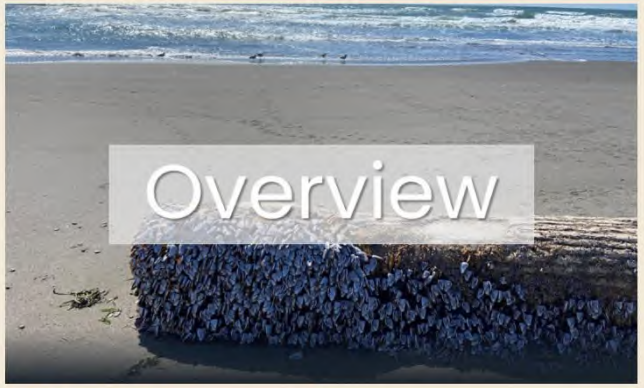
California Department of Fish and Wildlife

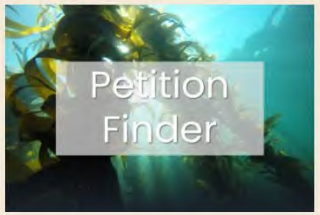
Click through the collection to:

→See an **overview** of the petition process, petition evaluation framework, and anticipated timeline

→Dive into an **interactive map** to visualize proposed changes

→Explore **petitions sorted** by numerical order, change category, or county, and click the links to learn more about each petition. Any petition proposing a change that can be visualized on a map (e.g., boundary or designation change) will have an image with a slider to swipe between the existing network and the proposed change. Any petition proposing a non-spatial change (e.g., take allowance or regulatory language change) will have a static image showing the location of the affected MPA(s).





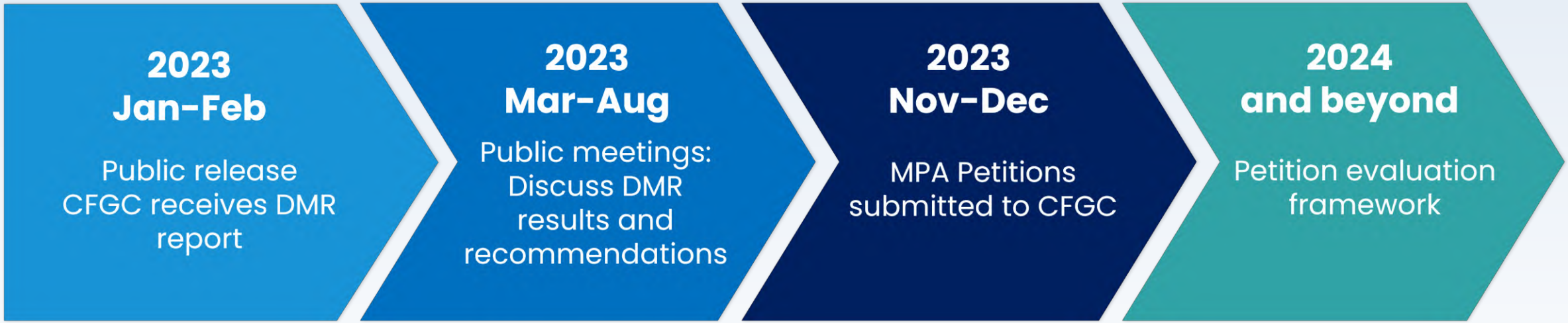
- Current status:
  - CDFW is in Phase 2 of its 3-phased petition evaluation framework and splitting each petition into individual action items
  - ***NEW*** CDFW released its draft recommendations for the Commission's consideration of Bin 1 petitions

Explore and stay up-to-date!

CALIFORNIA MARINE PROTECTED AREAS

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

Recap: Decadal Management Review and Petition Timeline



Common acronyms:
CFGC=California Fish and Game Commission
CDFW=California Department of Fish and Wildlife
DMR=Decadal Management Review
MRC=Marine Resources Committee

CALIFORNIA MARINE PROTECTED AREAS

Where We Are: MPA Petition Process

2024 to date

Petition evaluation framework

- **February:** CFGC referred all 20 received petitions to CDFW for evaluation.
- **March – May:** CFGC approval of CDFW's proposed 3 phase evaluation approach.
- **June-August:** CFGC receives update on the other 27 DMR recommendations; MRC and CFGC approve Phase 1 outcomes.
- **October-November:** CDFW provides status update on Bin 1 evaluation; CFGC, MRC discuss process and next steps for Bin 2 petition amendments.

CALIFORNIA MARINE PROTECTED AREAS

Petition Evaluation Framework: Status

Phase 1: Bin Whole Petitions

Phase 1:
Bin whole petitions

Bin 1

- Policy direction not needed for next phases
- Within CFGC authority
- Immediate evaluation possible
- Limited clarification needed from petitioner
- Limited controversy anticipated

Bin 2

Do not meet criteria for Bin 1

Bin 1 Petitions Summary

CFGC Tracking No.	Petition Contact	Affected MPA(s)	Description
2023-22MPA	Wendy Berube, Orange County Coastkeeper	Various Orange County MPAs	Change color coding on outreach maps, add language to tidepool take prohibitions, modify definition of tidepools, and allow research, monitoring, restoration, and education in Orange County MPAs, with the exception of Upper Newport Bay (Bolsa Chica, Laguna Beach, Crystal Cove, and Dana Point).
2023-25MPA	Burton Miller	Various Catalina Island MPAs	Change color designation of Blue Cavern Onshore and Casino Point SMCAs, change boundary of Long Point SMR, and remove allowance for feeding fish in Lover's Cove and Casino Point SMCAs.
2023-26MPA	Katie O'Donnell, WILDCOAST	Various San Diego County MPAs	Shift Swami's SMCA south from the lifeguard tower to the State/Solana Beach line to cover tidepools on the south side and change outreach map color of no-take SMCAs at Bautiquitos Lagoon, San Elijo Lagoon, and Famosa Slough from purple to red.*
2023-30MPA	Robert Jamgochian	Big River Estuary SMCA	Change gear restrictions within Big River SMCA to only allow Type A hoop nets that are compatible and eliminate the hoop net Type B option (rigid frame) from general provisions, reduce the number of set traps allowed from 10 to 5, and reduce the bag and possession limit for recreational take of crabs from 10 to 5.
2023-31MPA	Ashley Eagle-Gibbs, Environmental Action Committee of West Marin	Drake's Estero SMCA / Estero de Limantour SMR	Reclassify Drakes Estero SMCA to an SMR to prohibit take, and combine with Estero de Limantour into a single SMR.

Next Steps for Bin 2 Action Evaluation

- CDFW completed preliminary sorting Bin 2 petitions into actions and scoring against Bin 1 criteria.
- Process to sort and evaluate Bin 2 petitions
  - Amendments?
  - Feasibility and science guidelines


Steve Lonhart, NOAA

Proposed Process and Timeline for MPA Petition Amendments

- December Commission meeting:
  - Consider acting on Bin 1 petitions.
  - Guidance for Bin 2:
    - Petition amendment process
    - Other
  - CDFW presents Annual MPA Management update.


J. Ugoretz, CDFW

CALIFORNIA MARINE PROTECTED AREAS

Thank You

Questions?

fgc@fgc.ca.gov

mpamanagementreview@wildlife.ca.gov

State of California
Department of Fish and Wildlife

Memorandum

Date: October 25, 2024

Received 10/25/24;
Original signed copy on file

To: Melissa Miller-Henson
Executive Director
Fish and Game Commission

From: Craig Shuman, D. Env.
Marine Regional Manager

Subject: Agenda Item 2 A and B, Marine Protected Area Regulations Change Petitions-Evaluation Process

At its February 14-15, 2024 meeting, the California Fish and Game Commission (CFGC) referred 20 Marine Protected Area (MPA) petitions to California Department of Fish and Wildlife (CDFW) for review, evaluation, and recommendation. CDFW developed a draft 3-phase approach to evaluate MPA petitions that was supported by the Marine Resources Committee (MRC) and approved by CFGC in April. CDFW completed Phase 1, which involved sorting the petitions into two bins, Bin 1, which are "near-term" petitions where CDFW had enough information to evaluate the petition and make a recommendation, and Bin 2, petitions that are longer-term because there is a need for policy guidance, additional data or information, and/or resources to support evaluation. CDFW presented the draft proposed binning of petitions for tribal and public input and discussion at the July 17 MRC meeting. Five petitions were sorted into Bin 1 and the remaining 15 were sorted into Bin 2. MRC supported the draft outcomes from binning, which were subsequently approved by CFGC in August. CFGC requested that CDFW bring draft recommendations on Bin 1 actions to the November 2024 MRC meeting.

In response to the CFGC's request in August 2024, CDFW prepared draft recommendations for each Bin 1 petition action (attachment 1) evaluated against the applicable metrics in CFGC's approved petition evaluation framework (see attachment 6, page 232 of CFGC meeting materials) for consideration by MRC at the November 6-7, 2024 meeting. Bin 1 petitions are split into their individual actions, and CDFW has provided recommendations for each action and brief justifications on how they do or do not meet the petition evaluation framework. CDFW will also provide an update on progress with sorting Bin 2 petitions into actions and scoring them against the Bin 1 criteria.

If you have any questions or need more information, please contact Dr. Craig Shuman, Marine Regional Manager, at (805) 568-1246.

Attachment 1: Draft CDFW recommendations on Bin 1 petition actions
Attachment 2: Marine Protected Area Petition Evaluation Status and Next Steps Power Point

ec: Jenn Eckerle, Deputy Secretary for Ocean and Coastal Policy
Natural Resources Agency

Claire Waggoner, Environmental Program Manager
Marine Region

Stephen Wertz, Senior Environmental Scientist Supervisor
Marine Region

DRAFT California Department of Fish and Wildlife Recommendations for California Fish and Game Commission Action on Bin 1 Marine Protected Area Petitions

In 2023, the California Department of Fish and Wildlife (CDFW) released the first 10-year comprehensive review of California's Marine Protected Area (MPA) Network and Management Program that included 28 adaptive management recommendations for the next decade of MPA management. One of the near-term priority recommendations (#4) called for applying what was learned from the review to support proposed changes to the MPA Network and Management Program. To help advance this recommendation, the California Fish and Game Commission (CFGC) informed members of the public that they could submit petitions to amend MPA regulations for receipt at CFGC's December 2023 meeting. California Native American Tribes and tribal communities were invited to submit MPA petitions by the February 2024 meeting. CFGC received 20 petitions with over 80 unique requests for changes to the MPA Network.

At its February 14-15, 2024 meeting, CFGC referred all 20 MPA petitions received to CDFW for review, evaluation, and recommendation. CDFW developed a draft 3-phase approach to evaluate MPA petitions that was supported by the Marine Resources Committee (MRC) and approved by CFGC in April. CDFW completed Phase 1, which involved sorting the petitions into two bins, Bin 1, which are "near-term" petitions where CDFW had enough information to evaluate the petition and make a recommendation, and Bin 2 petitions, which are longer-term because there is a need for policy guidance, additional data or information, and/or resources to support evaluation.

CDFW presented the draft proposed binning of petitions for tribal and public input and discussion at the July 17 MRC meeting. Five petitions were sorted into Bin 1 and the remaining 15 were sorted into Bin 2. MRC supported the draft outcomes from binning, which were subsequently approved by CFGC in August. CFGC requested that CDFW bring draft recommendations on Bin 1 actions to the November 2024 MRC meeting.

In response to CFGC's request in August 2024, CDFW has prepared draft recommendations for each Bin 1 petition action evaluated against the applicable metrics in CFGC's approved petition evaluation framework (see attachment 6, page 232) for consideration by MRC at its November 6-7, 2024 meeting. The approved framework includes metrics such as, but not limited to:

- Compatibility with Marine Life Protection Act goals and MPA Master Plan guidelines including CDFW's design feasibility guidelines and existing regulations.
- Ability to help advance any of the 28 Decadal Management Review recommendations.
- Garners community support from diverse sectors.

Table 1 includes the Bin 1 petitions split into their individual actions, recommendations on how to proceed on each action, and brief justifications on how each action does or does not meet the petition evaluation framework. Each action is identified by the CFGC tracking number and action ID assigned by CFGC when petitions were first received, the MPA affected by the proposal, action category (e.g. modify existing regulations, establish new MPA and no action), and action type (e.g. MPA classification change, boundary change, or change in take).

Table 1. DRAFT Bin 1 recommendations for each petition action with brief justifications, and preferred pathway. More information regarding current regulations referenced below can be found at the following links: California Code of Regulations (CCR) Title 14 (Section 632), California Fish and Game Code (FGC Sections 2850-2863), and Public Resources Code (PRC Sections 36600-36690).

CFGC Tracking No.	Petitioner Contact	Action ID	Affected MPA	Action Category	Action Type	Petition Proposed Action	CDFW Recommendation	Brief Justification and Proposed Action
2023-22MPA	**Wendy Berube, Orange County Coastkeeper**	2023-22MPA_1	Bolsa Chica Basin SMCA	No Action	Non-regulatory	Change color of no-take SMCA from purple to red on outreach maps.	**Support w/ alternative pathway**	This proposed action does not require a change to existing regulations. Discuss alternative pathway to identify how best to implement the change.
		2023-22MPA_2	Laguna Beach SMCA	No Action	Non-regulatory	Change color of no-take SMCA from purple to red on outreach maps.	**Support w/ alternative pathway**	This proposed action does not require a change to existing regulations. Discuss alternative pathway to identify how best to implement the change.
		2023-22MPA_3	Crystal Cove SMCA	Modify	Allowable Uses	Add "non-living, geological or cultural" to marine resource tidepool take prohibition for consistency with 632(a)1(C).	**Deny w/ alternative pathway**	Redundant with 632(a)1(C) that already prohibits tidepool take. Recommend striking specific language regarding tidepools from the Crystal Cove SMCA regulations for clarity and consistency.
		2023-22MPA_4	Crystal Cove SMCA	Modify	Allowable Uses	Change description of tidepools to "rocky intertidal zone" with a modified definition, "the rocky intertidal zone includes all hard substrate between the highest high tide and lowest low tide."	**Grant w/ alternative pathway**	Simplifies regulatory language and could help enhance public understanding. Recommend striking from regulations for this individual MPA and add a definition of rocky intertidal habitat to general provisions in a new subsection 632(a)(16).
		2023-22MPA_5	Dana Point SMCA	Modify	Allowable Uses	Add "non-living, geological or cultural" to marine resource tidepool take prohibition for consistency with 632(a)1(C).	**Deny w/ alternative pathway**	Redundant with 632(a)1(C) that already prohibits tidepool take. Recommend striking specific language regarding tidepools from the Crystal Cove SMCA regulations for clarity and consistency.
		2023-22MPA_6	Dana Point SMCA	Modify	Allowable Uses	Change description of tidepools to "rocky intertidal zone" with a modified definition, "the rocky intertidal zone includes all hard substrate between the highest high tide and lowest low tide."	**Grant w/ alternative pathway**	Simplifies regulatory language and could help enhance public understanding. Recommend striking from regulations for this individual MPA and add a definition of rocky intertidal habitat to general provisions in a new subsection 632(a)(16).
		2023-22MPA_7	All Orange County MPAs, except Upper Newport Bay	Modify	Allowable uses	Add an amendment that "Scientific research, monitoring, restoration, and education is allowed pursuant to any required federal, state, or local permits, or as otherwise authorized by the department.	**Deny**	Redundant with what is already allowed in SMCAs pursuant to statute (PRC sections 36600-36690).

CFGC Tracking No.	Petitioner Contact	Action ID	Affected MPA	Action Category	Action Type	Petition Proposed Action	CDFW Recommendation	Brief Justification and Proposed Action
2023-25MPA	**Burton Miller**	2023-25MPA_1	Blue Cavern Onshore SMCA	No Action	Non-regulatory	Change color of no-take SMCA from purple to red on outreach maps.	**Support w/ alternative pathway**	This proposed action does not require a change to existing regulations. Discuss alternative pathway to identify how best to implement the change.
		2023-25MPA_2	Casino Point SMCA	Modify	Allowable uses	Remove allowance for feeding fish.	**Deny**	Fish feeding has been a long-standing practice in this area associated with local tourism that outdates the MLPA planning process. Because of this, and the enhancement of wildlife viewing, and educational opportunities provided by the practice, the MLPA Initiative Blue Ribbon Task Force recommended, and CFGC adopted, an exemption for feeding fish in subsection 632(a)(6) if specifically authorized in 632(b) to continue to allow the practice for this MPA.
		2023-25MPA_3	Casino Point SMCA	No Action	Non-regulatory	Change color of no-take SMCA from purple to red on outreach maps.	**Support w/ alternative pathway**	This proposed action does not require a change to existing regulations. Discuss alternative pathway to identify how best to implement the change.
		2023-25MPA_4	Long Point SMR	Modify	Boundaries	Change the type of boundary from a latitude and longitude to a certain, specified distance from shore. To maintain overall size, the northeast corner could be trimmed and fitted to western edge of offshore boundary to create a standard distance from shore (in similar fashion to Arrow Point to Lion Head SMCA).	**Deny**	Requested change does not align with CDFW's Feasibility Guidelines to align MPA boundaries with whole minutes of latitude and longitude whenever possible to enhance enforceability. Using distance from shore is also inconsistent with this guidance. CDFW Law Enforcement Division is not supportive because it could decrease enforceability and result in reduced protection of marine resources.

CFGC Tracking No.	Petitioner Contact	Action ID	Affected MPA	Action Category	Action Type	Petition Proposed Action	CDFW Recommendation	Brief Justification and Proposed Action
2023-25MPA (continued)	**Burton Miller**	2023-25MPA_5	Lover's Cove SMCA	Modify	Allowable uses	Remove allowance for feeding fish.	**Deny**	Fish feeding has been a long-standing practice in this area associated with local tourism that outdates the MLPA planning process. Because of this, and the enhancement of wildlife viewing, and educational opportunities provided by the practice, the MLPA Initiative Blue Ribbon Task Force recommended, and CFGC adopted, an exemption for feeding fish in subsection 632(a)(6) if specifically authorized in 632(b) to continue to allow the practice for this MPA.
2023-26MPA	**Katie O'Donnell, WILDCOAST**	2023-26MPA_1	Swami's SMCA	Modify	Boundaries	Shift the entire MPA boundary shape south (from lifeguard tower to State/Solana Beach line to cover tidepool on south side).	**Deny**	Northern boundary change was not evaluated at request of petitioner. Requested change at southern boundary does not align with CDFW's Feasibility Guidelines to align MPA boundaries with whole minutes of latitude and longitude whenever possible to enhance enforceability. CDFW Law Enforcement Division is not supportive because it could decrease enforceability and result in reduced protection of marine resources.
		2023-26MPA_2	Batiquitos Lagoon SMCA	No Action	Non-regulatory	Change color of no-take SMCA from purple to red on outreach maps.	**Support w/ alternative pathway**	This proposed action does not require a change to existing regulations. Discuss alternative pathway to identify how best to implement the change.
		2023-26MPA_3	San Elijo Lagoon SMCA	No Action	Non-regulatory	Change color of no-take SMCA from purple to red on outreach maps.	**Support w/ alternative pathway**	This proposed action does not require a change to existing regulations. Discuss alternative pathway to identify how best to implement the change.
		2023-26MPA_4	Famosa Slough SMCA	No Action	Non-regulatory	Change color of no-take SMCA from purple to red on outreach maps.	**Support w/ alternative pathway**	This proposed action does not require a change to existing regulations. Discuss alternative pathway to identify how best to implement the change.
2023-30MPA	**Robert Jamgochian**	2023-30MPA_1	Big River Estuary SMCA	Modify	Take	Make recreational take of Dungeness crab more restrictive by changing crab gear regulations to only allow Type A hoops and eliminate hoop net Type B option.	**Deny**	Outside the scope of MPA management. Action more appropriate to be considered through fishery management process.

CFGC Tracking No.	Petitioner Contact	Action ID	Affected MPA	Action Category	Action Type	Petition Proposed Action	CDFW Recommendation	Brief Justification and Proposed Action
2023-30MPA (continued)	**Robert Jamgochian**	2023-30MPA_2	Big River Estuary SMCA	Modify	Take	Make recreational take of Dungeness crab more restrictive by reducing the number of set traps from 10 to 5 for recreational take of Dungeness crab.	**Deny**	Outside the scope of MPA management. Action more appropriate to be considered through fishery management process.
		2023-30MPA_3	Big River Estuary SMCA	Modify	Take	Make recreational take of Dungeness crab more restrictive by reducing the recreational bag limit from 10 to 5 crabs per person.	**Deny**	Outside the scope of MPA management. Action more appropriate to be considered through fishery management process.
2023-31MPA	**Ashley Eagle-Gibbs, Environmental Action Committee of West Marin**	2023-31MPA_1	Drake's Estero SMCA	Modify	Classification/Take	Reclassify Drakes Estero SMCA to an SMR to prohibit take.	**Grant**	Drake's Estero was designated as an SMCA to allow the existing aquaculture activities to continue operating. The MLPA North Central Coast Regional Stakeholder Group recommended changing the classification from an SMCA to an SMR if it is feasible to do so. Aquaculture activities ceased in 2014. Redesignation to an SMR could help protect biodiversity in the eelgrass beds that have recovered since the removal of the aquaculture infrastructure. There is limited recreational clamming activity that would be displaced by the classification change.
		2023-31MPA_2	Estero de Limantour SMR	Modify	Boundaries	Combine SMR with a reclassified Drake's Estero SMR into one single SMR.	**Grant**	Creating one SMR would eliminate the confusing boundary between the current SMCA and SMR.

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE REPORT ON THE CALIFORNIA MARINE PROTECTED AREA PETITION PROCESS

At the Council's June 2024 meeting, a petition for changes to specific California Marine Protected Areas (MPAs) was presented by Mr. Blake Hermann in public comment (Agenda Item C7, Public Comments). This petition involved potential changes to MPAs around the California Channel Islands (Figure 1), which would allow fishing for specific pelagic species in MPAs that extend into federal waters with shared jurisdiction between California and the Channel Islands National Marine Sanctuary (CINMS). The California Department of Fish and Wildlife (CDFW) and California Fish and Game Commission (CFGC) are currently in the process of considering petitions requesting such amendments to California's Marine Protected Area (MPA) Network. CDFW acts as the lead management and enforcement agency for the MPA Network, while CFGC has regulatory authority to create, remove, or modify State MPAs (California Fish and Game Code, §1590).

In 2022, CDFW publicly released the first 10-year comprehensive review of the MPA Network and Management Program (Decadal Management Review) that included 28 recommendations for the next decade of MPA management. One priority recommendation called for applying what was learned from the Decadal Management Review to support adaptive management actions, including proposed amendments to the MPA Network. To advance this recommendation, the CFGC requested petitions be submitted for their December 2023 meeting. They received 20 petitions with more than 80 unique requests to amend the MPA Network, including addition of new MPAs, changing the levels of protection in existing MPAs, and minor clarifications to regulatory language. Mr. Hermann's petition was one of the 20. All 20 MPA petitions received were referred to CDFW for review, evaluation, and recommendation at the February 14-15, 2024, CFGC meeting. CDFW recommended a 3-phase approach to evaluate the MPA petitions that was approved by the CFGC in April 2024. This approach included the following:

- **Phase 1** – Categorize petitions into two bins to determine which petitions can be evaluated in the near-term (Bin 1) and which will require additional policy guidance, information, and/or resources prior to evaluation (Bin 2).
- **Phase 2** – Separate all Bin 1 petitions into individual actions and proceed to phase 3. Separate Bin 2 petitions into individual actions and identify additional policy guidance, information, and/or resources necessary to advance individual actions to phase 3.
- **Phase 3** – Evaluate specific petition actions using a framework to identify which will be recommended to be granted, denied, or considered through an alternative pathway.

CDFW completed Phase 1 with recommended bin designations for each petition, and the CFGC approved these recommendations in August 2024. Mr. Hermann's petition was included in Bin 2, requiring additional guidance before proceeding with full evaluation. The rationale for this included the fact that the proposal would change a no-take State Marine Reserve into a limited-take State Marine Conservation Area, thus reducing its relative level of protection, and the

changes would require extensive coordination with external partners, including but not limited to CINMS, National Park Service, and National Marine Fisheries Service (NMFS). It is important to note that the federal waters portions of MPAs around the Channel Islands were established under both Magnuson authority for the prohibition on bottom contact fishing (via the groundfish regulations in 50 CFR §660.12) and CINMS regulations for ecosystem-level protection prohibiting all take (via the regulations in 15 CFR §922.71 and 922.73). As such, changes to federal waters MPAs in these areas would require amendment to CINMS regulations and may require both Council and NMFS input and action.

The timeline to consider specific actions for Bin 2 petitions is still being developed. At the August 2024 CFGC meeting, CFGC discussed a potential timeline and next steps for the petition evaluation process for the remainder of 2024, including:

- **October 2024 CFGC meeting**: CDFW provided an update on the petition process and discussion points for the November CFGC Marine Resources Committee meeting.
- **November 2024 MRC meeting**: CDFW will present draft Bin 1 proposed petition actions and recommendations for discussion and draft approach for Bin 2.
- **December 2024 CFGC meeting**: CFGC considers near-term Bin 1 petition recommendations and discusses next steps for the petition evaluation process.
- **March 2025 MRC meeting**: Further discussion on CDFW recommendations for Bin 2 remaining proposed actions and next steps.

For more information on the current MPA petitions, CDFW has created an online story map that provides detailed information on all of the petitions received by the Commission with location and regulatory proposals. CDFW and CFGC will continue to work closely with agency partners at the Office of National Marine Sanctuaries, NMFS, and the Council on evaluation of petitions that apply to areas where there are adjoining and/or overlapping jurisdictions.

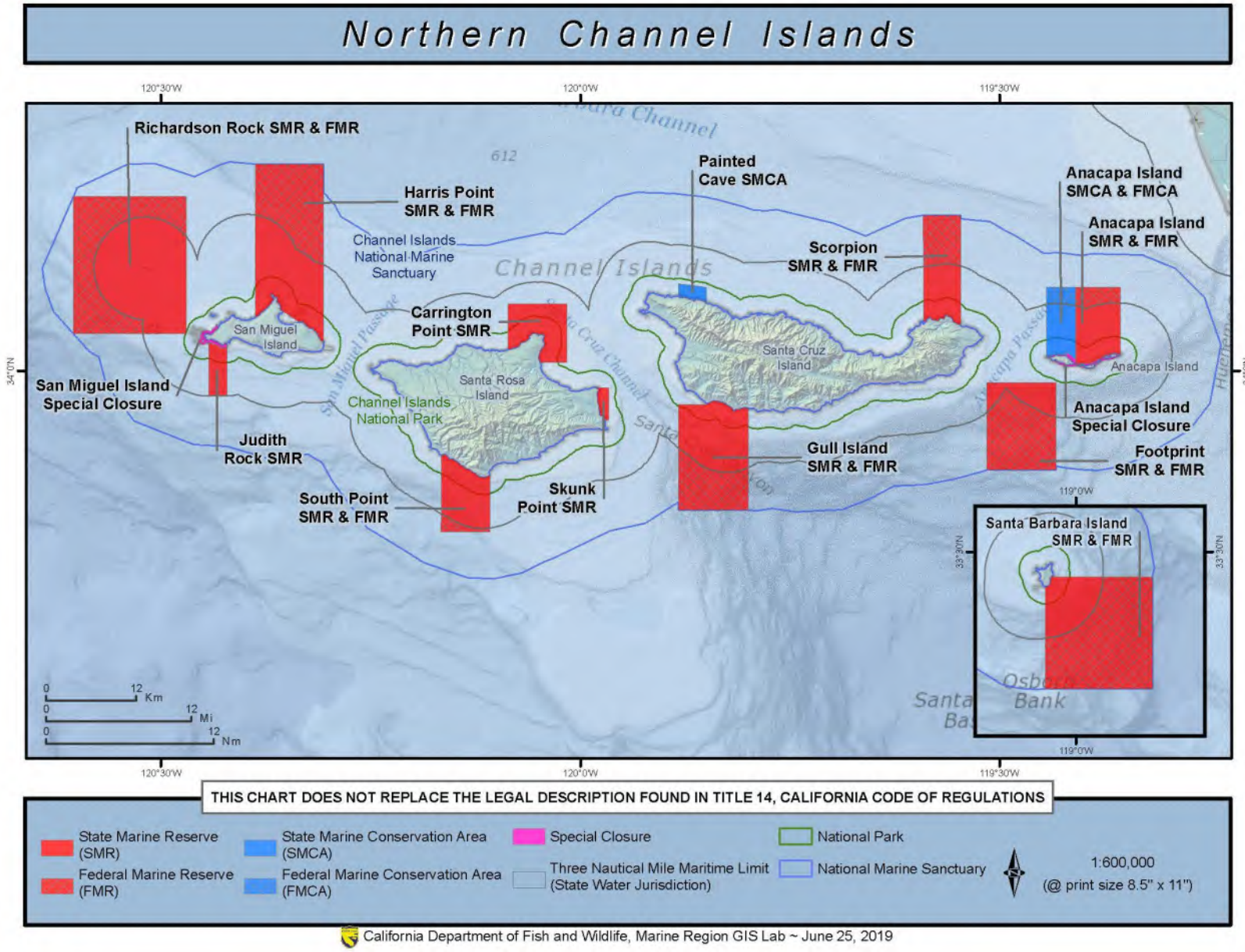


Figure 1 – Map of the Channel Islands state and federal marine protected areas.

California Fish and Game Commission
Staff-Proposed Process for Submitting Revisions to an Existing Marine Protected Area (MPA) Regulation Change Petition

October 25, 2024

At its December 2023 meeting, the California Fish and Game Commission (Commission) received 20 regulation change petitions proposing changes to California's MPA network. In most cases, multiple requested MPA changes were bundled into single petitions; over 80 individual requested actions were included in the 20 petitions. Based on a recommendation from the California Department of Fish and Wildlife (CDFW), in August 2024 the Commission divided petitions into two categories: Bin 1 (with five petitions identified for near-term evaluation) and Bin 2 (with fifteen petitions identified for longer-term evaluation). In December 2024, the Commission is expected to receive a recommendation for proposed actions for the Bin 1 petitions.

Over the last ten months, many Bin 2 petitioners have been engaged in dialogue with other stakeholders, local communities, government agencies, and Native American tribes and tribal communities, to help ensure the actions proposed in their petitions are supported and appropriate for the relevant area. During conversations, petitioners have noted the desire to make revisions to their original petition and have inquired about the process for making such changes. The Commission has agreed to accept requests from MPA petitioners to revise petitioned actions within their original MPA petition; this document proposes a process and parameters for revisions to the 15 MPA petitions.

Who: Petitioners with a petition in Bin 2 may submit a request to amend their original petition. There are 15 petitions included in Bin 2.

Format: Submit to fgc@fgc.ca.gov a revised version of Form FGC 1 (petition for regulation change) that you originally submitted to the Commission.

- Please show revisions in strike-out (~~for deletions~~) and underline (<u>for new content</u>). Alternatively, you may use the track changes function in word processing software.
- Create a cover message detailing which petition action(s) you request to change, what is the specific change, and the rationale (what is the purpose).

Extent of changes: Only revisions to or withdrawal of petition actions in the original petition may be requested. *No new proposed actions will be accepted as revisions to a petition*.

Deadline: All requests must be received by the Commission no later than [to be determined: mid-to-late January 2025 at 5:00 p.m.]

Commission receipt and action: The Commission will receive requests for MPA petition revisions at its February 12-13, 2025 meeting.

- Petition numbers will remain the same, with an "R" added at the end to indicate it is a revised version.
- Staff will recommend the Commission refer revised MPA petitions to the Department and the Commission Marine Resources Committee.

OPC Investments for MPA Petition Evaluation

Staci Lewis, Ph.D., Marine Protected Area Network Program Manager

November 6, 2024

CALIFORNIA
OCEAN
PROTECTION
COUNCIL

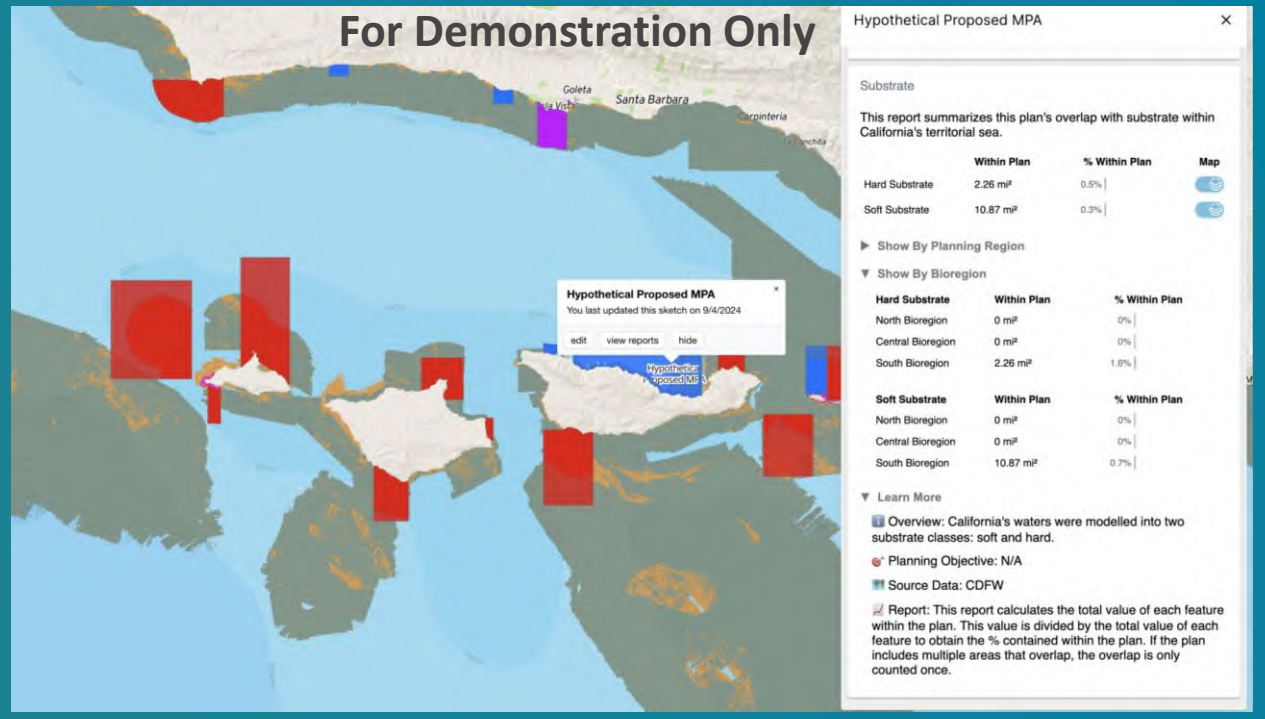
SeaSketch -- Mapping Tool of the MPA Network

University of California, Santa Barbara

Public platform to clearly visualize habitats and other features within California state waters

The platform can be used to visualize proposed changes to the network including:

- Changes to MPA size and spacing
- Overlap of MPA petitions with important locations and habitats



Anticipated release date in Winter/Spring 2025

CALIFORNIA OCEAN PROTECTION COUNCIL

Updating the Connectivity Model

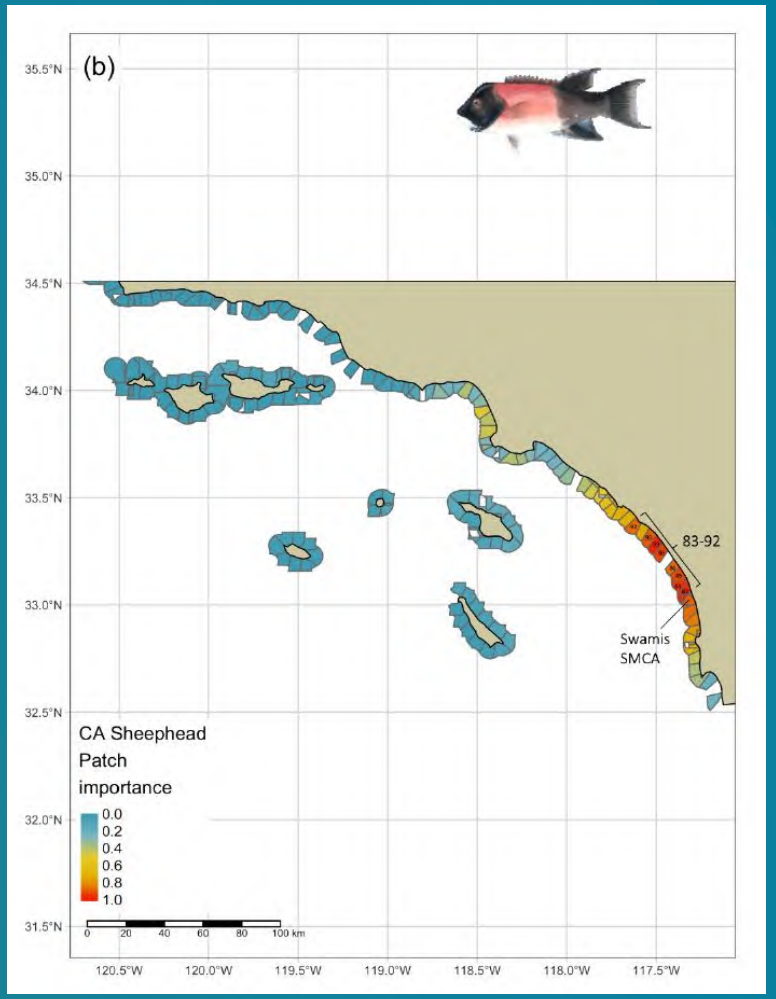
University of California, Santa Cruz

Model updates are needed to:

- Ensure results are more representative of current and future ocean conditions
- Fill some gaps in near-shore habitat mapping

These updates would produce a more accurate assessment of network connectivity and ecological stability

Updated preliminary results anticipated by Summer 2025



CALIFORNIA OCEAN PROTECTION COUNCIL

From: Katie O'Donnell <[redacted]>
Sent: Tuesday, October 22, 2024 3:09 PM
To: Ashcraft, Susan@FGC <[redacted]>
Cc: Wertz, Stephen@Wildlife <[redacted]>; Waggoner, Claire@Wildlife <[redacted]>; Miller-Henson, Melissa@FGC <[redacted]>; [redacted]
Subject: WILDCOAST MPA Petition Change - Removal of Boundary Change Action

Hi Susan,

Hope you're doing well! Thanks again for chatting with me the other week about WILDCOAST's MPA petition. We greatly appreciate your partnership!

My team and I have discussed the next steps for our petition and have decided to withdraw the Swami's boundary change proposal part of our petition. We would only like to move forward with the color change for no-take SMCAs at Batiquitos Lagoon, San Elijo Lagoon, and Famosa Slough from purple to red on outreach materials only.

Please let me know if there is anything else we need to do to formally withdraw the Swami's boundary change portion of our petition!

We are working on our next steps in our conservation work and looking forward to our continued partnership with you all! I am happy to set up a call if you'd like to discuss anything further at this time!

Thank you,

Katie

WILDCOAST COSTASALVAJE

Katie O'Donnell

US Ocean Conservation Manager

she/her/hers

From: Joel Weltzien <[redacted]>
Sent: Wednesday, October 23, 2024 9:46 PM
To: FGC <FGC@fgc.ca.gov>
Subject: BHA's Written Comments for the November 6-7th MRC Meeting

Please see attached comments. Thank you.

Joel Weltzien | California Chapter Coordinator (CA)

Backcountry Hunters & Anglers
Phone: [redacted]
www.backcountryhunters.org

BACKCOUNTRY
HUNTERS & ANGLERS
CALIFORNIA

Marine Resources Committee
California Fish and Game Commission
1416 9th Street, Room 1320
Sacramento, CA 95814

RE: Action item 2a - Receive and discuss Department evaluation and recommendations for MPA petitions in Bin 1

On behalf of the California chapter of Backcountry Hunters & Anglers (BHA), the voice for our wild public lands, waters and wildlife, we wish to comment on the California Department of Fish & Wildlife's (the Department) recommendations regarding the petitions currently placed into the California Fish & Game Commission's (the Commission) Bin 1. BHA is a North American, grassroots non-profit with chapters and members in 49 states, Washington D.C., two Canadian provinces and one Canadian territory. With a membership that is young, politically diverse and tremendously engaged, our chapters consistently advance policies and projects that ensure our North American heritage of hunting and fishing in a natural setting through education and work on behalf of wild public lands, waters and wildlife.

Barring the finding of any significant impacts to overall ecosystem integrity or species health in the Department's review and recommendations, we request that petitions 2023-26MPA (Swami's SMCA), 2023-30MPA_1 (Big River SMCA restrictions) & 2023-31MPA_1 (Drakes Estero) be denied. All these petitions seek to reduce or eliminate recreational harvest, yet none of them provide sufficient scientific documentation for doing so. As we have stated previously, the reduction of recreational harvest without adequate scientific rationale is not in the best interests of our at-risk marine ecosystems, but instead disenfranchises a portion of the public from a food source, their connection to the ocean and a constitutional right to fish. BHA, and indeed the vast majority of responsible recreational anglers, have supported restrictions on recreational harvest when there was a clear negative impact on an ecosystem associated with the continuation of harvest, and when reduced harvest could be reasonably shown to improve the health of the ecosystem or species of concern. Unless the Department can provide a logically sequential demonstration of how reducing recreational harvest could help significant ecological outcomes at Swami's, Big River and Drakes Estero, we encourage the Commission to recommend denying these petitions.

In addition to prior comments submitted to the Commission in February and the Marine Resources Committee in July of 2024 regarding the Big River and Drakes Estero petitions, we would like to express our concern and opposition to Petition 2023-26 MPA, in particular the

proposal to move the Swamis SMCA shape southward. The redrawn SMCA boundary would partially cover Tabletops / Seaside Reef, a popular diving site where Californians have been sustainably harvesting reef fish and lobsters for generations. The cultural impact of a loss of access to Tabletops / Seaside Reef, without any scientific justification, would be devastating to our community.

We are concerned with what may have been a lack of stakeholder engagement in the creation of the petition. The petitioner, Wildcoast, alleges to have discussed the proposal and secured the support of fishing groups during a meeting of the San Diego MPA Collaborative on June 26th, 2023. However, a review of MPA Collaborative members on the organization's website shows a lack of substantive engagement with the broader fishing community. We feel anglers were not adequately consulted and that, if successful, the closure of Tabletops / Seaside Reef would have occurred without sufficient consultation with the angling community.

Wildcoast cites the negative effects of tide-pooling, and SMCA enforcement challenges as reasons to shift the SMCA shape south. We believe both issues could be easily resolved with the appropriate allocation of the City of Solana Beach and State Parks resources. Changing the location of the SMCA shape is simply the wrong tool for the job. More concerning, this petition risks alienating the angling and diving community from state policymakers and conservation organizations in our shared goal of conserving and celebrating our coastal ecosystems. We recommend the Commission deny this petition.

Further, BHA and other members of the public eager to engage in the MPA petition process would continue to encourage Commission staff and Department staff to share recommendations and analysis concerning petitions currently in Bin 1 as quickly as possible prior to the Marine Resource Committee (MRC) meeting on November 6-7th, 2024. Having the Department's recommendations and being able to study and respond to them in our comments that we submit prior to MRC meetings would result in a more informed discussion and process.

Thank you for your time.

Joel Weltzien

Chapter Coordinator – Backcountry Hunters & Anglers

From: Volker Hoehne <[redacted]>
Sent: Wednesday, October 16, 2024 4:35 PM
To: [redacted]
Cc: [redacted]; fgc@fgc.ca.gov
Subject: Swamies MPA expansion Petition 2023-26

My name is Volker Hoehne,

I'm from Carlsbad CA and I am speaking to oppose and express concerns with Petition **2023-26** MPA, specifically for expending the Swamies MPA south 300 ft.

I started diving table top reef in while attending Skyline Elementary School in fourth grade. I have seen this reef thrive over the years.

Expanding the Swamies MPA south 300 ft closes 4.8 million square feet to recreational fishing because the closure goes out to see by 3 miles. Moving the country from 33.000 N to 32.998N splits tabletop reef which confuses tide pool enforcement.

Species diversity and density on table tops intertidal reef is low because it is regularly burred under sand by the U.S. Army Corps of Engineers sand pumping . The U.S. Army Corps of Engineers restoration dumps 50-foot-wide beach fill along a 7,800-foot-long stretch of shoreline using 340,000 cubic yards of compatible sediment, with re-nourishment (in the amount of 220,000 cubic yards) every 5 years on average over a 50-year period of Federal Los Angeles District > Missions > Civil Works > Projects and Studies > Solana-Encinitas Shoreline Study (army.mil)

This MPA expansion negatively impacts recreational and commercial fishing. It will confuse tide pooling enforcement by bisecting the tide pooling area.

It

Please oppose expanding the Swamies MPA.

From: David Clutts <[redacted]>
Sent: Monday, October 21, 2024 11:20 AM
To: FGC <FGC@fgc.ca.gov>
Subject: Letter of Opposition to Swami's, Py Loma MPA expansion

Dear California Fish & Wildlife,

I am writing to express my opposition to the proposed expansions of both the Swami's Marine Protected Area (MPA) and the Point Loma MPA.

Swami's already experiences minimal recreational fishing pressure. Access to the current fishing area from the shore is critical, and the expansion would complicate enforcement due to the difficulty in determining the new boundary lines. Expanding the MPA further would significantly limit fishing opportunities in Solana Beach, which has been a vital fishing area for decades. Closing additional area makes little sense while the Army corps of engineers routinely covers much of the reef with the sand replenishment at Solana beach. Therefore, I respectfully urge the California Department of Fish & Wildlife to deny the proposed expansion of the Swami's MPA.

Similarly, I oppose the expansion of the Point Loma MPA. This area contains some of the last remaining healthy kelp beds that can support fishing activities in southern San Diego County. The argument presented by the organization petitioning for the expansion, claiming it is necessary to save the kelp, is unfounded. Fishermen have protected and sustained these kelp beds as valuable fishing grounds for over a century. Expanding the MPA will only displace fishing pressure to other areas, disrupting a balanced ecosystem and limiting sustainable fishing opportunities.

I strongly urge the Department to deny the expansion of the Point Loma MPA, as it will negatively impact both the environment and the fishing community.

Thank you for your consideration.

Sincerely,
David Clutts
Member: San Diego Freedivers, Norcal skindivers, Richmond Pelican Skindivers

Spear fisherman, Fisherman, Diver, Scuba Diver

DAVID CLUTTS

Broker Associate

C: [redacted] (San Diego) | C: [redacted] (Northern CA)

[redacted]

www.TeamClutts.com

1424 Camino Del Mar | Del Mar | CA | 92014

David Clutts]
[redacted]
10/21/2024

California Department of Fish and Wildlife
[Address if available]

Dear California Fish & Wildlife,

I am writing to express my opposition to the proposed expansions of both the Swami's Marine Protected Area (MPA) and the Point Loma MPA.

Swami's already experiences minimal recreational fishing pressure. Access to the current fishing area from the shore is critical, and the expansion would complicate enforcement due to the difficulty in determining the new boundary lines. Expanding the MPA further would significantly limit fishing opportunities in Solana Beach, which has been a vital fishing area for decades. Closing additional area makes little sense while the Army corps of engineers routinely covers much of the reef with the sand replenishment at Solana beach. Therefore, I respectfully urge the California Department of Fish & Wildlife to deny the proposed expansion of the Swami's MPA.

Similarly, I oppose the expansion of the Point Loma MPA. This area contains some of the last remaining healthy kelp beds that can support fishing activities in southern San Diego County. The argument presented by the organization petitioning for the expansion, claiming it is necessary to save the kelp, is unfounded. Fishermen have protected and sustained these kelp beds as valuable fishing grounds for over a century. Expanding the MPA will only displace fishing pressure to other areas, disrupting a balanced ecosystem and limiting sustainable fishing opportunities.

I strongly urge the Department to deny the expansion of the Point Loma MPA, as it will negatively impact both the environment and the fishing community.

Thank you for your consideration.

Sincerely,
David Clutts
Member: San Diego Freedivers, Norcal skindivers, Richmond Pelican Skindivers

Spear fisherman, Fisherman, Diver, Scuba Diver

From: Ashley Eagle-Gibbs <[redacted]>
Sent: Thursday, October 24, 2024 04:28 PM
To: FGC <FGC@fgc.ca.gov>
Cc: Eric Sklar <[redacted]>; Samantha Murray <[redacted]>; Ashcraft, Susan@FGC <[redacted]>; Rogers, Kimberly@fgc <[redacted]>; Leslie Adler-Ivanbrook <[redacted]>; Worden, Sara@Wildlife <[redacted]>; Wertz, Stephen@Wildlife <[redacted]>; Waggoner, Claire@Wildlife <[redacted]>

Subject: EAC Comments re. Agenda Item 2(A), MPA Petition for Drakes Estero (2023-31MPA)

Dear Commissioners and staff,

Please find attached a short comment letter for the November MRC related to Item 2A and bin 1 petition, Drakes Estero (2023-31MPA). I look forward to the meeting.

Thank you,

Ashley Eagle-Gibbs

--

Ashley Eagle-Gibbs, Esq. (She/Her)

Executive Director & Legal and Policy Director

Environmental Action Committee of West Marin (EAC)

PO Box 609 | 65 Third Street, Suite 12

Point Reyes Station, CA | 94956

[redacted]

ashley@eacmarin.org

Protecting and Sustaining the Lands, Waters, and Biodiversity of West Marin Since 1971

Join our Member Circle or
Renew your Annual Support

Website | Facebook | Twitter | Instagram

PRIVILEGE AND CONFIDENTIALITY NOTICE

This message may contain information that is confidential, privileged or otherwise protected by work product immunity or other legal rules. If you are not the intended recipient to whom the message is addressed, please notify me immediately at the above number and delete it from your system. Any dissemination, distribution, or copying of this communication or other use of a transmission received in error is strictly prohibited. Thank you.

west marin environmental action committee

October 24, 2024

Marine Resources Committee
California Fish and Game Commission
P.O. Box 944209,
Sacramento, CA 94244-2090
Via Electronic Mail: fgc@fgc.ca.gov

RE: Agenda 2(A), *Marine protected area (MPA) regulation change petitions – evaluation process, MPA Petition for Drakes Estero (2023-31MPA)*

Dear Commissioners,

The Environmental Action Committee of West Marin's mission is to protect and sustain West Marin's lands, waters, and biodiversity. On November 30, 2023, we submitted a petition to change the regulations for Drakes Estero State Marine Conservation Area (SMCA); petition no. 2023-31MPA. While we are eager to review the staff report and participate in the November 6th Marine Resources Committee meeting, we submit this short letter to reiterate our original petition request and summarize some of the background and support for this petition.

Our petition request was preceded by our participation in the decadal management review (DMR) process including analysis of our existing local MPAs, informed by our leadership of Marin MPA Watch at Drakes Estero and other sites in Marin County, which includes data collection. We also submitted prior letters voicing the need for regulatory change at this location as early as March 2023. All of these letters are included in the record.

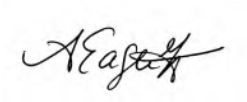
We note that there is significant support on the record for the petition including support from at least 22 NGOs, the National Park Service, and Marin County Supervisor Rodoni, who represents this region in his district. The record also includes support from scientists, community-based organizations, local individuals, and tribal support.

We have also participated in two Golden Gate Collaborative meetings on August 24, 2023, and September 26, 2024. At the August 24th Golden Gate Collaborative meeting, a full consensus in support of this petition was reached by the participants.[1]

The requested change is consistent with DMR goals and adaptive management under the Marine Life Protection Act.

We encourage the Marine Resources Committee and the full Commission to lend their support for this request. If you have questions, please contact me at [redacted]. Thank you for your dedication to the conservation of our shared marine resources.

Sincerely,



Ashley Eagle-Gibbs, Esq.
Executive Director
Environmental Action Committee of West Marin

[1] Also included with our petition, see rows 50-51, https://docs.google.com/spreadsheets/d/1Eu1efUliHZ2bazdKM5lK5UKzsIEluHEU9k9HdR1oudo/edit#gid=0

From: Kim Selkoe <[redacted]>
Sent: Thursday, October 24, 2024 02:28 PM
To: FGC <FGC@fgc.ca.gov>
Cc: Ava Schulenberg <[redacted]>; [redacted]
<[redacted]>
Subject: Written Comment for the upcoming MRC re MPA Petition Process

Dear Fish and Game Commissioners,

Please see the attached letter.

Thank you,

Kim

--
Kim Selkoe, Ph.D.
~~~~~~~~~~~~~~~~
Executive Director
Commercial Fishermen of Santa Barbara
[redacted]
~~~~~~~~~~~~~~~~

COMMERCIAL FISHERMEN OF SANTA BARBARA
Commercial Fishermen of Santa Barbara, Inc.,
6 Harbor Way, #155 Santa Barbara, CA 93109
www.cfsb.info

October 23, 2024

To: The California Fish and Game Commission
fgc@fgc.ca.gov

Re: November 6th, 2024 FGC MRC Meeting Agenda Item 2 - Marine protected area (MPA) regulation change petitions – Evaluation process

Dear Commissioners,

For over 40 years, The Commercial Fishermen of Santa Barbara ("CFSB"), a 501(c)3 non-profit organization, has been committed to making our local fishing community resilient and effective by providing healthy, high quality seafood to local and global markets, ensuring the economic and biological sustainability of fisheries, and maintaining California's fishing heritage. CFSB is a highly-respected organization within the California fishing community and represents the interests of a diverse set of vastly experienced fishermen, aquaculturists, and seafood processors and distributors who are leaders in the commercial fishing industry.

This petition process should not be used for creating new MPAs or significant changes to the boundaries of MPAs.

It is our stance that we categorically oppose the Marine Resources Committee ("MRC") and Fish & Game Commission's ("FGC") usage of the petition process to expand existing Marine Protected Areas ("MPAs") and create new MPAs. While the petition process is a reasonable adaptive management tool required by the Marine Life Protection Act, it should *not* be used to make the proposed significant changes to the existing MPA network due to a lack of: (1) scientific data, (2) clear and measurable goals and objectives, and (3) an effective and reasonable system for stakeholder engagement.

Please recognize the devastating amount of spatial loss that our commercial fishing fleet has already endured in past years *and* all the newly proposed spatial take on the horizon. California has one of the most comprehensive MPA networks in the US, with 124 designated protected areas and 16% of waters closed. Furthermore, there are many other large areas off limits to our state's largest fisheries, such as Rock Cod Conservation Areas, whale entanglement prevention zones, no-trawl zones, and massive spatial closures to gillnet

fisheries. There are additionally many de-facto fishing closures currently and imminently coming from: oil and gas leases, military uses, shipping lanes, offshore wind, aquaculture, wave energy, and the 30x30 Initiative. Rocket launch frequency at Vandenberg has rapidly increased, such that a large area is closed to fishing for over two months out of the year (72+ days). At the same time, California has lost two thirds of its active fishing boats over the past 30 years. California fisheries management is successful and effective. The net result of all of these factors is that there are no overfished marine species in California, and many fish populations are increasing in abundance, such as many key groundfish species.

The science of MPAs is not being properly applied nor evaluated in context, violating the MLPA.

The first goal of the Marine Life Protection Act ("MLPA") states that MPAs must, "Protect the natural diversity and abundance of marine life, and the structure, function and integrity of marine ecosystems," and the fifth rule states that MPAs must, "Ensure California's MPAs have clearly defined objectives, effective management measures and adequate enforcement and are based on ***sound scientific guidelines.***" Adding to California's MPA network must be done with a scientific process, not a haphazard undefined one such as the petition process. It must also consider the many de-facto MPAs and the success of fisheries regulations in protecting biodiversity without new MPAs. These factors make it far from clear that adding new MPAs will achieve any measurable enhancement in marine biodiversity or climate change resilience.

In fact, adding new MPAs may unintentionally hurt the large-scale coastal marine ecosystem's resilience to climate change if the effects of new closures on fishing behavior and ecosystems outside of MPAs are not considered. The health and functioning of the ecosystem at the regional scale is far more relevant to climate resilience than the local scale. Renowned fisheries scientist Ray Hilborn asks the important question, "If the MPAs show more stability because fishing effort was removed, would we not expect the reference sites to show less stability because fishing efforts increased there?" But this is not the case. A net positive impact of new MPAs on biodiversity and/or climate resilience should be demonstrated at the regional scale, not just within the bounds of the MPAs, with new, peer-reviewed scientific models that consider the de-facto no-fishing zones that currently exist and the impacts to spatial patterns of fishing pressure before approving more MPAs.

COMMERCIAL FISHERMEN OF SANTA BARBARA

In the July 2024 MRC FGC Meeting, Commissioner Murray stated that, “MPAs are not fisheries management tools,” and that “They’re not going to launch new monitoring projects to help this process.” She emphasized that her “Current questions are about the data they already have,” and stated that essentially there will not be any opportunities to collect new data when evaluating these petitions. Not investing in efforts to collect sound scientific data given the vast implications of such proposed new/expanded MPAs is a violation of the fifth rule of the MLPA. Relying on stale data, and a process without a clearly defined role for science is an irresponsible way to evaluate any controversial initiative, especially when evaluating these disputed petitions that have the potential to substantially change people’s lives for the worse and threaten collapse of our working waterfronts.

Section 2861 (a) of the MLPA states that “The commission shall, annually until the master plan is adopted and thereafter at least every three years, receive, consider, and promptly act upon petitions from any interested party, to add, delete, or modify MPAs, *favoring those petitions that are compatible with the goals and guidelines of this chapter*.” Goal number two of the MLPA states that MPAs must “Help sustain, conserve and protect marine life populations, ***including those of economic value,*** and rebuild those that are depleted.” It is impossible to comply with this regulation without scientific evaluation and clear metrics.

The rationale of adding new no-take MPAs to increase climate resilience is faulty and unclear.

There is a great deal of controversy around the theory that MPAs protect us from the effects of climate change. An MPA has not been proven to keep water cooler, nor has it been proven to lower the acidity of water, or even prevent or reverse urchin barrens. Furthermore, MPAs do not prohibit any land or air-based pollution sources. As we have seen on the North Coast of CA, the kelp populations have severely diminished and there exists now an ecological upheaval from purple urchins invasions inside and outside of MPAs. In fact MPA regulations make it hard to implement active habitat restoration to help increase kelp density and abundance. Without sound science to back it up, it is inappropriate to characterize expanding the MPA network as a means to buffer the effects of climate change.

If anything, more MPAs will only increase our carbon footprint by being more dependent as a society on foreign-caught/farmed seafood due to the damage to our local commercial fisheries. The demand for seafood has only increased in recent years and if our communities are not able to access seafood harvested by our local commercial fishermen, people will still buy seafood,

they will just be forced to buy it from unknown sources with unknown environmental/human rights regulations from unknown distances. This is the wrong direction for our society to go.

This process flies in the face of the FGC's new Coastal Fishing Communities policy.

The FGC recently adopted a new Coastal Fishing Communities (CFC) policy that states "Coastal fishing communities are facing unprecedented and dynamic challenges that strain and disrupt their social and economic fabric…The challenges coastal fishing communities face pose a significant threat to their sustained existence." It is tragic that the Commission followed this achievement with a direct assault on the fishing community. This totally chaotic petition process has drastically increased the strain on the fishing community to engage and fight to protect the survival of our State's working waterfronts.

The tenants of the CFC policy must be applied when evaluating new and potentially expanding MPAs. Scientific analysis of socio-economic impacts of any new or expanded MPAs on the commercial and recreational fishing industries must be found to be compatible with the CFC policy. Adding more closures to fishing grounds only further fractures our fleets' ability to provide for their families. There are few commercial fishermen remaining in the State of CA and those that are left have already been subjected to extreme regulations and spatial loss. Not to mention introducing more closures has a compounding ripple effect on the job security of processors, wholesalers, food establishments, and more. It also impacts the food security of all who individually consume locally harvested seafood.

This petition process is bad governance.

This petition process is not to be used for a 30x30 agenda, according to the Fish and Game Commission's official position. Having the 30x30 process going on concurrently with this new, untested and unclear petition process is especially crippling for the fishing community and it leads to confusion, bad governance and waste of government resources. Note Commissioner Murray's quote in the July 2024 MRC meeting that "we are making this up as we go along." Having two separate initiatives, one driven by The Ocean Protection Council ("OPC") 30x30, and another driven by the MRC/FGC with the petition process, is an example of the State making a mistake by pursuing two separate, essentially MPA, initiatives, made more crippling for us as small-scale fishermen who are already facing established area loss proposals from the numerous aforementioned factors.

COMMERCIAL FISHERMEN OF SANTA BARBARA

From an enforcement perspective, the California Department of Fish and Wildlife ("CDFW") is currently inundated with the work associated with just entertaining the challenges of analyzing the efficacy of new or expanded MPAs. The question of how CDFW's bandwidth will abruptly expand to be able to regulate and sustain all the hypothetically new/expanded MPAs has yet to be addressed. The infrastructure to support the proposed substantial new/expanded MPAs and then monitor their efficacy does not seem to exist nor have we seen any potential plans or cost-benefit analysis to materialize such a shift in the current framework should that become necessary. Nor has there been an effort to clearly articulate measurable goals tied to their establishment.

The entire petition process has complicated this landscape to a ridiculous degree when the topic of MPAs and other state-wide conservation initiatives are wildly complicated to begin with. Two state fisheries with gear types widely regarded as most threatening to biodiversity, trawling and set gillnets, were recently reviewed for their actual impacts to biodiversity. The scientific analysis of the set gill net and halibut trawl fisheries bycatch impacts were determined to be insignificant in relation to biodiversity and habitat impacts. Fisheries management measures have been effective in mitigating biodiversity impacts of our fisheries. Trawl grounds and set net grounds were severely reduced and are closely monitored. This is an example of how well-founded scientific data collection steered the FGC and CDFW in the direction of effective and science-based conservation decisions.

In conclusion, we ask the FGC to please seriously consider our rational, sound and evidence-based arguments for curtailing and revising the dysfunctional and unscientific MPA Petition Process that is unfolding. We ask that there be rigorously comprehensive justifications provided to the public before any expansion/introductory MPA petitions are approved. The implications of this petition process on the Santa Barbara commercial fishing industry and all CA commercial fishing fleets along with our subsequent consumers/beneficiaries are, in short, insidious.

Thank you for your time and consideration,

Chris Voss
President, CFSB

Kim Selkoe, Ph.D.
Executive Director, CFSB

Ava Schulenberg
Assistant Director, CFS

From: Kim Selkoe <[redacted]>
Sent: Thursday, October 24, 2024 02:49 PM
To: FGC <FGC@fgc.ca.gov>
Cc: [redacted] <[redacted]>
Subject: Written Comment from Get Hooked Seafood

Dear Fish and Game Commission,

Please find attached written comments from Get Hooked Seafood about the MPA Petition process in advance of the upcoming MRC meeting.

Thank you,

Kim Selkoe

--
Kim Selkoe
~~~~~~~~~~
Founder & CEO
Get Hooked Seafood
[redacted]
[redacted]
~~~~~~~~~~

Date: 10/24/2024

From:
Kimberly Selkoe, CEO
Get Hooked Seafood LLC
[redacted]

Dear Fish and Game Commissioners,

Get Hooked Seafood is a Community Supported Fishery program with a mission to support the public's access to local and sustainable seafood, and to add resilience to our fishing community and local food systems. We have operated since 2018 and have recently expanded to service not just households and restaurants but school districts and food banks. In addition, we are turning fish scraps into soil amendments that build soil health, sink carbon and reduce ocean pollution.

We stand with our fishing community in protesting the use of the MPA petition process to allow the proposal and consideration of new no-take MPAs. Our fisheries are a world leader in sustainable management and our MPA network covers a larger percentage of state waters and fishing grounds than what has been achieved in the vast majority of other US states. Our marine fish stocks are flourishing and none are experiencing overfishing. At the same time, our fishing communities are struggling to persist, and the number of fishing families is dwindling.

Taking away more fishing grounds will not protect us from climate change and will not reduce our contribution to climate change. In fact, it will increase our contribution to climate change because more seafood will need to be imported and marine ecosystems in other parts of the world where fisheries management is not effective will suffer.

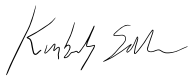
The survival of Get Hooked Seafood and the access to healthy sustainable seafood that we provide to thousands of Californians is directly threatened by taking away fishing grounds and accelerating the attrition of our environmentally-friends fishing fleets.

The MPA Petition process is deeply flawed and non-transparent. There is no science framework to it, and highly inadequate stakeholder engagement. It is a waste of state resources and the public's time and energy to evaluate every possible petition that any individual or group choses to submit. The majority of the petitions are a distraction from solving major pressing problems for our environment and our health and wellbeing.

This process is pitting the fishing community against both the environmental community and the native nations communities which will destroy our ability to come together and address real climate issues.

Please pause the petition process to redesign it and get public input on the redesigned petition process. We need a just, equitable, transparent, science-driven and fiscally responsible process to move forward.

Thank you,



Kimberly Selkoe
CEO
Get Hooked Seafood LLC

Victoria Voss,
COO
Get Hooked Seafood LLC

From: miles wallace <[redacted]>
Sent: Thursday, October 24, 2024 03:20 PM
To: FGC <FGC@fgc.ca.gov>
Subject: Nov. 6 2024 FGC MRC meeting

Good afternoon,

Thank you for taking the time to read my submission.

Miles Wallace

Miles Wallace
Owner, Open Ocean Seafood
[redacted]
[redacted]

October 23, 2024

TO: The California Fish and Game Commission
Attn: fgc@fgc.ca.gov
715 P Street, 16th Fl.
Sacramento, CA, 95814

RE: November 6th, 2024 FGC MRC Meeting Agenda Item 2 - Marine protected area (MPA) regulation change petitions – Evaluation process

For over 25 years, The California Lobster & Trap Fishermen's Association ("CLTFA"), a 501(c)3 non-profit organization, has been established as a corporation to aid, encourage, and promote activities and affairs that maintain the populations of the California Spiny Lobster species and other kinds of fish and crustaceans off the coast and islands of the State of California. CLTFA has continued to maintain levels of maximum sustained yields, to aid, encourage, and promote activities and affairs that further the goal of viable and equitable access to such living marine resources by commercial fishermen licensed by the State of California. As a well-respected organization within the California fishing community, it represents the interests of vastly experienced trap fishermen from a variety of regions, from Point Conception to San Diego. It is our stance that we vehemently oppose the Marine Resources Committee ("MRC") and Fish & Game Commission's ("FGC") usage of the petition process to expand existing Marine Protected Areas ("MPAs") and create new MPAs. While the petition process is a reasonable adaptive management tool required by the Marine Life Protection Act, it should *not* be used to make the proposed significant changes to the existing MPA network due to a lack of scientific data and stakeholder engagement.

We ask that you please recognize the devastating amount of spatial loss that our commercial fishing fleet has already endured in past years and all the newly proposed

spatial take on the horizon. Currently, fishing communities along the California coast are faced with significant area loss associated with offshore wind, aquaculture, wave energy, and the 30x30 Initiative. Additionally, anticipated aggressive spatial and temporal closure, such as Rock Cod Conservation Areas, whale entanglement prevention zones, and Elon Musk's SpaceX rocket launch initiatives, would ban fishing in the surrounding offshore areas of the Vandenberg Base over two months out of the year (72+ days). Sixteen percent of highly valuable marine habitats are already closed in the State of California, with no sign of that figure decreasing any time soon. Adding more closures to fishing grounds only further fractures our fleets' ability to do their job and provide for their families. Introducing more closures has a compounding ripple effect on the job security of processors, wholesalers, food establishments, and families. Moreover, it also impacts the food security of all who individually consume locally harvested seafood.

The first goal of the Marine Life Protection Act ("MLPA") states that MPAs must, "Protect the natural diversity and abundance of marine life, and the structure, function and integrity of marine ecosystems," and the fifth rule states that MPAs must, "Ensure California's MPAs have clearly defined objectives, effective management measures and adequate enforcement and are based on **s**ound scientific guidelines." According to renowned scientist Ray Hilborn's recent article, there is no scientific evidence to prove that MPAs promote biodiversity any more than in an unprotected area. He asks the important question, "If the MPAs show more stability because fishing effort was removed, would we not expect the reference sites to show less stability because fishing efforts increased there?" In the July 2024 MRC FGC Meeting, Commissioner Murray stated that, "MPAs are not fisheries management tools," and that "they're not going to launch new monitoring projects to help this process." Commissioner Murray emphasized that her "current questions are about the data they already have," and stated that essentially there will not be any opportunities to collect new data when evaluating these petitions. Not investing in efforts to collect sound scientific data given the vast implications of such proposed new/expanded MPAs is a violation of the fifth rule of the MLPA. Relying on stale data, and an immense lack of scientific data in general, especially in an environment as hostile as the ocean, is not only irresponsible, but not the fair way to evaluate any controversial initiative, especially when evaluating these disputed petitions that have the potential to drastically change people's lives for the worse.

Section 2861 (a) of the MLPA states that "the commission shall, annually until the master plan is adopted and thereafter at least every three years, receive, consider, and promptly act upon petitions from any interested party, to add, delete, or modify MPAs, favoring those petitions that are compatible with the goals and guidelines of this chapter." Goal number two of the MLPA states that MPAs must "help sustain, conserve and protect marine life populations, including those of economic value**,** and rebuild those that are depleted." If the Commission approves and implements petitions that aim

to expand/introduce new MPAs and our ability to fish in more areas is severed, marine populations of economic value *may* be more conserved (though this has not been scientifically proven), but there is no economic value to populations unharvested? The goal of specifically protecting marine populations of economic value would become a moot point.

With regard to the 30x30 Initiative, it is crucial for us as community organizers and commercial fishermen, to have two separate processes with the same objective (30x30 Initiative and the petition process). If we can eliminate the ability to close significant areas through the petition process and focus solely on the 30x30 Initiative, we would be able to concentrate our efforts to deal with that initiative, albeit one that is also designed to take massive fishing areas away from us, in a more reasonable fashion. Having two separate initiatives, one driven by The Ocean Protection Council ("OPC") which is the 30x30 Initiative, and another driven by the MRC/FGC with the petition process, is an example of the State making a mistake by pursuing two separate, essentially MPA initiatives, creating intentional struggles for us as small-scale fishermen, who are already facing established area loss proposals from the numerous aforementioned factors.

Additionally, there is a great deal of controversy around the theory that MPAs protect us from the effects of climate change. An MPA has not been proven to keep water cooler, nor has it been proven to lower the acidity of water. Furthermore, MPAs do not prohibit any land or air-based pollution sources, if anything, they will only increase our carbon footprint by being more dependent on foreign-caught/farmed seafood due to our local commercial fishermen being zoned out by the introduction of the very initiative (new/expanded MPAs) designed to "help mitigate climate change" in the first place; The claims that more MPAs are going to build climate change resilience in the marine environment are not well grounded in legitimate science. As we have seen on the North Coast of CA, the kelp populations have severely diminished and there exists now this ecological upheaval of purple urchins dominating - This occurrence may be the result of climate change causing warmer water, but kelp die-offs are happening in *and* outside MPAs, so it's inappropriate to characterize expanding the MPA network as a means to buffer the effects of climate change. We understand that MPAs cannot do everything and that we are not just looking at one single aspect of climate change - Kelp loss/marine heat waves are just an example. There are plenty of reasons to use and not use MPAs, but the demand for seafood has only increased in recent years and if our communities are not able to access seafood harvested by our local commercial fishermen, people will still buy seafood, they will just be forced to buy it from unknown sources with unknown environmental/human rights regulations from unknown distances traveled; This is not the direction our society should be going in, we urge the Commission to make decisions that steer us away from that path.

From an enforcement perspective, the California Department of Fish and Wildlife

("CDFW") is currently inundated with the work associated with just *entertaining* the challenges of analyzing the efficacy of new or expanded MPAs; The question of how CDFW's bandwidth will abruptly expand to be able to regulate and sustain all the hypothetically new/expanded MPAs has yet to be addressed. The infrastructure to support the proposed substantial new/expanded MPAs does not seem to exist nor have we seen any potential plans or cost-benefit analysis to materialize such a shift in the current framework should that become necessary.

The entire petition process has complicated this landscape to an unreasonable and unmanageable degree when the topic of MPAs and other state-wide conservation initiatives are wildly complicated to begin with. There are few commercial fishermen remaining in the State of CA, and those that are left have already been subjected to extreme regulations and spatial loss. We ask the FGC to please seriously consider how much we have to respond to and keep ourselves on top of just in order to keep our head above water and make a living fishing in an already extensively regulated space. The implications of this petition process on the CA commercial trap fisheries and all CA commercial fishing fleets, along with our subsequent consumers/beneficiaries, are profoundly insidious, and we therefore ask that there be rigorously comprehensive justifications provided to the public before any expansion/introductory MPA petitions are approved.

Thank you for your time and consideration.

Miles Wallace
Owner, Open Ocean Seafood

[redacted]FGC

From: Matthew Bond [redacted]
Sent: Thursday, October 24, 2024 8:28 AM
To: fgc@fgc.ca.gov
Cc: Christopher Killen
Subject: Nov. 6th 2024 MRC Meeting Agenda Item 2 a&b Commnet.

Dear Members of the California Fish and Game Commission,

Thank you for the difficult work you are doing as volunteers to steward California's natural resources.

In light of some concerning comments and exchanges by Commissioners and Department leadership at recent Commission and MRC meetings about how MPA petitions may or may not be scientifically analyzed, which forum (full commission or MRC) should be used to discuss these petitions, and if petitioners should be allowed to modify their petitions (contrary to the normal petition process), we bring the Commission's attention to Section 2855 (a) of the MLPA, which called for the creation of a guiding document for the creation and implementation of the MLPA:

"The commission shall adopt a master plan that guides the adoption and implementation of the Marine Life Protection Program adopted pursuant to Section 2853 and **decisions regarding the siting of new MPAs and major modifications of existing MPAs.**"

In sending this passage to the Commission we hope to remind you that your group is a constitutional rule making body that was vested the authority to implement the MLPA. The Commission, through an extensive, science based, costly, and public process, adopted a network of MPAs and the guidance document for their management. The management document was adopted through your authority in August 2016 and is known as **the Master Plan for MPAs (Master Plan).** This plan lays out clearly how any amendments to the network should be considered. If the Commission determines they need to change the adaptive process, they

have the authority to amend that plan through their deliberate process. We can find no mention in the Master Plan of an instance where the creation of a completely new process to consider MPAs, like the one you are following now, is authorized or even recommended.

It is our opinion that the choice to abandon the Master Plan and instead implement the ad hoc process you are currently following is directly contrary to the expectation the public has from your creation and adoption of the Master Plan. The aforementioned problematic comments by leadership are an example of the resulting confusion and lack or rigid guidance due to this choice. The Master Plan was specifically designed for this very situation. It calls for a science-based process, with clear funding mechanisms, and provides a very detailed description of how changes to MPAs must be approached. The following excerpt from the 2016 Master Plan, Appendix A, Page A-13 makes abundantly clear the creation of any new, or major modification to existing, MPAs is expected to follow the same process as the original MLPA:

"The MLPA also requires that MPAs be managed as a network, to the extent possible, implying a coordinated system of MPAs. MPAs might be linked through biological function, as in the case of adult and juvenile movement or larval transport. However, MPAs managed as a network might also be linked by administrative function. The important aspects of this interpretation are that MPAs are linked by common goals and a comprehensive management and monitoring plan, and that they protect areas with a wide variety of representative habitats as required by the MLPA. **MPAs in a network should be designed based on the same guiding principles, design criteria, and processes for implementation. In this case, a statewide network could be one that has connections through design, funding, process, and management. At a minimum, the Master Plan should insure that the statewide network of MPAs reflects a consistent approach to design, funding, and management**. The desired outcome would include components of both biological connectivity and administrative function to the extent that each are practicable and supported by available science."

On July 28th, 2024 we sent a message to Executive Director Miller-Hensen and Director Bonham expressing serious concerns with the

decision by The Department and Commission to design a new process to evaluate the MLPA DMR related petitions before the Commission and ignore the policy mandates and very clear process guidance included in the Master Plan on how new, or major changes to existing, MPAs should be considered. Our July comment is included in its entirety below:

The MLPA, and the 2008 and 2016 Master Plans for Marine Protected Areas (Master Plans) lay out clear processes and public expectations for how decisions regarding the siting of new MPAs and major modifications of existing MPAs will be handled, with particular focus on the areas of stakeholder and tribal input, independent scientific and economic impact review, and the necessity of securing sufficient funding in MLPA related MPA creation and expansion. We feel many key tenets of these Commission adopted documents are being ignored.

There are numerous sections of directives contained in MLPA, and the 2008 and 2016 Master Plans which are not being followed because of what we are being told are budgetary/resource shortfalls. Instead of the robust, inclusive, objective, process promised in the MLPA, followed in the 2008 Master Plan, and delineated in the 2016 Master Plan, The Department and Commission have decided on a process which relies on only The Department's and their own subject matter expertise, admittedly has no dedicated funding source for both the mandated analysis, creation, implementation, management, outreach, education, monitoring, and enforcement of any new or expanded MPAs which may result, and only allows for public input leading up to or during Commission meetings.

We feel this approach to public comment and stakeholder engagement is particularly harmful. It only allows for a very select class to be able to participate. The vast majority of Californians have no idea this process is taking place. Of those who do, the chosen plan allows for input from only those privileged few who work for an entity with interest in the outcome of this process, or from those individuals whose economic or life circumstance allows them the luxury of time to either follow remotely and write public comment, or show up to a live meeting during the work week. At live meetings, comment is almost always limited to 90 seconds; not nearly enough time to express detailed and nuanced opinions and

concerns. Those vulnerable individuals and communities, who rely most on the health of our ocean and their local access to catch fish in order to feed their families, are mostly excluded by the current process. The only language being spoken at the commission meetings is English and we know of no outreach or education in an effort to include the voices in this already live process of communities that do not call English their native tongue.

The Commission and Department have publicly recognized shortcomings with the lack of inclusion of the Tribal Community and traditional knowledge in the first phase of the MLPA process. A lot of great work has been done by those agencies to avoid future harm to that very important and historically mistreated group in our marine ecosystems and fisheries management decisions. The addition of a new tribal liaison to The Commission team is a wonderful example of this commitment to justice and inclusion. But we fear the approach The Commission and Department are now taking toward stakeholder input has the potential to create the circumstance for other marginalized and unrecognized communities and people to be excluded from, and hurt by, the ultimate decisions around these petitions.

The adherence to the prescribed process The MLPA included for stakeholder participation, science and economic advisory panels, secured funding sources, and interagency cooperation, and their execution in the carrying out of the 2008 Master Plan established for the public at minimum a strong expectation, and likely an actual precedent, that a mostly identical process would be followed going forward, should new MPAs or major modifications to existing MPAs be considered.

A second but related concern is that there is an arbitrary haste in this petition review process which is absolutely counter to the importance of the task. It is dangerous to ignore the fine detail the drafters of the MLPA and Master Plans very purposefully gave us in how to design, implement, and adaptively manage the most successful MPA network in existence. In fact, the stakes are even higher now in our management of our marine environments as compared to when the MLPA was written and our network implemented. In light of what we now know about the potential ravages of climate change, marine heat waves, and a myriad of

other potential harm causing stressors to our marine ecosystem, we need to act with extreme care and be incredibly methodical in analyzing every aspect of management decisions. This critical work cannot be done properly without a sufficient budget and without as much time as it takes to do it right.

Department staff and Commission members both have repeated the sentence “we can’t (or don’t want to) do a “MLPA 2.0”” in public meetings. We again are told that this is because of lack of resources. It is very clear in the examples the two failed attempts to initiate the original MLPA provide us that proper funding is critical to the ultimate success of MPA projects. The MOU between our state and Resource Legacy Fund, which was the differentiator between the two failures and our current success, was so pivotal in its enablement of our network that the need to secure similar, sufficient, funding for new MPAs or expansions of existing MPAs has been enshrined as one of the core tenants of the 2016 Master Plan. This begs the question, if there isn’t now enough money or time to do this as prescribed in the MLPA and Master Plans, why aren’t these petitions tabled until proper resources can be allocated?

It is easily argued that California’s ocean and marine resources are both one of its most valuable attributes as well as one of its most complex and fragile. More than 20 years ago concerns of severe degradation and future risks facing these resources, voiced by leading environmental groups, scientists, members of the fishing community, and many other diverse stakeholder groups, the state legislature passed the MLPA and The Department, Commission and other state and private organizations dutifully and successfully implemented one of the most extensive marine conservation projects ever undertaken. The MLPA serves as a global model of exceptional marine conservation.

We now find ourselves with a warming climate and many unknowns with regard to the future health of our marine ecosystems. What the MLPA and Master Plans provide us in these challenging circumstances are proven methodologies to follow in the consideration of the use of MPAs as part of an overall ecosystem level protection strategy. To deviate from this guidance now, particularly in light of the aforementioned increased

risk factors and because of budgetary shortfalls, is not only shortsighted, but could result in tremendous wasted resources, loss of public support, and actual harm to our ocean and our state's population who depend on it for their heath, recreation, nutrition, and income.

Because of these concerns and the provided rational, we ask that you dismantle the current process you have adopted and replace it with the one prescribed in the MLPA, which resulted in the 2008 and 2016 Master Plans and which was followed to create and manage the amazing network of MPAs now off our coast. And further, if lack of dedicated funding and resources, as demanded in the 2016 Master Plan, are not allowing The Department and Commission to carry out the robust, objective, and inclusive review process of these petitions, we expect you to wait until the promised and proven process can be successfully carried out.

Respectfully,

Matt Bond
Allwaters PAC

[redacted]FGC

From: CLTFA [redacted]
Sent: Thursday, October 24, 2024 1:27 PM
To: fgc@fgc.ca.gov
Cc: Ray Kennedy
Subject: Written Public Comment Regarding November 6th FGC/MRC Meeting Agenda Item Number Two
Attachments: CLTFA FGC MRC 11_6 Meeting Written Public Comment Letter (signed).pdf

Dear Commissioners,

My name is Ava Schulenberg and I am a commercial fisherman from Santa Barbara, CA. I am also the Executive Director of the California Lobster & Trap Fishermen's Association - Please see our attached letter on agenda item two of the upcoming November 6th FGC/MRC meeting.

Thank you for your time spent reviewing our letter. Please confirm if it's been received.

--
Kind Regards,
Ava Schulenberg
Assistant Director | Commercial Fishermen of Santa Barbara (CFSB)
Manager | Saturday Fishermen's Market of Santa Barbara
Executive Director | CA Lobster & Trap Fishermen's Association
Laboratory Assistant II | CA Sea Grant
Deckhand | F/V Drema
(805) 403-4811

California Lobster & Trap Fishermen's Association 315 Meigs Rd., STE A 279, Santa Barbara, CA 93109 https://www.californialobstertrapfishermensassociation.org/

October 23, 2024

To:
The California Fish and Game Commission
fgc@fgc.ca.gov

Re: November 6th, 2024 FGC MRC Meeting Agenda Item 2 - Marine Protected Area (MPA) regulation change petitions – Evaluation process

For over 25 years, the California Lobster & Trap Fishermen's Association (CLTFA), a 501(c)3 non-profit organization, has been established as a corporation to aid, encourage, and promote activities and affairs that maintain the populations of the California Spiny Lobster species and other kinds of fish and crustaceans off the coast and islands of the State of California at levels of maximum sustained yields, and to aid, encourage, and promote activities and affairs that further the goal of viable and equitable access to such living marine resources by commercial fishermen licensed by the State of California. CLTFA is a well-respected organization within the California fishing community and represents the interests of vastly experienced trap fishermen from a variety of regions from Point Conception to San Diego. It is our stance that we vehemently oppose the apparent process being used by the Fish and Game Commission (FGC) to amend the existing network of Marine Protected Areas (MPAs). It was our expectation that the 2016 Master Plan adopted by the FGC would guide the approval process for future modifications to the network of MPAs. Unfortunately, the FGC has apparently decided to abandon that guidance and instead has tried to shortcut that process through the Marine Resources Committee (MRC) and FGC usage of the petition process to expand existing MPAs and to create new MPAs. While the petition process is a reasonable adaptive management tool required by the Marine Life Protection Act, it should *not* be used to make the proposed significant changes to the existing MPA network simply because of insufficient funding and an unwillingness to spend the time needed to conduct the science and stakeholder engagement.

We ask that you please recognize the devastating amount of spatial loss that our commercial fishing fleet has already endured in past years *and* all the newly proposed spatial take on the horizon. Currently, California coastal fishing communities are faced with significant area loss associated with offshore wind, aquaculture, wave energy, and the 30x30 Initiative. There are also aggressive proposed spatial and temporal closures such as Rock Cod Conservation Areas, whale entanglement prevention zones, and Elon Musk's SpaceX rocket launch initiatives which would ban fishing in the surrounding offshore areas of the Vandenberg Base over two months out of the year (72+ days). Sixteen percent of highly valuable marine habitats are already closed in the State of California, with no sign of that figure decreasing any

time soon. Adding more closures to fishing grounds only further fractures our fleets' ability to do their job and provide for their families. Not to mention that introducing more closures has a compounding ripple effect on the job security of processors, wholesalers, food establishments, and more, and also impacts the food security of all who individually consume locally harvested seafood.

The first goal of the Marine Life Protection Act (MLPA) states that MPAs must "Protect the natural diversity and abundance of marine life, and the structure, function and integrity of marine ecosystems," and the fifth rule states that MPAs must "Ensure California's MPAs have clearly defined objectives, effective management measures and adequate enforcement and are based on ***sound scientific guidelines***" According to a recent article by renowned scientist Ray Hilborn, there is no scientific evidence to prove that MPAs promote biodiversity any more than in an area under modern fishery management. He asks the important question, "If the MPAs show more stability because fishing effort was removed, would we not expect the reference sites to show less stability because fishing efforts increased there?" In the July 2024 MRC FGC meeting, Commissioner Murray stated "MPAs are not fisheries management tools" and "They're not going to launch new monitoring projects to help this process." Commissioner Murray emphasized that her "Current questions are about the data they already have" and stated that essentially there will not be any opportunities to collect new data when evaluating these petitions. Not investing in efforts to collect sound scientific data given the vast implications of such proposed new/expanded MPAs is a violation of the fifth rule of the MLPA and the Master Plan the FGC adopted to guide this very effort. Relying on stale data, and a massive lack of scientific data in general, especially in an environment as hostile as the ocean, is an irresponsible way to evaluate any controversial initiative, especially when evaluating these disputed petitions that have the potential to drastically change people's lives for the worse.

Section 2861 (a) of the MLPA states "The commission shall, annually until the master plan is adopted and thereafter at least every three years, receive, consider, and promptly act upon petitions from any interested party, to add, delete, or modify MPAs, *favoring those petitions that are compatible with the goals and guidelines of this chapter*." Goal number two of the MLPA states that MPAs must "Help sustain, conserve and protect marine life populations, ***including those of economic value,*** and rebuild those that are depleted." If the Commission approves and implements petitions that aim to expand/introduce new MPAs and our ability to fish is eliminated in more areas, marine *populations* of economic value *may* be more conserved (though this has not been scientifically proven), but the economic value of those unharvested populations will be unrealized. The goal of specifically protecting marine populations of economic value would become a moot point.

It is confounding for us as community organizers and commercial fishermen to have two separate processes (the Ocean Protection Council 30x30 initiative and the current FGC MPA petition process) with the same basic objective. It is unreasonable for the State to be conducting these two processes simultaneously, unless the State is seeking to divide and confuse those trying

to engage in an effort to protect access to the public's sustainable natural resources. By pursuing two separate, essentially MPA, initiatives, the State is making participation more difficult for us as small-scale fishermen who are already facing established area loss proposals from the numerous aforementioned factors. This is an insensitive effort that leads to exclusion, inequity, injustice, and a lack of diversity in the decision-making process.

An example of our concerns over this apparent rush to add and expand MPAs is the justification that they will help protect our coastal ecosystems from the effects of climate change. The claims that more MPAs are going to build climate change resilience in the marine environment are not well grounded in legitimate science. As we have seen on California's North Coast, the kelp populations have severely declined, which has resulted in an ecosystem dominated by purple urchins. This occurrence may be the result of climate change causing warmer water, but kelp die-offs are happening in *and* outside MPAs, which suggests that expanding the MPA network is unlikely to buffer even this one possible effect of climate change. Moreover, we have not seen the science demonstrating that MPAs will alter any of the larger climate change issues, such as lowering the temperature and acidity of the marine environment.. Furthermore, MPAs do not prohibit any land- or air-based pollution sources; If anything, they will only increase our carbon footprint by increasing our dependence on foreign-caught/farmed seafood as local commercial fishing activities are restricted by new/expanded MPAs adopted under the very initiative designed to "help mitigate climate change.

We understand that MPAs are not expected to address every aspect of climate change, kelp loss/marine heat waves are just an example. There are multiple factors to consider when adopting or not adopting MPAs; However, it should be recognized that the demand for seafood has only increased in recent years. If our communities are not able to access seafood harvested by our local commercial fishermen, they will instead be forced to buy it from distant sources with unknown environmental/human rights regulations from unknown distances traveled. This only increases the carbon footprint of the product and is contrarian to the current emphasis in society to "buy local." We urge the Commission to make decisions that steer us away from that path.

From an enforcement perspective, the California Department of Fish and Wildlife (CDFW) is currently inundated with the work associated with just *entertaining* the challenges of analyzing the efficacy of new or expanded MPAs, the question of how CDFW's bandwidth will abruptly expand to be able to regulate and sustain all the hypothetically new/expanded MPAs has yet to be addressed. The infrastructure to support the proposed substantial new/expanded MPAs does not seem to exist nor have we seen any potential plans or cost-benefit analysis to support such an expansion should that become necessary.

The topic of MPAs and other statewide conservation initiatives was convoluted to begin with, and the entire petition process has now complicated this regulatory landscape to a ridiculous degree. There are few commercial fishermen remaining in California and those that

are left have already been subjected to extreme regulations and spatial loss. We ask the FGC to please seriously consider how much our industry must address and monitor just to keep our head above water and make a living fishing in an already extensively regulated space. The implications of this petition process on the California commercial trap fisheries and all California commercial fishing fleets, along with our subsequent consumers/beneficiaries, are profoundly insidious. We therefore ask that the process outlined in the 2016 Master Plan be followed and that the scientific and stakeholder engagement be extensive and thorough. The costs/benefits of any changes must be well documented and understood so that you as decision-makers can be confident of making wise, effective, and just decisions for the future of California and all its citizens.

Thank you for your time and consideration.

Ava Schulenberg
Executive Director, CLTFA

Ray Kennedy
President, CLTFA

From: Ava Schulenberg <[redacted]>
Sent: Thursday, October 24, 2024 04:45 PM
To: FGC <FGC@fgc.ca.gov>
Cc: Ava Schulenberg <[redacted]>
Subject: Written Public Comment Regarding November 6th FGC/MRC Meeting Agenda Item Number Two

Dear Commissioners,

My name is Ava Schulenberg and I am a commercial fisherman from Santa Barbara, CA. Please see my attached letter on agenda item two of the upcoming November 6th FGC/MRC meeting.

Thank you for your time spent reviewing our letter. Please confirm if it's been received.

--

Kind Regards,

Ava Schulenberg

Assistant Director | Commercial Fishermen of Santa Barbara (CFSB)

Manager, Saturday Fishermen's Market of Santa Barbara

Secretary, CA Lobster & Trap Fishermen's Association

Deckhand F/V Never Satisfied

[redacted]

October 24, 2024

To: The California Fish and Game Commission, fgc@fgc.ca.gov

Re: November 6th, 2024 FGC MRC Meeting Agenda Item 2 - Marine Protected Area (MPA) regulation change petitions – Evaluation process

Dear Commissioners,

My name is Ava Schulenberg and I am a 28 year-old second-generation commercial fisherman from Santa Barbara, California. I have a degree in Environmental Studies and Philosophy from Tulane University, and in addition to crewing on various fishing vessels (I primarily have fished for Spiny Lobster, Rock Crab, Halibut, and Rockfish), I work for the Commercial Fishermen of Santa Barbara Association and the California Lobster & Trap Fishermen's Association, both of which are 501(c)3 non-profit organizations. I do contracted projects with California Sea Grant as well, and crew as a stewardess on charter boats in any spare time I have. I am a proud daughter of a lifelong commercial fisherman and am grateful to have been raised in the Santa Barbara harbor where the importance of local food production was instilled in me from a young age.

I will not duplicate here what I have submitted in other letters on behalf of the organizations I work for, I instead am submitting this additional letter to speak to the emotional impact these closures would have should they come to fruition.

Of all my jobs, being a deckhand is by far the most rewarding. As you all likely know, commercial fishing is a wonderful, dangerous, exhilarating, and fulfilling job that transcends most occupational norms to say the least. It is a job that humbles you and keeps you on your toes; You are invariably at the mercy of the weather and Mother Nature is your one true boss. Commercial fishing is a great equalizer - Our fleet is comprised of people with different socio-economic backgrounds, religions, educations, ethnicities… but on the water we are all the same. This industry represents a craft that has been handed down to us through hundreds of generations, and it's a craft that will hopefully be here long after we are gone because of our actions now.

With that said, this petition process has been exceptionally threatening to our industry's future and devastatingly debilitating to us as a fleet. As you all know, fishermen are not paid for anything other than fishing and landing product. Yet the level of advocacy that has been required for this treacherous fight on top of all the other opposing forces we face (30x30, aquaculture, offshore wind, SpaceX, to name a few) has been enormous and often impossible given that fishermen are at the mercy of the weather and often do not have reception to be able to chime into important meetings. From the advocacy efforts we have been able to perform, we have voiced our respect for the beautiful environment we are fortunate to work in, and we have reminded our community and all stakeholders that as fishermen/ocean harvesters, we care a great deal about the wellbeing of the planet and our local habitats. Commercial Fishermen are largely a misunderstood group - Speaking to Santa Barbara's fleet specifically, the vast majority are

extremely hard-working, conscientious individuals who make a living by working *with* the environment and think and act in three dimensions in order to make do. At the end of the day, feeding people healthy, sustainably caught seafood is the most important element of the job that drives us, and the ability for us to do that hinges substantially on our access to healthy fishing grounds.

Moreover, I have yet to see an independent, comprehensive study that exhibits data that justifies the expansion and/or introduction of new Marine Protected Areas. Show us the science in absolute terms, and *then* force us to lose more areas (which would be devastating, but at least would be backed by proof), but to even *entertain* the proposed spatial loss put forth by some of the Bin 2 petitions without proper scientific evidence and stakeholder engagement is ludacris and a neglectful, offensive assault on all commercial fishermen, who, as you know, are axiomatically the people who spend the most time on the ocean and in the areas being potentially subjected to restriction.

Surely you have all been told this several times, but I want to again underscore the fact that commercial fishing is more than just a job to us, it is <u>everything</u>. It is the heartbeat of our livelihoods and our passions and it is a way of life that we will do anything to preserve. We work seven days a week and commute on an erratic freeway that changes every night. There are no "days off" - Any time spent not fishing leads a fisherman's mind to the same questions: What is the weather doing? Is the gear ok? What is the market doing? Do I need bait? Do I need fuel? Is anything wrong with the boat? The list goes on… It is so rare that you come across individuals that exhibit this level of sweeping dedication to their careers. Therefore it would be in the best interest of all Californians if our Fish and Game Commission and regulatory agencies held our industry in a higher regard, because if statewide/domestic commercial fishing activity becomes more scarce, our society will become forcibly dependent on imported/farmed seafood, thereby drastically increasing our carbon footprint. The demand for seafood has only increased in recent years and if our communities are not able to access seafood harvested by our local commercial fishermen, people will still buy seafood, they will just be buying it from unknown sources with unknown environmental/human rights regulations from unknown distances traveled.

From a personal perspective, growing up with a dad who was a commercial fisherman was something of a dream. There is no influence that has been more significant in my life than the time I spent working with him and being embraced by the special fishing community that the Santa Barbara Harbor holds. My dad passed when I was 12, but the lessons he impressed upon me drive me to this day; Some of which include the fact that working with mother nature is one of the most difficult yet illuminating jobs in the world, you must always treat the environment with the utmost gratitude and respect, consuming locally sourced food is paramount to the planet's health and your personal health, you must be there for your comrades implicitly, and my favorite pearl of wisdom he shared is, that when we are out fishing, we are able to deeply appreciate and acquaint ourselves with the world in which we came from. There is something really beautiful about that - I take pride in knowing that most of the gear we use has been used for centuries, and the areas we fish are sacred and prehistoric; We are connected to eras that no longer exist, yet it is still our reality.

As I touched upon earlier, commercial fishing humbles you in ways you cannot imagine unless you have done the job, and there has never been a more important time to build consistent touchpoints into our lives that do that… touchpoints that bring us back to Earth and remind us that we are small, but the impact our work has on the wellbeing of others is still profound. The collective wealth of knowledge held by all California commercial fishing fleets is precious and something that ought to be approached with a goal of perpetuation, not inhibition; Once it is gone, it is gone for good.

In case it has not yet been evident, the goal of keeping commercial fishing alive has been the throughline of my life, and it would be heart-breaking to see family legacies end due to an unviable industry for future generations to be a part of… An unviable industry caused by fleets being zoned out until there are so few remaining areas left to fish that it becomes impossible due to more MPAs on top of the aforementioned spatial threats.

All this to say, *please* consider investing in more legitimate scientific research pertaining to each expansion/introductory MPA petition in Bin 2 before initiating the evaluation process. California is already home to some of the most regulated fisheries in the world, and losing more fishing grounds backed by unfounded justifications would be a crime against history, all commercial fishermen, all of our subsequent consumers and beneficiaries, and all citizens of the State of California. When we look back, I hope that this period of impending change will show an outcome that is well-grounded in science, and enables small-scale food producers like California's commercial fishermen to thrive and persist for generations to come.

Thank you for your time and consideration.

Ava Schulenberg
Assistant Director | Commercial Fishermen of Santa Barbara (CFSB)
Manager | Saturday Fishermen's Market of Santa Barbara
Executive Director | CA Lobster & Trap Fishermen's Association
Laboratory Assistant II | CA Sea Grant
Deckhand
E: [redacted]
P: [redacted]

Exhibit 19

Agenda Item 2, Marine Protected Areas Petitions Evaluation

Received by the California Fish and Game Commission for the November 6-7, 2024 Marine Resources Committee Meeting

List of Public Comments and Attachments

1. Email from Chris Killen, All Waters PAC, transmitting op ed from Dr. Ray Hillborn, Professor, posted online at Santa Barbara Independent, and an article by Dr. Jason Johns, Conservation Scientist, posted to sbfreedivers.com, received October 9, 2024
2. Email from Bill Shed, CCA California, transmitting two attachments: Op ed from Dr. Ray Hillborn, Professor, posted online at Santa Barbara Independent (see comment 1), received 10/22/24
3. Email from Bill Shed, CCA California, transmitting two journal articles: Ceccarelli et al, 2024, and Hopf et al, 2024.

From: Christopher Killen <[redacted]>
Sent: Wednesday, October 9, 2024 11:50 AM
To: [redacted]; Ashcraft, Susan@FGC <[redacted]>; [redacted]; FGC <FGC@fgc.ca.gov>; [redacted]; [redacted]
Cc: [redacted]
Subject: A few recent papers about the effectiveness of MPA's

Hi all,

I hope my messages find you all well and good.

Attached is a collection of papers for your review as we continue in our efforts to pull together data and science around MPAs.

The first, which I'm assuming you have all seen by now, is from Ray Hilborn; a Professor in the School of Aquatic and Fishery Sciences at the University of Washington and served on the Science Advisory Team for 2 of the 4 regions during MLPA planning. He has been awarded the World Fisheries Science Prize and the Volvo Environmental Prize.

The second is from Jason Johns, a PHD out of Santa Barbara who founded One People One Reef.

Post-Doctoral Fellow

- Post-doctoral fellow with OPOR; using genomic tools to understand connectivity between the islands of Ulithi
- PhD in Ecology, Evolution, and Marine Biology, University of California Santa Barbara, September 2023
- Jason is interested in coupling vast indigenous knowledge earned over time with modern tools to better understand the management of ecosystems and natural resources.
- Jason has spent most of his life in the ocean surfing, fishing, and free diving, but is beginning his professional marine science career with OPOR, as his background is in plant biology and genetics. He is looking forward to blending his love for the ocean and learning from people from different parts of the world with his love for doing science.

Would love to know your thoughts!

Respectfully,

Chris

Show Me the Benefits

10 Years in, What Have Marine Protected Areas Accomplished?

By **Ray Hilborn**
Tue Oct 01, 2024 | 4:49pm

More fish, more sustainable fisheries, and an ecosystem better protected from threats was the promise of the Marine Life Protection Act (MLPA) and the 124 MPAs now in place in California. Ten years on, what have they accomplished? The recently completed 10-year review by the California Department of Fish and Wildlife, as well as numerous scientific papers, suggest that our hopes were misplaced. The review concludes “statewide and regional trends across habitats showed no difference in biodiversity inside compared to outside MPAs.” As to the very real threats to California’s coastal ecosystems, climate change and recent marine heat waves, the review is decidedly not sanguine “analysis across habitats in the central coast revealed that MPAs did not provide strong resilience against the marine heatwave.” Ouch! Finally, there is not even evidence that there are any more fish in California state waters now, except for some of the areas that are closed to fishing. The only study to look at whether there were more fish overall suggests that the answer is no. Where fishing is intense, there are definitely more fish inside the closed area, but the fishing boats simply moved outside the boundary and caught them there.

The structure of the 10-year review alone squashes any expectations that the MPAs might be protecting our ocean from any threats. The review devotes 9 pages to governance and partnerships, 22 pages to research, 15 pages to outreach and education, and 14 pages to enforcement. A paltry 4 pages deal with how marine species have changed, and another 4 pages deal with climate resilience. The blatant absence of “good news” is spun into research, public engagement and enforcement as if those had been the goals the MPAs were meant to achieve.

Unsurprisingly, the only threat the MPAs do address is overfishing, and that is not a problem in state waters. The Marine Life Protection Act was conceived and implemented at a time of serious concerns about declines in many rockfish species in federal waters, but are not the focus of fisheries in state waters and are rarely found there. One should not

expect major benefits from no-fishing zones when there is no overfishing to begin with.

Make no mistake, California coastal ecosystems face many threats. These include climate change related warming, ocean acidification, storm severity and sea level rise. Moreover, the coasts face a wide range of terrestrial impacts from coastal development, sedimentation, land based runoff of sediments and pollutants, and water diversions. New exotic species and diseases have arrived, and ship traffic is increasing. California's MPA network provides no protection from any of these threats, and yet the MPA advocates are still claiming to have protected the ocean.

The Marine Life Protection Act was born in a research network of academics who formed a group call PISCO that published a report called "The Science of Marine Reserves" in 2007. The opening paragraph states "fish, shellfish, and other species are declining in many places. The changes are impairing the ocean's capacity to provide food, protect livelihoods, maintain water quality, and recover from environmental stress." Whatever happened to food and livelihoods? There is not a whisper or mention of those in the 10-year review.

Does California need even more marine reserves? The public should demand to know what the objectives are, how success is measured, what perceived threats are being addressed, and would the funds be better spent to address the real threats to California's coastal ecosystems. In a pinch, we could say that MPAs to some extent restrict fishing. But wait, we already have an agency that does that, the California Department of Fish and Wildlife (CDFW). Perhaps funding to implement more MPAs should be redirected to CDFW to do its job even better? Perhaps more importantly, the funds could be used to better regulate terrestrial impacts on the coastal ecosystem.

Ray Hilborn is a professor in the School of Aquatic and Fishery Sciences at the University of Washington and served on the Science Advisory Team during MLPA planning for Santa Barbara reserves. He has been awarded the World Fisheries Science Prize and the Volvo Environmental Prize.

Source: https://sbfreedivers.com/news/a-petition-to-expand-california-marine-protected-areas-contradicts-science-and-itself/

A Petition To Expand California Marine Protected Areas Contradicts Science And Itself

By Jason Johns, Conservation Scientist

Marine Management and Conservation

Conservation is a critical tool in maintaining the health of our ocean ecosystems. The kelp forests of California are important sources of ecological, cultural, and economic value. Their careful management is one of the highest priority initiatives for all of their stakeholders and stewards, including policy makers, tribes, fishers, divers, conservation biologists, and others.

Building marine management plans is a complex endeavor, and the success of any given initiative relies on its ability to consider multiple, sometimes conflicting perspectives. Each stakeholder group brings unique and important expertise, and each perspective has both assets and limitations. The asset that the scientific perspective brings to management is the ability to produce and analyze objective, tangible evidence.

Using science objectively, not selectively

While it's a no-brainer to use science in conservation decisions, it requires additional effort to use it objectively and comprehensively. Part of this objectivity is being sure to consult all of the science available on the issue at hand. We need to be wary of "using" any science to support a given initiative, especially when we have a personal stake in the outcome. Omitting relevant studies from the conversation undermines both the legitimacy and success of conservation initiatives.

Several organizations recently submitted a petition to the California Fish and Game Commission to protect kelp forests in Southern and Central California. The purpose of this letter is to address their incomplete and improper acknowledgement of the science around kelp health in California.

Let me first establish my biases. I'm fortunate to have a deep relationship with and respect for the ocean, which started in my childhood. I interact with the ocean by any means possible, whether it be riding waves, paddling various crafts, snorkeling, scuba diving, and occasionally sourcing food from it with various tools. I am also a scientist with a keen interest in learning more about the dynamics of the natural world, and a conservation biologist working to support its longevity. Accordingly, I approached this petition with an open mind, and multiple sources of both expertise and motivation.

I looked at the scientific papers and reports cited in the petition to examine the evidence myself. While sharing opinions is an important part of this process, the following are not my opinions - rather objective analyses of two fundamental errors in petition 2023-33MPA that either contradict the scientific literature and/or the petition itself.

Errors in the petition

The first major error that the petition makes is claiming that kelp density itself is positively influenced by MPAs. While we know that some California kelp dwelling species can be positively affected by MPAs, such as lobsters and sheephead (Kay et al., 2012; Hamilton & Caselle, 2015), kelp density has never been shown to be consistently higher in MPAs than outside them. In fact, the vast majority of published science on this topic from California demonstrated that that kelp density is unaffected by MPAs (Malakhoff & Miller, 2021; Smith et al., 2023). The second inconsistency is in the petition's description of the selection process for the sites chosen for MPA expansion or establishment. These two errors are fundamental to the petition, and their lack of rigor substantially undermines its legitimacy.

Error #1: MPAs improve kelp density and resilience to climate change

The petition is written with the intention of protecting kelp itself, which relies on the premise that MPAs enhance the health of kelp. It is true and relatively uncontroversial that MPAs protect many fish and invertebrate species - there are generally more fish and larger fish within MPAs than outside of them (Lester et al., 2009; Rolim at al., 2019). This has been demonstrated many times in various ecosystems around the world. Importantly, though, there is a lack of scientific evidence demonstrating that kelp itself is positively influenced by MPAs (Malakhoff & Miller, 2021; Smith et al., 2023).

However, the petition makes the following claim: "The Decadal Management Review of the statewide MPA network found that, while kelp species across the state experienced large-scale declines during the 2014-2016 marine heatwave, 'overall, kelp canopy was more stable and appeared to be more resilient inside MPAs' (CA MPA DMR 2022)."

The Decadal Management Review (DMR) does state this, but does not show any data to support it, which makes it an inappropriate citation in this context. A more appropriate citation would have been the 2021 report by Carr and colleagues that the DMR authors cited, entitled "Monitoring and Evaluation of Kelp Forest Ecosystems in the MLPA Marine Protected Area Network."

While the Carr et al. report did compare kelp resilience in MPAs and non-MPAs across California, there are multiple factors that make it a less than appropriate citation for this claim, especially considering there is much more directly relevant science to consult on this topic (Malakhoff & Miller, 2021; Smith et al., 2023). First, two out of three

comparisons had no visual difference between MPAs and their “reference” non-MPAs. In addition, when looking specifically at kelp resilience, the DMR lumped all MPAs across California into one analysis (Figure 25), rather than splitting them into Southern, Central, and Northern California regions, as they did with their other analyses. Given the many fundamental differences between these regions, including the species of kelp that dominate them, it is difficult to draw any region-specific conclusions from this analysis. The strong differences between California regions are emphasized elsewhere in the DMR, as well as in two other studies currently (Hall-Arber et al. 2021 and Kumagai et al).

Further, the DMR did not show any statistics in this particular analysis, which is a fundamental part of determining the confidence that any apparent trend is a true representation of the entire population. This is likely why they chose the language, “appeared to be more resilient.” Finally, the authors acknowledge the inherent difficulty in comparing MPAs with non-MPAs, as MPAs are often chosen *because* they are known or suspected to be especially resilient, even before their protection.

A more directly applicable study to the petition’s claim is Smith et al. (2023), which did split their analyses of kelp communities in California MPAs by region, and fortified the trends they found with statistics. They found that “for all habitats except the rocky intertidal, MPAs did not impart increased resistance or recovery from marine heatwave-driven community changes compared to sites outside of MPAs.”

Malakhoff & Miller (2021) would have also been an important study to consider, which found that “no significant effect of reserve status (MPA vs. non-MPA) or time period or the interaction between status and time was evident for kelp stipe density” (Figure 1). They also compared grazing and urchin density inside and outside MPAs, and found “no evidence, therefore, that increases in predators inside Channel Islands MPAs are causing, either through direct or indirect effects, a trophic cascade leading to positive effects on kelp forests via decreased sea urchin biomass and grazing.” They conclude that “urchin biomass overall has increased inside

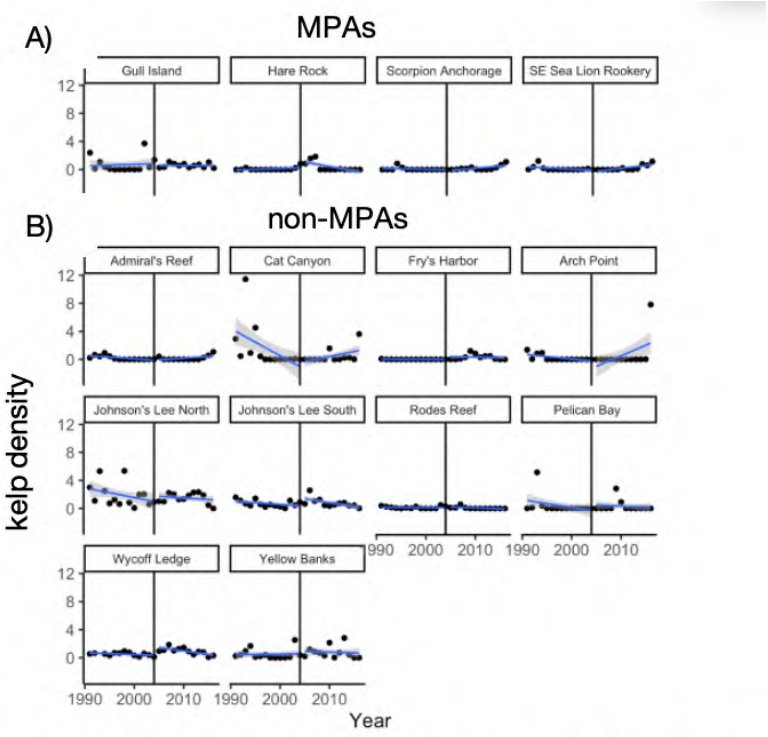


Figure 1. *Adapted from Malakhoff & Miller (2021) Figure S3. “Change in kelp stipe density over time with regression lines fit before and after the establishment of marine reserves in 2004 (vertical lines) at reserves (A) and control (B) sites.”

reserves, and we found no evidence that giant kelp is positively affected by reserves."

While it is not yet published, it is important to mention a recent study by Kumagai et al. which found that kelp resilience and recovery to the 2014-2016 marine heatwave was slightly more robust inside Southern California MPAs than outside (there was no effect of MPAs in Central California). They do, however, acknowledge that their measurements of kelp resilience and recovery are subject to some amount of error, as they were from satellite imagery. In contrast, both Malakhoff & Miller and Smith et al. measured kelp directly by counting the density of stipes (aka "stringers") on the reef, which is arguably a more thorough measure of kelp health. They also acknowledge the bias associated with the selection of MPA sites - "Taken together, these results could be biased if MPAs had been non-randomly placed in habitat more favorable to kelp recovery."

Importantly, this study is in preprint, meaning it has been submitted to a scientific journal and is currently under peer review. The petition does not cite this paper, nor should it, but the preprint is publicly available, thus it is mentioned here for thoroughness.

Another study not cited by the petition, but worth mentioning, is Eisaguirre et al. (2020). Like Kumagai et al., they did not examine the effects of non-random placement of MPAs, which likely could have affected their finding of higher kelp density in MPAs than outside in the Northern Channel Islands. This result contrasts that of Malakhoff & Miller, which found no effect of MPAs on kelp density. Notably, Malakhoff & Miller surveyed 33 sites and analyzed each site both individually and together, with statistics. Eisaguirre et al. surveyed 7 sites and lumped them all together, reporting no statistical hypothesis testing, but rather models that did not fit their data particularly well.

The above literature review demonstrates the objective failure of the petition authors to thoroughly examine the science relevant to their initiatives and claims, rendering the petition illegitimate.

Error #2: Sites were chosen because they were not listed as "high priority" by Giraldo-Ospina et al., 2023.

The second contradiction is in regard to the strategy used to select sites for MPA expansion. This error is not a contradiction or omission of the literature, but rather a contradiction of the petition itself.

The petition narrative states, "we did not focus on 'high priority' restoration sites identified by Giraldo-Ospina et al. 2023…" However, Table 1 of the petition suggests that they propose to expand the two MPAs on the Northern Channel Islands *because* they hold portions of high priority sites: "The Northern Channel Islands contain some of the largest remaining resilient kelp beds in state waters, although large portions of the

islands have experienced die-offs and are rated as ‘high priority’ sites by Ospina-Giraldo et al. 2023.”

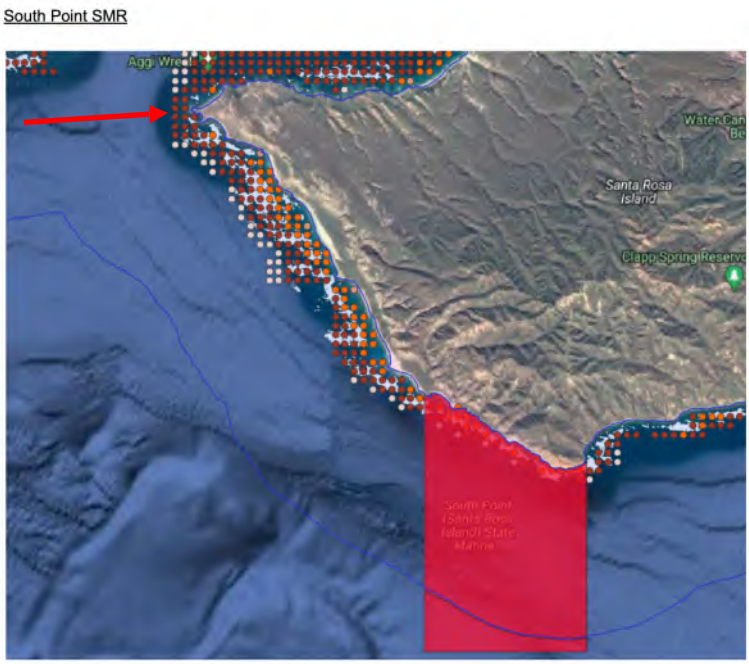


Figure 2. *Adapted from Petition 2023-33 MPA. The red polygon indicates the current South Point MPA on Santa Rosa Island. The red arrow indicates the point to which the MPA is being proposed to expand, 3nm out. Dark red circles indicate “high priority” zones.

Further, Giraldo-Ospina explicitly states that Santa Rosa has a concentration of high priority sites: “Sites in the south coast classified as high priority for giant kelp restoration are visibly clustered around San Miguel and Santa Rosa Islands.” This is clear from the map of Santa Rosa Island included on page 17 of the petition, which proposes to expand the current South Point MPA (red polygon) on the southwest side of Santa Rosa Island all the way to the west end of the island (red arrow; Figure 2). The dark red circles indicate “high priority” areas, which clearly constitute the majority of the proposed expansion area.

This is another egregious error that undermines the legitimacy and relevance of petition 2023-33MPA. The authors of this petition gathered thousands of signatures on a fundamentally flawed document, which is negligent at best.

Going forward

The intent of this letter is not to denigrate marine management and protection, nor any of the science cited in the petition, rather to expose the lack of foundation for this proposal. The errors identified here not only undermine the legitimacy of the petition itself and its signatures, but demonstrate a lack of regard for complete and objective due diligence for a potentially highly impactful initiative. My hope is that this previously ignored information will be considered in all discussions going forward.

Finally, I remind that the natural sciences, while crucial, are not the only factor to consider. There is also a robust body of social science research examining the effects of marine reserves on other tangible and intangible factors such as livelihoods, cultures (both indigenous and non-indigenous), healthy subsistence, and lifelong passions. These considerations should also be weighed heavily, yet were mostly ignored in this petition. Knowledge is power, and it is our duty to incorporate all of the relevant knowledge available to us in these significant decisions.

References

California Department of Fish and Wildlife. California's Marine Protected Area Network Decadal Management Review. 2022

Carr, Mark H., et al. California Sea Grant, 2021, *Monitoring and Evaluation of Kelp Forest Ecosystems in the MLPA Marine Protected Area Network*, https://caseagrant.ucsd.edu/sites/default/files/Kelp%20Forest%20Technical%20Report%20Narrative_v2.pdf.

Eisaguirre, J. H. *et al.* Trophic redundancy and predator size class structure drive differences in kelp forest ecosystem dynamics. *Ecology* **101**, e02993 (2020).

Giraldo-Ospina., et al. "Where, when and how? A Guide to Kelp Restoration in California UsingSpatio-temporal Models of Kelp Dynamics. A report to California Seagrant and California Ocean Protection Council. 2023. 72pp.

Hall-Arber, M.*, Murray, S.*, Aylesworth, L., Carr, M., Field, J., Grorud-Colvert, K., Martone, R., Nickols, K., Saarman, E., Wertz, S. Scientific Guidance for California's MPA Decadal Reviews: A Report by the Ocean Protection Council Science Advisory Team Working Group and California Ocean Science Trust, June 2021

Hamilton, S. L. & Caselle, J. E. Exploitation and recovery of a sea urchin predator has implications for the resilience of southern California kelp forests. *Proc. Biol. Sci.* **282**, 20141817 (2015).

Kay, M. C., Lenihan, H. S., Kotchen, M. J. & Miller, C. J. Effects of marine reserves on California spiny lobster are robust and modified by fine-scale habitat features and distance from reserve borders. *Mar. Ecol. Prog. Ser.* **451**, 137–150 (2012).

Lester, S. E. *et al.* Biological effects within no-take marine reserves: a global synthesis. *Mar. Ecol. Prog. Ser.* **384**, 33–46 (2009).

Malakhoff, K. D. & Miller, R. J. After 15 years, no evidence for trophic cascades in marine protected areas. *Proc. Biol. Sci.* **288**, 20203061 (2021).

Rolim, F. A. *et al.* Network of small no-take marine reserves reveals greater abundance and body size of fisheries target species. *PLoS One* **14**, e0204970 (2019).

Smith, J. G. *et al.* A marine protected area network does not confer community structure resilience to a marine heatwave across coastal ecosystems. *Glob. Chang. Biol.* **29**, 5634–5651 (2023).

From: Bill Shedd <[redacted]>
Sent: Tuesday, October 22, 2024 03:29 PM
To: FGC <FGC@fgc.ca.gov>
Cc: Wayne Kotow <[redacted]>; Marc Gorelnik <[redacted]>
Subject: Hilborn Editorial for Nov 6 MRC meeting

Dear Sirs:

See the attached editorial from Ray Hilborn. I am requesting this be discussed at the Nov 6 MRC meeting.

My name is Bill Shedd, and I am chairman of the board of CCA Cal. The science is far from settled on the actual value of no-fishing MPAs. Most marine scientists agree that fish populations inside a no-fishing MPA will grow. However, there is no consensus as to whether MPAs actually increase total fish populations as fishing effort simply moves outside the MPA. There are two sides on the issue regarding the value or lack of with no-fishing MPAs. Discussing the attached editorial from Ray Hilborn at the Nov 6 MRC will make it clear there remains serious debate within the marine science community on no-fishing MPAs and whether or not they provide any overall benefit. - Bill

Bill Shedd | Chairman/CEO

AFTCO | [redacted]

[redacted] | [redacted]

aftco.com | marshwearclothing.com

From: Bill Shedd <[redacted]>
Sent: Wednesday, October 23, 2024 04:58 PM
To: FGC <FGC@fgc.ca.gov>
Cc: Wayne Kotow <[redacted]>; Marc Gorelnik <[redacted]>
Subject: MPA science papers for Nov 6

Dear Sirs

Please include the attached 2 papers for discussion during the Nov 6 MRC discussions.

– Bill

The Ceccarelli paper looks at the Great Barrier Reef Marine Park in Australia which has been in place since 1975 and has 33% closed to fishing since 2004, a closed area of 117,000 square km which is 50 times more than the MLPA. The key lessons that have been learned are that the MPAs have had a small impact on the fish communities, and significant effects have only been found for the most heavily fished species.

The Hopf paper is a review of the large literature on the impact of marine protected areas on the abundance of fish, and has two very important results relevant to the MLPA. They compare the estimated change in abundance inside MPAs using three methods, inside-outside comparison, before and after, and the statistical method called before-after-controlled-impact BACI. Almost all evaluation of the increase in fish abundance in MPAs has been done using before-after. This is true for the MLPA. Hopf et al. found that inside-outside comparisons suggested a much higher increase than the before-after or BACI -- roughly 35% increase compared to only 20%. Even more importantly, Hopf found that using before-after or BACI it was almost equally likely that there was no or a negative impact of the MPA closure on the density of fish. The bottom line is that even in the parts of the MLPA that appear to show an increase in fish abundance, it is likely that this increase has been overestimated.

Bill Shedd | Chairman/CEO

AFTCO | [redacted]

[redacted] | [redacted]

aftco.com | marshwearclothing.com

Received: 5 May 2024 | Revised: 13 August 2024 | Accepted: 15 August 2024

DOI: 10.1111/gcb.17506

Global Change Biology WILEY

RESEARCH ARTICLE

Regional-scale disturbances drive long-term decline of inshore coral reef fish assemblages in the Great Barrier Reef Marine Park

Daniela M. Ceccarelli[1,2] | Murray Logan[2] | Richard D. Evans[3,4] | Geoffrey P. Jones[1,5] | Marji Puotinen[6] | Caroline Petus[7] | Garry R. Russ[1,5] | Tane Sinclair-Taylor[2] | Maya Srinivasan[5,7] | David H. Williamson[1,8]

[1]ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Queensland, Australia

[2]Australian Institute of Marine Science, Townsville, Queensland, Australia

[3]Department of Biodiversity, Conservation and Attractions, Kensington, Western Australia, Australia

[4]Oceans Institute, University of Western Australia, Crawley, Western Australia, Australia

[5]College of Science & Engineering, James Cook University, Townsville, Queensland, Australia

[6]Australian Institute of Marine Science, Crawley, Western Australia, Australia

[7]Centre for Tropical Water and Aquatic System Research, James Cook University, Townsville, Queensland, Australia

[8]Great Barrier Reef Marine Park Authority, Townsville, Queensland, Australia

Correspondence
Daniela M. Ceccarelli, Australian Institute of Marine Science, Townsville, Queensland, Australia.
Email: d.ceccarelli@aims.gov.au

Present address
Daniela M. Ceccarelli, Australian Institute of Marine Science, Townsville, Queensland, Australia

Funding information
Department of Climate Change, Energy, the Environment and Water; Centre of Excellence for Coral Reef Studies, Australian Research Council

Abstract

Anthropogenic pressure is increasing the variety and frequency of environmental disturbance events, limiting recovery and leading to long-term declines in wild plant and animal populations. Coral reefs and associated fish assemblages are inherently dynamic due to their susceptibility to a host of disturbances, but regional-scale nuances in the drivers of long-term change frequently remain poorly resolved. Here, we examine the effects of multiple potential drivers of change in coral reef fish assemblages across 4 inshore regions of the Great Barrier Reef Marine Park (GBRMP), Australia, over 12–14 years (2007–2021). Each region had a unique disturbance history, in conjunction with long-term changes in physical and habitat variables. Phases of recovery were apparent in the years between disturbance events at all locations, but these were not long enough to prevent substantial declines in reef fish density (by 33%–72%) and species richness (by 41%–75%) throughout the study period. The main drivers of change in fish assemblages varied among regions; however, the most rapid changes followed cyclone and flood events. Limited recovery periods resulted in temporal shifts in fish species composition from typically coral-associated to algae-associated. Most trophic groups declined in density except farmers, grazers, omnivores and parrotfish. No-take marine reserves (NTMRs) had small and inconsistent effects on total fish assemblages, but delivered benefits for fishery-targeted piscivores. Our findings suggest that coral reef responses to local stressors and cumulative escalating climate change impacts are highly variable at regional scales, and that small NTMRs are unlikely to mitigate the impacts of increasingly frequent climatic disturbances. Nearshore coral reefs worldwide are high-value habitats that are either already degraded or vulnerable to degradation and the loss of important fish groups. Global efforts to reduce greenhouse gas emissions must be coupled with effective local management that can support the functioning and adaptive capacity of coral reefs.

KEYWORDS
coral reefs, cyclone, ecological drivers, habitat degradation, marine heatwave, temporal dynamics

1 | INTRODUCTION

Ecological communities are subject to natural intermittent disturbances followed by periods of recovery, resulting in fluctuations over time, both in terms of population abundance and assemblage composition (Dallas & Kramer, 2022; Dayton, 1971; Levin & Paine, 1974; Paine & Levin, 1981). Such disturbances are thought to play a major role in maintaining complex landscapes and promoting species diversity (Connell, 1978; Sousa, 1979, 1984). However, in the Anthropocene, disturbance regimes are changing because of human activities, such as extraction, habitat destruction and increasingly chaotic fluctuations in the weather as the climate changes (Micheli et al., 2016; Turner, 2010). The increasing severity, diversity and frequency of disturbances are combining to shrink the recovery window for many ecosystems (Hughes, Anderson, et al., 2018). Anthropogenic pressures and disturbances threaten the existence of foundation species, degrade landscapes, reduce population sizes and diminish biodiversity (Byrnes et al., 2011; Detmer et al., 2021; Seidl et al., 2022). The processes driving long-term change may be complex, depending on regional differences in disturbance regimes, the resistance of key foundation or habitat-forming species and their ability to recover (Jurgens & Gaylord, 2018; O'Leary et al., 2017; van der Heide et al., 2021). Management actions designed to protect communities from disturbance or promote recovery are urgently needed (Anthony et al., 2015; Pelletier et al., 2020). Additionally, more studies are needed on region-specific disturbance regimes, their long-term effects on community metrics, the biophysical factors that interact with periodic perturbations and the effectiveness of management actions to halt long-term degradation.

Coral reefs are dynamic ecosystems, subject to disturbances such as cyclones, crown-of-thorns starfish outbreaks and bleaching events (Moritz et al., 2021; Plass-Johnson et al., 2018). Unfortunately, coral reefs are also among the ecosystems most vulnerable to the increasing array of anthropogenic stressors, including increasing water temperatures and terrestrial run-off, all of which impact negatively on hard corals, the building blocks of coral reefs and essential habitat for most reef-associated organisms (Nyström et al., 2000). In a rapidly warming climate, coral reefs are the 'canaries in the coalmine' for the impacts of sea surface temperature (SST) increases (Henley et al., 2024). Different growth forms of hard corals vary in their ability to either resist these disturbances or recover rapidly during the intervening disturbance-free periods (Madin, 2005). Long-term studies are increasingly documenting severe degradation of coral reef habitats, declining biodiversity and, in some cases, persistent regime shifts from coral to algal-dominated states (Arias-González et al., 2017; Crisp et al., 2022; McManus & Polsenberg, 2004). However, the suite of anthropogenic stressors impacting reefs, the potential for assemblages to recover and the effectiveness of management actions in mitigating impacts or promoting recovery are still being documented.

Coral reef fishes are significant contributors to important ecological processes and trophic interactions in coral reef ecosystems (Polunin, 1996; Sale, 2002). Reef fishes link pelagic and benthic communities through larval dispersal, adult movement (Green et al., 2015; Jones et al., 2009) and planktivory (Hobson & Chess, 1978; Morais & Bellwood, 2019), exert top-down control through predation (Brandl et al., 2019; Hixon, 1991), influence the benthos through grazing and invertivory (Graham et al., 2015; Hatcher, 1988; Kramer et al., 2015) and even contribute to primary production by farming or gardening (Ceccarelli et al., 2005). They range from being versatile omnivores (e.g. Mendes et al., 2019), to occupying highly specialised niches such as corallivory (Pratchett et al., 2013), coprophagy (Robertson, 1982) and parasite-cleaning (Grutter, 1995). While affecting coral reef habitats, they also depend on the integrity of the habitat to support the full complement of species, processes and functions (Darling et al., 2017). This extends beyond living corals to the three-dimensional structure of the reef itself (Chong-Seng et al., 2012). Reef fishes also provide extensive socioeconomic benefits through fisheries and tourism revenue (Cinner et al., 2016). Understanding spatial and temporal patterns in reef fish abundance, diversity and species composition, and their key drivers, is fundamental to the design, implementation and evaluation of conservation and management actions to support persistence and productivity (Eggertsen et al., 2019; Sale et al., 2005).

Reef fish assemblages are highly dynamic and subject to changes in abundance, species richness and composition due to a variety of extrinsic (e.g. disturbance events) and intrinsic (e.g. recruitment) factors. Changes to reef fish assemblages over time have been measured in response to fishing (Zgliczynski & Sandin, 2017), marine reserve protection (Hadj-Hammou et al., 2021; Olivier et al., 2022), changes in habitat structure (Lin et al., 2022; Nash et al., 2013), environmental conditions (Benthuysen et al., 2022; Feary et al., 2010), disturbance events (McClure et al., 2019) and stochastic factors such as recruitment pulses (Sale, 2004). Stuart-Smith et al. (2021) found that fish assemblages on tropical reefs are undergoing a shift towards more generalist species in response to climate change, while on temperate reefs there is a distinct 'reshuffling' of fish assemblages towards more warm-adapted species. General declines in abundance and species richness, as well as local extinctions, have been documented following marine heatwaves and other climatic disturbance events (Edgar et al., 2023; Pratchett et al., 2011; Wilson et al., 2006). Global reef fish diversity declines are expected with habitat loss, especially loss of corals (Strona et al., 2021). Other studies have found reef fish assemblages to be remarkably stable, even after repeated disturbance events resulting in profound habitat changes. (Cheal et al., 2008; Sano, 2000; Wilson et al., 2009). However, the perception of stability may depend on the taxonomic resolution of the study (Lamy et al., 2015), as concurrent species-level increases or declines may be masked within families, trophic or functional groups (Ceccarelli et al., 2016; Wilson et al., 2006).

It is well known that the physical disturbances that destroy habitat (e.g. temperature stress, cyclones and destructive fishing), indirectly affect fishes that rely on those habitats (Emslie et al., 2014; Graham & Nash, 2013; Pratchett et al., 2008), but do those physical forces also act on fish assemblages directly? With extreme SST anomalies, acute mortality events of fish are possible, and over time

this may alter the suite of species that occupy any given reef (Stuart-Smith et al., 2015; Stuart-Smith et al., 2018). Direct impact by cyclone waves and wave-born debris may kill some fishes, but the dominant impact of storm events is typically habitat loss (Munday, 2004; Munday et al., 2008; Triki & Bshary, 2019; Wilson et al., 2006). Management and conservation measures superimposed upon these large-scale, dynamic processes may or may not mitigate disturbance impacts on populations, assemblages and habitat structure (Mellin et al., 2019). Teasing apart the forces that act on fish assemblages may not be possible without dedicated experimental research, although advances in statistical techniques that partition the relative importance of a given set of predictor variables is allowing increased insight into drivers of coral reef communities (Samoilys et al., 2019; Zinke et al., 2018).

No-take marine reserves (NTMRs) are a widely used marine conservation tool, with proven benefits for populations of target species (Allard et al., 2022; Emslie et al., 2015; Graham et al., 2011; Mellin et al., 2016). Effects on non-target species, habitats and processes are more equivocal, especially in regions where fisheries target a few select species with non-destructive fishing practices (Emslie et al., 2015). There is some evidence that NTMR reefs can be more resilient (McClure et al., 2020; McCook et al., 2010; Mellin et al., 2016), but this may not hold under a regime of increasing disturbance frequency and intensity. In fact, there is increasing evidence that NTMRs have a limited ability to protect reef habitats from extreme disturbances, leading to similar changes in fish assemblage structure in both NTMRs and fished areas (Graham et al., 2011; Jones et al., 2004; Williamson, Ceccarelli, Evans, Jones, & Russ, 2014).

In seeking to understand temporal dynamics of coral reef fish assemblages, and the ability of NTMRs to support resilience under environmental change, it is important to quantify key drivers of abundance, diversity and species composition. Fish assemblages can be shaped by a combination of interacting physical drivers, which include environmental factors such as temperature, depth or wave exposure (Floeter et al., 2005; Friedlander et al., 2003; Fulton et al., 2005; Jouffray et al., 2015; Maia et al., 2018; Roff et al., 2019), slope steepness, three-dimensional reef habitat structure (Chabanet et al., 1997; Graham & Nash, 2013; Luckhurst & Luckhurst, 1978) and biological drivers such as food availability, recruitment, competition and predation (Roff et al., 2019). The composition of the benthic community also affects the fish assemblage (Chong-Seng et al., 2012; Done, 1992; Gratwicke & Speight, 2005; Halford et al., 2004; Williams, 1982). Changing conditions due to disturbances (e.g. increased wave exposure and turbidity during/after storms) and resulting changes to benthic organisms all have an influence on the temporal dynamics of reef fishes (Pratchett et al., 2011). Superimposed on biophysical drivers are human factors such as exploitation, habitat destruction through coastal development, dredging and destructive fishing, and spatial management such as NTMRs (Pinca et al., 2012).

Multiple-use zoning management was first introduced to the Great Barrier Reef Marine Park (GBRMP, Marine Park) in the late 1980s. Networks of NTMRs were expanded throughout the Marine Park in 2004 and since that time approximately 33% of the Marine Park area (and 33% of the coral reef habitats) have been protected within NTMRs. Inshore GBR coral reefs are no exception to the alarming rates of global ecosystem degradation caused by the cumulative and escalating effects of global warming (Ceccarelli et al., 2020; Hughes, Kerry, & Simpson, 2018). The proximity to human populations means that pressure from extractive activities like recreational fishing is significant on inshore fringing reefs around islands near the coast (Williamson, Ceccarelli, Evans, Hill, & Russ, 2014; Williamson, Ceccarelli, Evans, Jones, & Russ, 2014). Furthermore, inshore reefs of the GBR are subject to the pressures typical of coastal and inshore reefs worldwide, despite active management of stressors and relatively low human population densities compared with other tropical coastal nations. In this sense, the response of the GBR inshore reefs to these pressures could serve both as a benchmark for thresholds of pressure these systems can withstand, and an example of what a reduction in pressure could result in for marine ecosystems that are much more heavily used and degraded.

In this study, we quantify regional and local differences in the key physical and biological drivers of fish assemblages and the ability of NTMRs to mitigate against multiple cumulative stressors. The primary aim was to examine long-term trends in the abundance, diversity and species composition of fish assemblages on inshore coral reefs within NTMRs and fished zones across four regions of the GBRMP: the Palm Islands, Magnetic Island, the Whitsunday Islands and the Keppel Islands. Specifically, we (1) quantify changes in fish density, species richness, species composition and the abundance of trophic groups over 12–14 years, (2) determine whether NTMRs reduced or halted any long-term declines in the summary metrics and (3) investigate the relative importance of 20 potential predictor variables in explaining the temporal variability of fish assemblages using boosted regression tree (BRT) models.

2 | METHODS

2.1 | Study locations, management zoning and reef survey protocols

The four inshore island regions are located 10–30 km from the mainland coast and span 4.5 degrees of latitude, from 18.603S to 23.19S (Figure 1). Inshore reefs of the GBR are high use and high value, and exist in waters with higher sediment, pesticide and nutrient loads than offshore reefs (Fabricius et al., 2008; Hughes, Kerry, & Simpson, 2018; Negri et al., 2011; Negri & Hoogenboom, 2011), particularly in sheltered (predominantly west-oriented) locations (Fabricius et al., 2008). Coastal waters with a terrestrial influence are often associated with reduced fish biomass and species richness, and a range of water quality parameters may affect fishes both directly and indirectly (Letourneur et al., 1998). Benthic communities on these reefs typically consist of a combination of hard corals, soft corals and macroalgae that are adapted to conditions of high turbidity, nutrients and suspended sediment (Ceccarelli

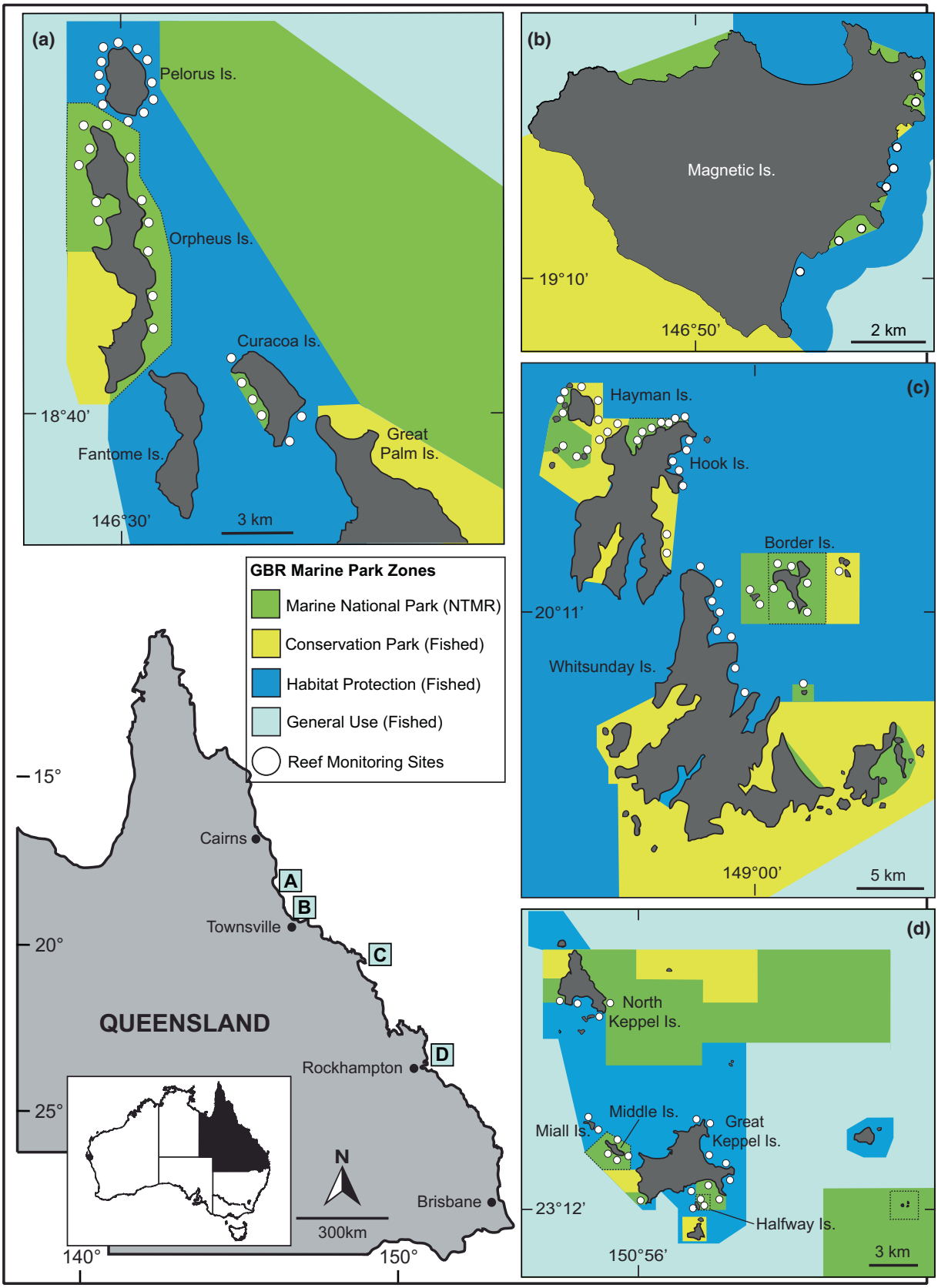


FIGURE 1 Composite map of coral reef monitoring sites in the Palm (a), Magnetic (b), Whitsunday (c) and Keppel (d) Island groups. White dots indicate the approximate position of monitoring sites within each island group. Colour-shaded areas represent the configuration of post-2004 Great Barrier Reef Marine Park (GBRMP) management zones. Light blue, dark blue and yellow zones are open to recreational fishing. Green zones are no-take marine reserves (NTMRs). NTMRs that were established in 1987 are bordered with black dashed lines. All other NTMRs were established in July 2004.

et al., 2020; Flores et al., 2012). Around the islands, reef flats are often exposed to the air on spring low tides, and the reef slopes vary from shallow, gentle inclines on the sheltered (western) sides of the islands to steeper formations and greater depths on the windward (eastern) sides. The reefs are often close to mangroves and seagrass beds, and sediment on inshore reefs has a high terrigenous component, unlike the biogenic carbonate sediments on reefs further offshore. These inshore reefs also tend to occur in shallower waters than those further offshore, with the base of the reef slope rarely exceeding 10 m in depth. Fish assemblages on these inshore reefs are composed of a subset of species that occur on mid-shelf and outer shelf reefs, with a few inshore specialists (Emslie et al., 2017; Emslie et al., 2019; Hoey et al., 2013; Russ, 1984; Williams, 1982).

Standardised underwater visual census protocols were used to survey benthic and fish assemblages at long-term monitoring sites on fringing reefs of the Palm Islands (30 sites), Magnetic Island (8 sites), Whitsunday Islands (42 sites) and Keppel Islands (20 sites) (Figure 1) between four and eight times during the period 2007–2021. The Palm and Whitsunday Islands were surveyed in 2007, 2008, 2009, 2012, 2014, 2016 and 2018, with an additional survey in 2017 at the Whitsunday Islands; the Keppel Islands were surveyed in 2007, 2008, 2009, 2011, 2013, 2015, 2017 and 2021, and Magnetic Island reefs were surveyed just four times due to weather constraints, in 2007, 2012, 2016 and 2019 (Table S1). Within each island group, monitoring sites were evenly distributed among reefs that are open to fishing (General Use, Habitat Protection and Conservation Park Zones) and NTMRs that were closed to fishing in either 1987 or 2004 (Figure 1).

At each of the 100 sites, five 50 m transects were deployed on the reef slope along a single depth contour between 4 and 12 m, depending on the reef slope depth and topography at each site. Fish and benthic surveys were conducted by trained and experienced observers on SCUBA, and all species of diurnal, non-cryptic reef fish were recorded. Large-bodied, mobile fishes were surveyed using a transect width of 6 m (i.e. 300 m^2 survey area) by two divers swimming side by side, with a third diver laying out the transect tape behind them. Small-bodied fishes (family Pomacentridae and small Labridae) were surveyed by one diver during the return swim along each transect, using a transect width of 2 m (i.e. 100 m^2 survey area). The same three observers conducted all fish surveys throughout the monitoring period (DHW, DMC and RDE). All recorded fish species were assigned to trophic groups (Table S2; parrotfish include scrapers and excavators), and counts were converted to density (individuals per 1000 m^2) for all analyses except the generalised linear mixed model, where individuals per 300 m^2 were used to satisfy the requirement of integers for the preferred negative binomial distribution (see below).

Benthic communities were surveyed using a standard point-intercept survey method (Williamson, Ceccarelli, Evans, Jones, & Russ, 2014) by one diver during the return swim along each transect. A single benthic point sample was recorded at every 1 m graduation mark along each transect tape (i.e. 50 samples per transect). Benthic biota and substrata were classified into the following categories: live and dead hard coral with further subdivision into morphological categories (branching, tabular, digitate, solitary, massive, foliose and encrusting), soft coral, sponge, clams (*Tridacna* spp.), other invertebrates (such as ascidians and anemones), macroalgae, coral reef pavement (covered in turf algae), rock, rubble and sand. Additionally, for the live hard coral categories (branching, tabular and digitate), each colony was further classified as either *Acropora* spp. or 'other'. The structural complexity of the reef habitat at each site was estimated using a simple method that gave a rank (1–5) to both the angle of the reef slope and the rugosity of the benthos for each 10-metre section of each transect (see Wilson et al., 2007).

2.2 | Physical predictor variables

2.2.1 | Cyclone wave exposure

We generated quantitative estimates of relative wave exposure at each monitoring site during each relevant cyclone (identified from a dataset described in Puotinen et al. 2016) from 1998 to 2021. We used modelled wave height and direction data from NOAA WAVEWATCH III and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to identify which cyclones generated significant wave heights (Hs = average of top 1/3 of wave heights) of 3.5 m or more at each monitoring site. For each cyclone at each site, the distance to the nearest wave-blocking obstacle was measured every 7.5 degrees around each site (fetch). These measures were weighted by the relative frequency at which cyclone-generated waves approached the site and their average magnitude. These distances were then summed and normalised to create a dimensionless index of relative cyclone wave exposure, as per previous studies (e.g., Gilmour et al. 2022; Table 1).

2.2.2 | Turbidity exposure

Daily Moderate Resolution Imaging Spectroradiometer (MODIS) Level-0 data were acquired from the NASA Ocean Colour website (https://oceancolour.gsfc.nasa.gov) and converted into RGB colour images with a spatial resolution of 500 × 500 m using the SeaWiFS Data Analysis System (SeaDAS; Baith et al., 2001). The images were then (i) spectrally enhanced to transform them from RGB to the Hue-Saturation-Intensity (HSI) colour system and (ii) classified into three distinct water colour categories corresponding to the three optical water types (primary, secondary and tertiary) commonly found in the GBR during the austral wet season (Devlin et al., 2015; Petus et al., 2014; Waterhouse et al., 2018; Wenger et al., 2016). For full detail on the water quality classification, see Appendix S1.

We used the primary water type characterisation to quantify the frequency of exposure of the monitoring sites to highly turbid water from flood plumes and subsequent sediment re-suspension during the 2003–2017 Queensland summer wet seasons

TABLE 1 Predictor variables tested with boosted regression trees, divided into physical forces acting directly on the fish community, habitat variables, prey density and a management variable (zoning). Units of measurement are provided in brackets for each driver.

Type	Driver	Justification
Physical	Cyclone exposure (index)	Different species show different susceptibilities to storms and cyclones (Gerlach et al., 2021)
	Exposure to primary flood-water (weeks)	Strong fluctuations in salinity and turbidity can affect reef fish communities (Johansen & Jones, 2013)
	Kd490 (m)	Changes in turbidity affect abundance, composition and behaviour of reef fishes (Johansen & Jones, 2013)
	Chlorophyll-*a* (mg L^{-1})	Nutrient loads affect the abundance and composition of reef fish assemblages (Sartori et al., 2021)
	Degree heating weeks (°C-weeks)	Thermal stress has lethal and sublethal effects on fishes (Stuart-Smith et al., 2018)
	SST mean (°C)	Reef fishes respond to temperature (Lloyd et al., 2012)
	SST anomaly (°C)	Thermal stress has lethal and sublethal effects on fishes (Pearce & Feng, 2013)
Habitat	Live hard coral (% cover)	Loss of live coral means a loss of food, shelter and recruitment habitat (Russ et al., 2021)
	Soft coral (% cover)	Loss of soft coral means a loss of food and shelter (Epstein & Kingsford, 2019)
	Turf (% cover)	Turf is the preferred food source for several groups of reef fish species (Tootell & Steele, 2016)
	Macroalgae (% cover)	Macroalgae can be food and recruitment habitat for some species, but many reef fishes avoid areas of macroalgal dominance (McClure et al., 2019)
	Unconsolidated substratum (% cover)	Has low structural complexity, but hosts specific types of fishes (Wolfe et al., 2021)
	Coral morphological diversity (index)	Is a measure of the complexity the three-dimensional structure of the habitat Higher habitat complexity tends to lead to higher abundance and species richness (Graham & Nash, 2013)
	Benthic richness (index)	Is a measure of the complexity the three-dimensional structure of the habitat, and the diversity of food sources. Higher habitat complexity tends to lead to higher abundance and species richness (Graham & Nash, 2013)
	Rugosity (score)	Is a measure of the complexity the three-dimensional structure of the habitat. Higher habitat complexity tends to lead to higher abundance and species richness (Graham & Nash, 2013)
	Slope (score)	Is a measure of the steepness of the reef slope, which can influence the species composition of reef fishes (Graham & Nash, 2013)
	Structural complexity index (index)	Is a measure of the complexity the three-dimensional structure of the habitat. Higher habitat complexity tends to lead to higher abundance and species richness (Graham & Nash, 2013)
Other	Prey density (individuals 1000 m^{-2})	Higher prey density means more food for carnivores and piscivores (Hixon, 1991)
	Prey biomass (kg 1000 m^{-2})	Higher prey biomass means more food for carnivores and piscivores (Hixon, 1991)
	Zoning (NTMR status: Fished, NTMR)	Fishery target species are usually larger and more abundant in NTMR zones (Emslie et al., 2015)

Note: Prey density and biomass were included in the models for carnivores and piscivores only.

(December–April inclusive). The primary water type represents high turbidity (Devlin et al., 2015), and high values of coloured dissolved organic matter (CDOM) and total suspended sediment (TSS) (Devlin et al., 2013). TSS and Secchi disc depth (SDD) in the primary water type are typically around 18.3 ± 45.7 mg L-1 and 1.8 ± 1.8 m (mean ± 1SD), respectively (Waterhouse et al., 2021). The primary water type is often associated with low salinity from flood plumes, but not always, as high turbidity can also reflect re-suspended sediment from wind and tides (Devlin et al., 2012). We created 22 weekly composites of daily images from 1 December to 30 April per wet season, to minimise the amount of area without data per image due to masking of clouds and sun glint (Alvarez-Romero et al., 2013). We assigned each weekly composite a presence/absence (0/1) value of primary water type in each pixel (500 × 500 m resolution; Table 1).

2.2.3 | Water quality

Two measures of water quality were used: remotely sensed Chlorophyll-a, which provides an estimate of phytoplankton biomass and can act as a proxy for seawater nutrient concentrations (Otero & Carbery, 2005), and Diffuse Kd490 (the Diffuse Attenuation Coefficient at 490 nm), which provides an estimate of turbidity (Lee et al., 2005). Chlorophyll-a (Hu et al., 2012) and Kd490 composite monthly 4 km data, collected using a

MODIS satellite, from 2003 to 2017 were downloaded from the ERDDAP website. (Chlorophyll-a—https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdMH1chlamday; Kd490—https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdMH1kd490mday). In situ measurements of these variables are preferred as there is increased uncertainty in turbid waters, however in their absence, remotely sensed measurements can and have been used in a number of other studies (Moustaka et al., 2018; Olsen et al., 2018; Zinke et al., 2018) (Table 1). The Whitsunday Islands data for both Chlorophyll-a and Kd490 were anomalous, so they were excluded from the Whitsundays BRT analyses (see below).

2.2.4 | Degree heating weeks

Degree heating week (DHW) values represent the accumulated thermal stress over the previous 12 weeks at a given pixel. DHW is calculated as the number of degrees above the coral bleaching threshold multiplied by the number of weeks that the elevated temperature persists (Skirving et al., 2020). Coral bleaching is likely at 4 DHW, and this is routinely used to estimate thermal stress on coral reefs (Hajime, 2017). Daily 5 km data from 1998 to 2016 were provided by NOAA Coral Reef Watch (2018). The maximum DHW reported between sequential surveys was used for each year; however, if the period between surveys exceeded 1 year, the maximum DHW within the two previous years was used in the following year of the study (Table 1).

2.2.5 | Mean sea surface temperature and SST anomaly

Annual average SST and SST anomalies were calculated from multi-scale, ultra-high resolution (MUR), SST and sea surface temperature anomaly (SSTA) data (Table 1). Monthly 1 km data from 2002 to 2017 were downloaded from the NOAA ERDDAP website (https://coastwatch.pfeg.noaa.gov/erddap/griddap/jplMURSST41mday.html and https://coastwatch.pfeg.noaa.gov/erddap/griddap/jplMURSST41anommday.html).

2.3 | Habitat-based predictor variables

The 11 habitat-based predictor variables included per cent cover of live hard coral, soft coral, algal turf, macroalgae and unconsolidated substratum (generally sand or rubble), two measures of benthic diversity (benthic richness: the sum of all broad benthic categories, and hard coral morphological diversity: the sum of all hard coral morphologies), three measures of overall complexity of the habitat (slope, rugosity and a combined structural complexity index) and prey density (specifically to account for variability in carnivores and piscivores) (Table 1).

2.4 | Data analysis

The temporal dynamics of total fish density and species richness were tested for each island group using a generalised linear mixed model with the glmmTMB package in R (Brooks et al., 2017). Pairwise comparisons were made between years and between NTMR and fished zones within each year. The analysis was repeated on the total density and species richness of reef fish, excluding the numerically dominant and species-rich Pomacentridae (damselfishes). This family has the potential to dominate temporal changes of the fish assemblage and to mask estimates of NTMR effects on inshore reefs, since Pomacentridae are not fished (Williamson, Ceccarelli, Evans, Jones, & Russ, 2014). Consistent spatial differences in fish assemblage structure among island groups and among locations within island groups during the monitoring period were explored using non-metric multidimensional scaling (MDS), using fish densities averaged across all sites for each year-zone combination at each island group. The contributions of individual species to the dissimilarities between years and NTR groups were tested with ANOSIM and SIMPER. The analyses were based on the Bray–Curtis similarity of fourth-root transformed density data with Primer-e Version 7.

Temporal trends in total fish density and hard coral cover were also explored graphically, using *ggplot2*. Third-order polynomials were fitted to fish density and hard coral cover to emphasise trends over time at each island group and zone, in particular to highlight where major changes to hard coral cover were associated with major changes in fish density.

Drivers of fish density and species richness were explored using gradient BRT models (Elith et al., 2008; Hastie et al., 2011). A total of 10,000 trees were fit using a binomial distribution (modified from a Bernoulli) to an interaction depth of 5, with a bag fraction of 0.5 and a shrinkage rate of 0.001. All the trees apply out of bag and cross-validation to minimise overfitting. The optimum number of trees to retain was determined by cross-validation from a total of 10-fold. All continuous covariates were centred, and monotonic forms were imposed when simple scatterplots suggested monotonic forms were appropriate, to increase the stability of the outcomes. All BRTs were fitted using the gbm package (Ridgeway, 2017) within the R statistical and graphical environment (R Core Team, 2024). Variable importance was calculated as the frequency of tree splits involving each covariate weighted by the associated square improvement in the model-averaged over all trees and scaled out of 100 such that larger values signify stronger influence. Variable importance values that exceed 1/p (where p is the number of covariates included in the model), were considered substantial. Missing data (e.g. where the timescales differ between response and predictor variables) were handled with surrogate splits (Elith et al., 2008).

The partial effects of each substantially important covariate were estimated by back-fitting a vector of covariate levels (1000 evenly spaced values) against the BRT model. For tree splits that do not involve the focal covariate, both branches are traversed in

their entirety and averaged together to form a partial prediction. For each covariate, the covariate value that corresponded to the maximum partial effect was used as an estimate of the value associated with optimum (maximum) cover. A *quasi-*R^2 for each covariate was calculated as the simple square of correlation between the observed and partial predicted response. The partial effects, optimum and *quasi-*R^2 values were aggregated over the 10 cross-validation folds so as to yield mean trends along with 95% confidence intervals.

The predictor variables were separated into 7 physical drivers, 11 habitat-based drivers, 2 measures of prey abundance and 1 management driver (NTMR status) that may affect fish density, species richness or species composition (Table 1). The predictor variables identified by the BRT models to be most influential for each fish metric were assigned to physical or habitat drivers and the proportion of each type of driver was calculated for fish density, species richness and the abundance of each fish trophic group. To test the effects of different drivers on reef fish species composition, the BRT models were run on the eigenvalues of PC1 of a principal components analysis for the individual island groups. When running the full analyses, the substantially influential predictors for any single analysis are identified. These predictors are then expressed as their temporal components by centring them against their respective temporal means for each location. The analyses are then repeated using just the important temporal versions of the influential predictors. This second analysis was used to identify which predictors should feature in temporally focussed analyses, as opposed to a spatial focus, and the analysis repeated with those predictors. As with the GLMM analysis, BRT analyses were repeated for total reef fish density, species richness and species composition (PC1) excluding the Pomacentridae (damselfishes), to explore the effects of drivers on the fish community, without the potentially overwhelming effects of this abundant and species-rich family. Furthermore, the fish assemblage was divided into trophic groups, and the BRT models repeated for each individual trophic group. Data and code are available through the Australian Institute of Marine Science Data Repository (AIMS, 2024).

3 | RESULTS

3.1 | Temporal dynamics in fish density, species richness and composition

Acute environmental disturbances led to several periods of decline and subsequent recovery in fish density and species richness that were unique to each island group, but recovery periods were insufficient to prevent an overall decline in both density and species richness over time in all regions (Figure 2, Table 2). Declines in density of between 39% and 72% were recorded on fished reefs, while declines of 33%–60% were recorded on NTMR reefs. Species richness also declined by up to 75% on fished reefs, and up to 63% on NTMR reefs. Despite similar temporal trajectories in total density and species richness without the Pomacentridae, the declines were not as pronounced (Figure S1, Table S3).

Each major decline followed an acute disturbance, especially cyclones and floods, and to a lesser extent, coral bleaching events. Major declines in fish density and species richness were recorded on reefs at the Palm Islands following Cyclone Yasi in 2011 (Figure 2a,b). There was some recovery in both fish density and species richness between 2012 and 2014 in the Palm Islands; however, there was a further decline in density between 2014 and 2018 following a flood plume in 2014 and coral bleaching in 2016 and 2017, while species richness declined between 2014 and 2016, and then recovered between 2016 and 2018 (Figure 2a,b). There were no significant differences in fish density between fished and NTMR reefs in the Palm Islands throughout the monitoring period, but species richness was significantly lower on NTMR reefs both before and after the disturbance events (Figure 2b). The analysis without the Pomacentridae resulted in lower density and species richness in the Palm Island NTMRs that were significant in several years (Figure S1a,b).

On Magnetic Island, there was no significant change in fish density and species richness between 2012 (after Cyclone Yasi, Figure S2.1) and 2019 in fished zones, but a significant increase in both occurred at NTMR reefs (Figure 2c,d). This pattern was not significant when the Pomacentridae were removed (Figure S1c,d). Overall, there were no differences in fish density and species richness detected between fished and NTMR reefs at Magnetic Island.

In the Whitsunday Islands, total fish density declined between 2009 and 2014, with a small recovery in 2016 (Figure S2.1), followed by a precipitous decline after Cyclone Debbie in 2017 (Figure 2e; Figure S2.1). Cyclone Ului did not appear to affect species richness, and Cyclone Debbie had a much smaller effect on fish species richness than on fish density (Figure 2f). There were no significant differences in fish density and species richness between fished and NTMR reefs (Figure 2e,f), with or without the Pomacentridae (Figure S1e,f).

Reefs in the Keppel Islands experienced a dramatic and significant loss of fish density and species richness following major flood plumes in 2011 and 2013 (Figures 2g, h, S2.2, S2.3). Fish density declined to almost an order of magnitude lower in 2013 compared with 2007–2009, and although it increased between 2013 and 2017, it did not reach the pre-flood levels of 2007–2009 (Figure 2g). Species richness in 2013 was half that in 2007–2009, remained low in 2015, increased between 2015 and 2017, and then declined in 2021 after successive bleaching events in 2017 and 2020 (Figure 2h; Figure S2.5–S2.7). Without the Pomacentridae, fish density and species richness recovered more rapidly in the later survey years (Figure S1g,h).

Species composition shifted over time at all four island groups and, in all cases, was different at the last survey period compared with the beginning of the monitoring programme (Figure 3). Species composition differed between fished and NTMR reefs at the Palm (Figure 3a), Keppel (Figure 3c) and Whitsunday Islands (Figure 3d), but the changes in composition over time occurred in parallel in the two zones. In the Palm and Whitsunday Islands, the

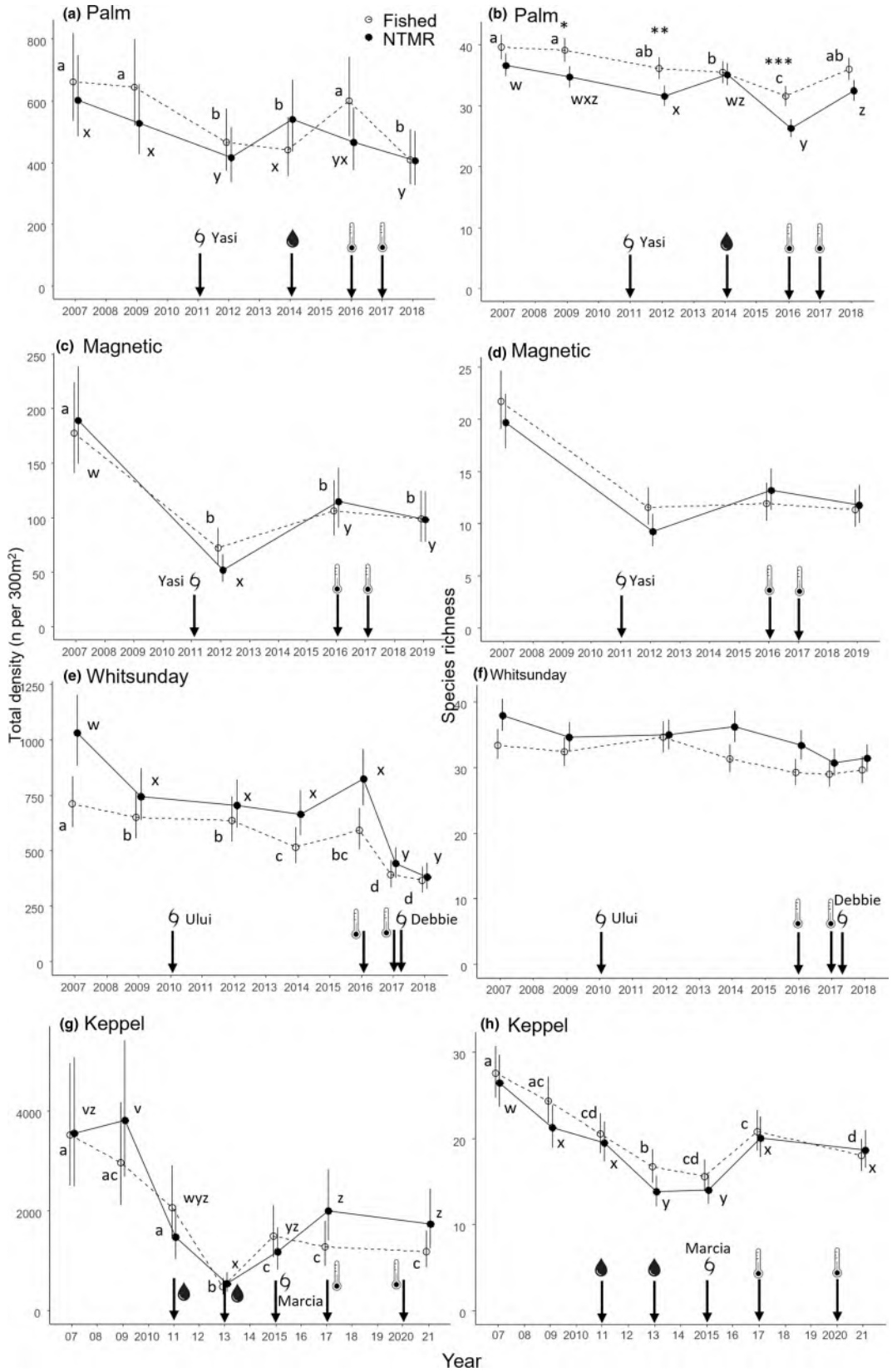


FIGURE 2 Temporal trends in the density (individuals 300 m^{-2}, a, c, e, g) and species richness (number of species per transect, b, d, f, h) of inshore reef fishes in the Palm (a, b), Magnetic (c, d), Whitsunday (e, f) and Keppel Islands (g, h). Arrows show the years of major disturbance events: spinning wheel: cyclones (named); thermometer: bleaching event; and water drop: flood. Open circles are fished zones and closed circles are no-take marine reserves (NTMRs). Letters mark significant differences among years (years that do not differ share the same letters) for each zone, and asterisks mark significant differences between fished and NTMR zones. *$p < .05$, **$p < .01$, ***$p < .001$. Error bars are standard errors; note the differences in scale among the *y*-axes in each panel.

TABLE 2 Results of generalised linear mixed models comparing fish density and species richness across years and zones in each island group.

	Estimate	Std. Error	*z* Value	Pr (>|z|)	Estimate	Std. Error	*z* Value	Pr (>|z|)
	Palm Islands–density				Palm Islands–species richness			
(Intercept)	6.50	0.11	59.39	**<0.001**	3.72	0.03	145.20	**<0.001**
2009	−0.03	0.06	−0.41	0.681	−0.01	0.03	−0.31	0.760
2012	−0.35	0.06	−5.61	**<0.001**	−0.08	0.03	−3.03	**0.002**
2014	−0.40	0.06	−6.39	**<0.001**	−0.10	0.03	−3.90	**<0.001**
2016	−0.10	0.06	−1.55	0.121	−0.22	0.03	−7.99	**<0.001**
2018	−0.48	0.06	−7.65	**<0.001**	−0.08	0.03	−3.05	**0.002**
Zoning	−0.09	0.15	−0.60	0.547	−0.09	0.04	−2.40	**0.016**
2009 × Zoning	−0.11	0.09	−1.19	0.235	−0.04	0.04	−1.11	0.269
2012 × Zoning	−0.02	0.09	−0.18	0.861	−0.06	0.04	−1.60	0.109
2014 × Zoning	0.29	0.09	3.29	**0.001**	0.07	0.04	1.82	0.069
2016 × Zoning	−0.16	0.09	−1.79	0.073	−0.10	0.04	−2.50	**0.012**
2018 × Zoning	0.09	0.09	0.98	0.327	−0.02	0.04	−0.64	0.523
	Magnetic Island–density				Magnetic Island–species richness			
(Intercept)	5.18	0.12	43.67	**<0.001**	3.10	0.07	45.87	**<0.001**
2012	−0.90	0.15	−6.19	**<0.001**	−0.65	0.09	−6.95	**<0.001**
2016	−0.51	0.15	−3.55	**<0.001**	−0.61	0.09	−6.60	**<0.001**
2019	−0.59	0.15	−4.05	**<0.001**	−0.66	0.09	−7.07	**<0.001**
Zoning	0.06	0.17	0.36	0.717	−0.11	0.09	−1.15	0.252
2012 × Zoning	−0.38	0.21	−1.83	0.068	−0.09	0.14	−0.70	0.484
2016 × Zoning	0.02	0.21	0.08	0.933	0.21	0.13	1.61	0.107
2019 × Zoning	−0.06	0.21	−0.31	0.754	0.14	0.13	1.05	0.295
	Whitsunday Islands–density				Whitsunday Islands–species richness			
(Intercept)	6.57	0.08	81.18	**<0.001**	3.54	0.04	97.20	**<0.001**
2009	−0.09	0.06	−1.48	0.139	−0.02	0.03	−0.73	0.464
2012	−0.11	0.06	−1.89	0.058	0.06	0.03	2.37	**0.017**
2014	−0.32	0.06	−5.28	**<0.001**	−0.04	0.03	−1.42	0.157
2016	−0.19	0.06	−3.08	**<0.001**	−0.10	0.03	−3.84	**<0.001**
2017	−0.60	0.06	−9.90	**<0.001**	−0.13	0.03	−4.90	**<0.001**
2018	−0.67	0.06	−11.00	**<0.001**	−0.10	0.03	−3.74	**<0.001**
Zoning	0.37	0.11	3.26	**0.001**	0.15	0.05	2.94	**<0.001**
2009 × Zoning	−0.23	0.08	−2.76	**0.006**	−0.07	0.04	−2.03	**0.043**
2012 × Zoning	−0.27	0.08	−3.15	**0.002**	−0.13	0.04	−3.62	**<0.001**
2014 × Zoning	−0.12	0.08	−1.40	0.160	0.02	0.04	0.53	0.597
2016 × Zoning	−0.04	0.08	−0.45	0.651	−0.02	0.04	−0.53	0.598
2017 × Zoning	−0.24	0.08	−2.89	**0.004**	−0.09	0.04	−2.36	**0.018**
2018 × Zoning	−0.32	0.08	−3.80	**<0.001**	−0.09	0.04	−2.47	**0.013**
	Keppel Islands–density				Keppel Islands–species richness			
(Intercept)	8.17	0.17	46.99	**<0.001**	3.35	0.06	58.58	**<0.001**
2009	−0.17	0.17	−1.01	0.312	−0.14	0.05	−3.06	**0.002**
2011	−0.54	0.17	−3.12	**0.002**	−0.32	0.05	−6.78	**<0.001**
2013	−2.02	0.18	−11.5	**<0.001**	−0.51	0.05	−10.50	**<0.001**
2015	−0.86	0.17	−4.99	**<0.001**	−0.57	0.05	−11.46	**<0.001**
2017	−1.02	0.17	−5.96	**<0.001**	−0.27	0.05	−5.90	**<0.001**

TABLE 2 (Continued)

	Estimate	Std. Error	z Value	Pr (>|z|)	Estimate	Std. Error	z Value	Pr (>|z|)
2021	−1.09	0.17	−6.61	**<0.001**	−0.45	0.05	−9.55	**<0.001**
Zoning	0.01	0.25	0.03	**<0.001**	−0.06	0.08	−0.69	0.488
2009 × Zoning	0.24	0.24	0.99	0.321	−0.09	0.07	−1.36	0.175
2011 × Zoning	−0.34	0.25	−1.40	0.163	0.01	0.07	0.22	0.829
2013 × Zoning	0.13	0.25	0.52	0.605	−0.12	0.07	−1.67	0.095
2015 × Zoning	−0.25	0.24	−1.04	0.230	−0.04	0.07	−0.61	0.544
2017 × Zoning	0.44	0.24	1.78	0.074	0.02	0.07	0.24	0.809
2021 × Zoning	0.38	0.24	1.59	0.111	0.11	0.07	1.59	0.112

Note: Significant differences are highlighted in bold. Site and Transect were included as random factors, and a negative binomial distribution was used.

separation between zones was clearly driven by a higher proportion of *Plectropomus maculatus* and *P. leopardus*, the primary fishery target species, in NTMRs (Figure 3a,c). In the Palm Islands, the greatest dissimilarity in species composition occurred between 2016 and all other years, but no one species contributed more than 2.3% to the overall change, suggesting subtle shifts in the abundances of numerous species. There was less separation between zones at Magnetic Island (Figure 3b) and the Keppel Islands (Figure 3d). The largest shift on Magnetic Island occurred in 2012 (after Cyclone Yasi), driven by a decline in the carnivore *Lutjanus fulviflamma*, coral-dependent *Pomacentrus moluccensis*, and small changes in the abundance of omnivorous and planktivorous damselfishes (Figure 3b). Similarly, changes between years in the Whitsunday and Keppel Islands were driven by highly abundant planktivorous damselfish species such as *Chromis nitida* (Figure 3c,d), but individual species contributions were never greater than 3.6% in the Whitsunday Islands and 9% in the Keppel Islands (Appendix S2).

3.2 | Regional differences in temporal drivers

3.2.1 | Potential drivers

Temporal changes in the drivers of fish assemblages were unique to each island group and sometimes varied among management zones (Figure S2.1–S2.19). Changes in cyclone exposure reflected the timing of major cyclones in each region. They reached higher index values in NTMRs in the Palm Islands (Cyclone Yasi, in 2011) and in fished zones in the Whitsunday Islands (Cyclone Ului, in 2010). Highly turbid water was measured in all island groups and zones at the beginning of the study, but kd490 and Chlorophyll-a values reflected this only in the Keppel and Palm Islands, and were higher in NTMRs (Figure S2.2,3,4). In contrast, the temperature-related variables (SST mean, SST anomaly, DHW) increased over the study period (Figures S2.5,6,7).

Over the 12–14 years of the study, the island groups experienced a loss and subsequent recovery of hard coral cover, coral morphological diversity and benthic richness (Ceccarelli et al., 2020). Turf, macroalgae and unconsolidated substratum followed the opposite trajectory to hard coral cover to some degree (Figure S2.8–14). Measures of structural complexity declined in the Keppel Islands, with the most recent estimate half of what it had been at the start of the study (Figure S2.5–7). In the Keppel Islands and on Magnetic Island, the cover of hard and soft corals, benthic diversity and structural complexity metrics were lower in NTMRs. The Whitsunday Islands experienced a relatively stable benthic community until Cyclone Debbie (2017) caused a dramatic loss of hard coral and benthic richness, with a concomitant increase in macroalgal cover (Figure S2.8–S2.19). Prey density and biomass followed the hard coral cover trajectory in the Keppel Islands, and declined at Magnetic Island, in the Palm Islands (with a recent recovery in biomass) and in the Whitsunday Islands (Figure S2.20–2.21).

3.2.2 | Trends in fish density and hard coral cover

Overlaying smoothed trends in live hard coral cover and total fish density shows that the responses to disturbance events occurred in parallel for most combinations of island group and zone (Figure 4). Despite disparate fluctuations in the Palm Islands, both fish and coral showed a downward trend; this decline was steeper in the Whitsunday Islands. On Magnetic Island and in the Keppel Islands, there were signs of recovery for both fish and corals towards the end of the study period (Figure 4).

3.2.3 | Regional drivers of fish assemblages

Across all island groups, the strongest relationships in the temporal dynamics of total fish density were with the cover of unconsolidated substrata, living hard corals, turf and macroalgae, and changes in temperature (mean SST, Figure 5a, Table S4). The strongest positive relationship was with the cover of living hard corals, with fish density rising rapidly to 2500 individuals per 1000 m^2 at 30% coral cover. Relationships with all other influential variables were negative

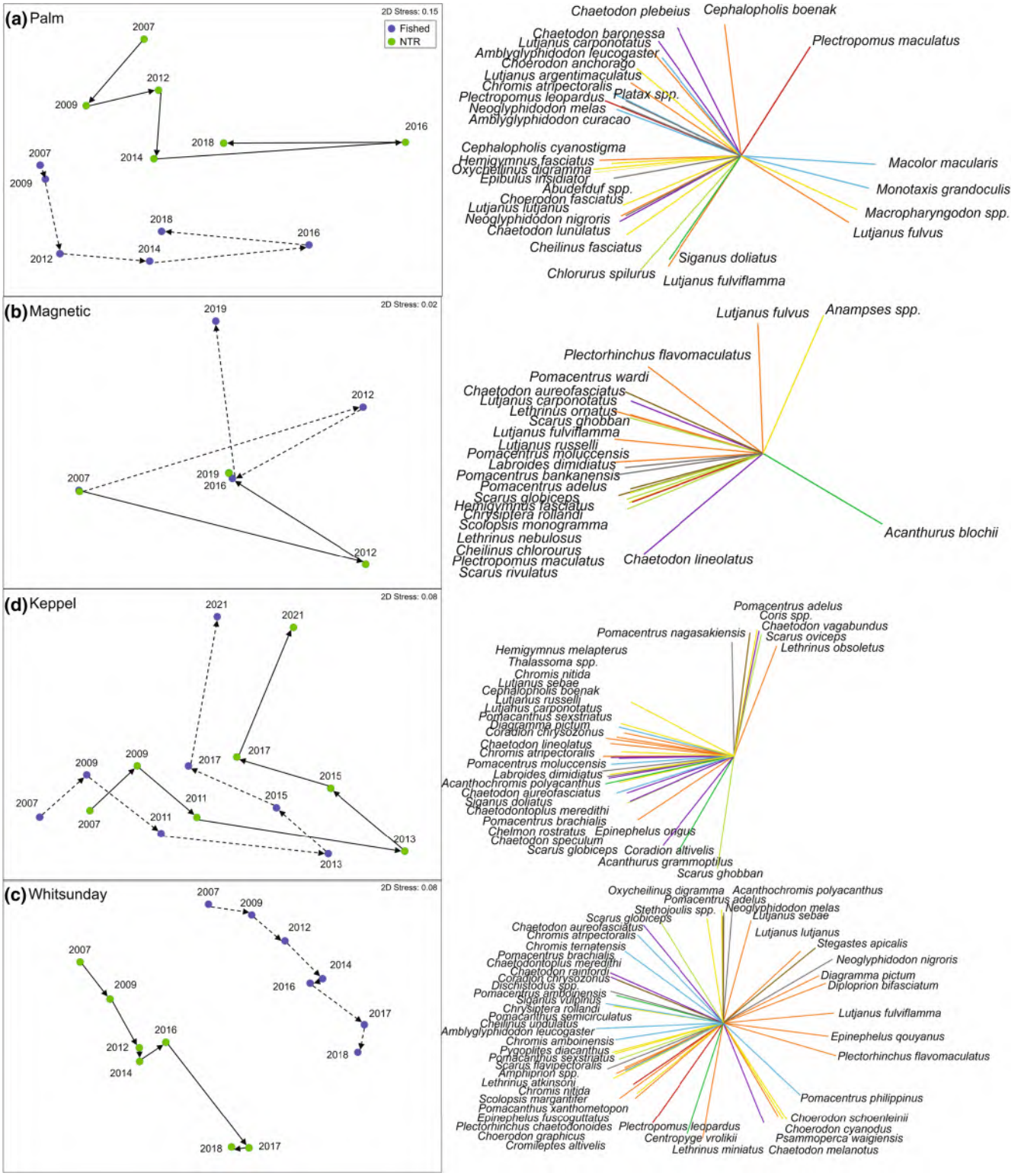


FIGURE 3 Non-metric multidimensional scaling plot (MDS) of temporal trends in fish species composition, performed on the Bray–Curtis dissimilarity matrix of zone-averaged, square-root transformed fish density data for each island group. Blue dots: fished zones and green dots: NTMRs. Vectors are coloured by trophic group: yellow: benthic invertivores; orange: carnivores; purple: corallivores; brown: farmers; dark green: grazers; grey: omnivores; light green: parrotfish; red: piscivores; and blue: planktivores.

(Figure 5a). Without the Pomacentridae, live coral cover was no longer among the most influential predictors (Figure S3a, Table S5). The total density of the remaining fish assemblage declined steeply with increasing mean SST, and had a positive relationship with the cover of turf and unconsolidated substrata (Figure S3a). Changes in fish species richness over time were positively correlated with

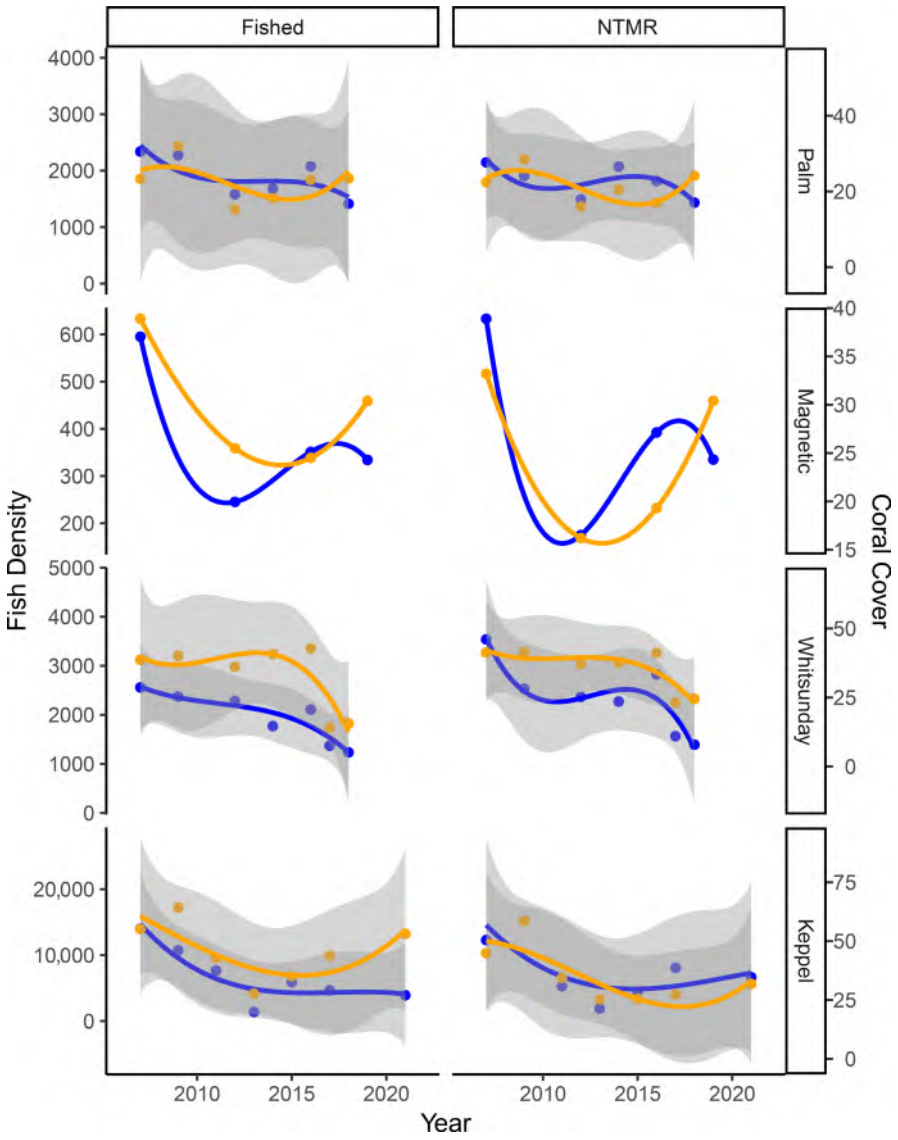


FIGURE 4 Summary trends (2007–2019) of total fish density (blue line) and live hard coral cover (orange line) for each island group and zone. Data points are year-level means across all sites at each island group, trend lines are third-order polynomials, and shading represents 95% confidence intervals. Magnetic Island's small number of sites did not allow the production of confidence intervals.

increases in benthic richness and negatively correlated with increases in mean SST and SST anomaly (Figure 5b). DHW had a weak positive relationship with overall species richness. Excluding the Pomacentridae revealed a positive effect of soft coral cover and mean SST on species richness, and a negative effect of SST anomaly (Figure S3b).

Across all island groups, temporal change in species composition was most strongly correlated with the cover of soft corals ($R^2 = 0.58$; Figure 5c). Soft coral cover above 5% was associated with a profound shift in species composition of reef fish; in the Palm and Whitsunday Islands, soft coral cover reached 30% at times. Mean SST was by far the most important driver of species composition once the Pomacentridae were removed; assemblage structure changed dramatically at approximately 25°C (Figure S3c). Overall, most trophic groups declined, except farmers, grazers, omnivores and parrotfish. However, the relationships between fish metrics and biophysical drivers varied between island groups.

3.3 | Local drivers of temporal dynamics

3.3.1 | Palm Islands

In the Palm Islands, the total density of reef fishes increased with increasing hard coral cover and had a negative relationship with the relative cover of unconsolidated substrata and changes in DHW (Figure 6a). Fish density decreased rapidly once unconsolidated substrata covered 10% or more of the benthos, but DHW was positively correlated at a value of 2.5, after which fish density plateaued (Figure S4.1, Table S4). Removing Pomacentridae from the model resulted in turf and unconsolidated substrata having a stronger, and positive, relationship with total fish density (Figure S5a, Table S5). DHW also had a positive relationship with species richness, together with the cover of soft corals and higher coral morphological diversity values (Figure 6a, Figure S4.2). Mean SST had a negative relationship with species richness, with richness declining rapidly even with small increases in mean SST

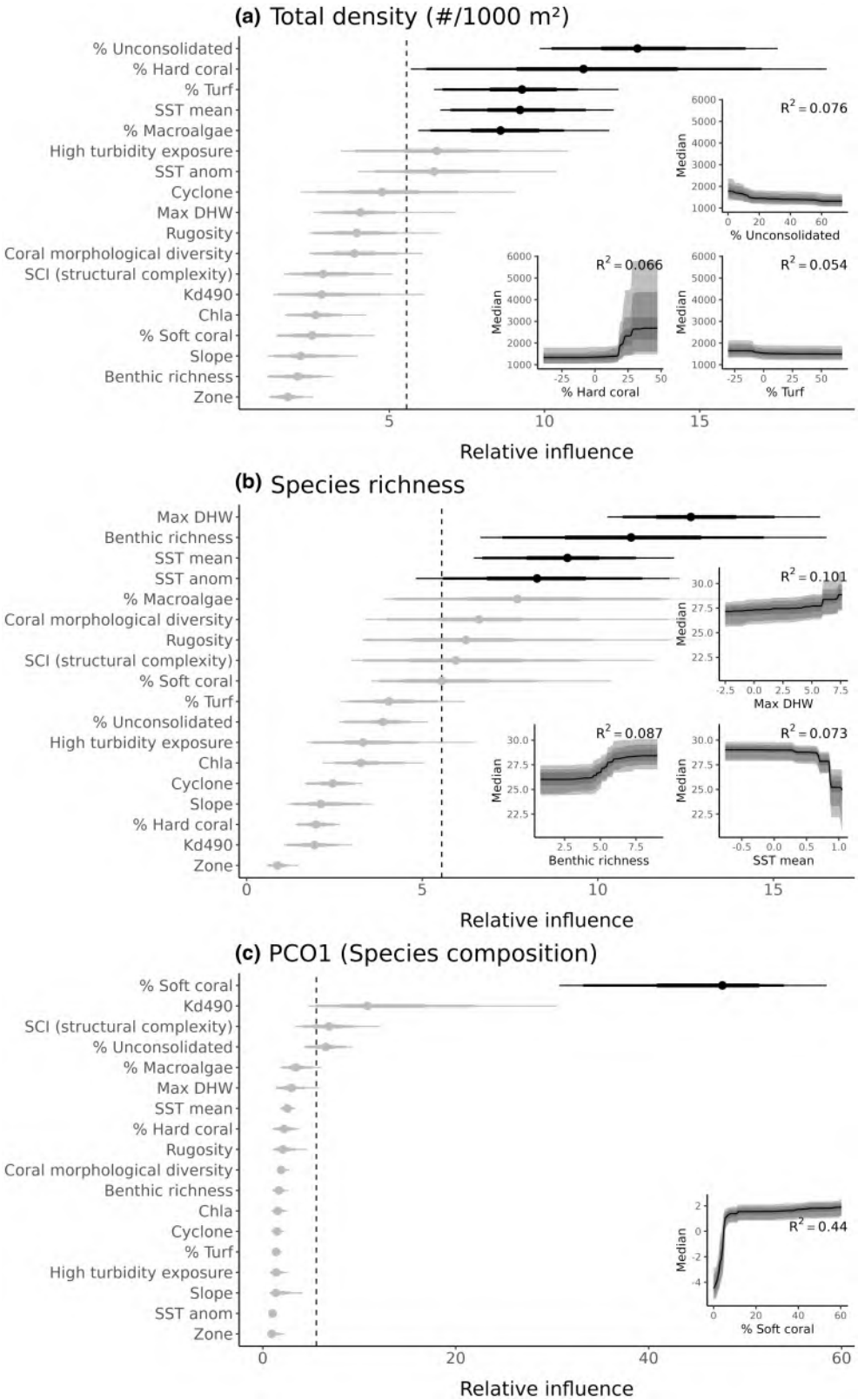


FIGURE 5 Relative importance plot for all predictors of (a) total fish density (individuals 1000 m^{-2}), (b) total fish species richness and (c) fish species composition as defined by the first axis of a principle coordinates analysis (PCO1), and partial plots of the most influential predictors across all island groups. Predictors that performed best (i.e. they were disproportionately represented in trees) are highlighted in bold. Confidence bands represent 95% quantiles on bootstrapped estimates; note the differences in the *y*-axes of the partial plots. The dashed vertical line represents a reference point of relative influence that would be expected if all predictors were equally influential. Values above (to the right of) this reference (black symbols) are therefore considered to exhibit a higher degree of influence than expected by chance.

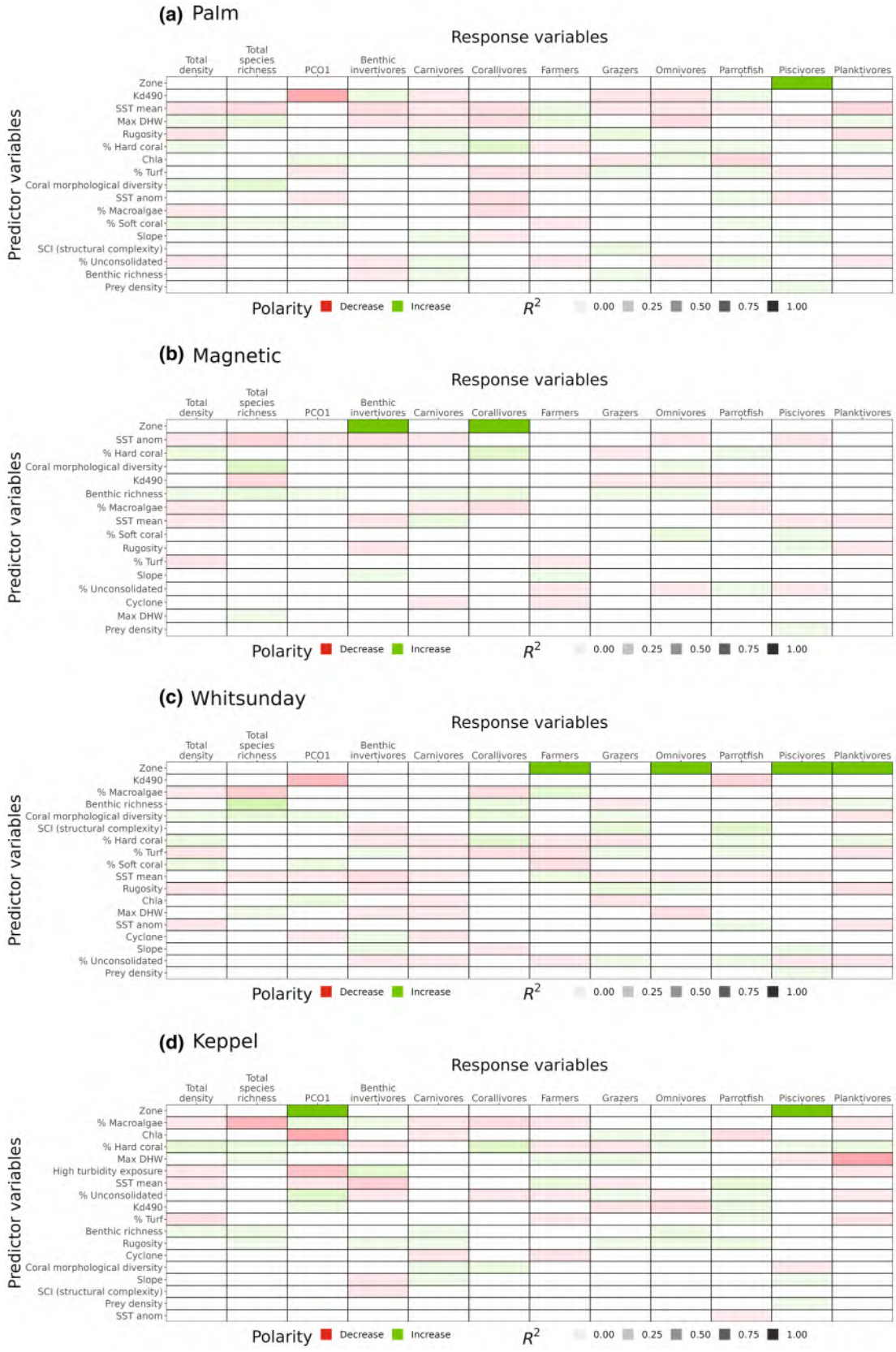


FIGURE 6 Heat map of the level of influence of each predictor variable with fish metrics (total fish density, fish species richness, species composition and density of each trophic group), as expressed by the R^2 value of the relationship, for (a) the Palm Islands, (b) Magnetic Island, (c) the Whitsunday Islands and (d) the Keppel Islands. The quasi-R^2 was calculated as the simple square of the correlation coefficient between the observed and partial predicted response. Warm colours are predictors that had a negative effect on fish metrics, green colours are predictors that had a positive effect on fish metrics. Only predictors that had an effect on at least one response variable are shown.

(Figure S4.2). Removing the Pomacentridae revealed a stronger relationship between species richness and SST anomaly, where there was a stepwise decline in species richness with increasing SST anomaly (Figure S5b). Increased turbidity and SST anomaly were correlated with higher values of PCO1 (Figure 6a), which were associated with a relatively depauperate, post-disturbance composition of fish species in the Palm Islands (Figure 4a; Figure S4.3). This depauperate assemblage was also correlated with higher DHW once Pomacentridae were removed, while higher structural complexity was indicative of a species-rich assemblage (Figure S5c).

All trophic groups except farmers had a negative or no relationship with mean SST, and all groups except farmers had a positive or no relationship with live hard and soft coral cover (Figure 6a, Table S6). Benthic invertivores showed a negative correlation with benthic richness and DHW and a positive correlation with Chlorophyll-a and turbidity (kd490) (Figure S6.1). Carnivores were negatively influenced by DHW (Figure S6.2). Corallivore densities showed neutral or negative relationships with all predictors except hard coral cover, to which they were positively correlated (Figure S6.3). Contrary to expectations, farmers were negatively correlated with soft coral cover and turf cover, and positive associations were found between farmers and mean SST and DHW (Figure S6.4). Grazers responded negatively to increasing turbidity (kd490) and DHW, and positively to increasing turf cover and rugosity (Figure S6.5). Although omnivores increased over time, they responded negatively to turbidity (kd490) (Figure S6.6). Parrotfish densities decreased with increasing Chlorophyll-a and mean SST but had positive or no relationships with all other predictors, including kd490 and hard coral cover (Figure S6.7). Piscivores were the only group that had a strong positive relationship with zoning, and their densities increased with NTMR protection, prey density and slope steepness (Figure S6.8). Planktivores had a negative relationship with turf cover, the cover of unconsolidated substrata and mean SST (Figure S6.9). Planktivores, omnivores and farmers, dominated by small-bodied species of Pomacentridae, nevertheless had different patterns in their associations with biophysical variables. For example, farmers had a negative association with hard coral cover, while planktivores and omnivores had a positive relationship with hard coral cover (Figure 6a). All three groups, however, had a negative relationship with unconsolidated substrata (Figure 6a), but farmers and planktivores appeared to have a threshold at approximately 20% unconsolidated substrata, after which they declined, whereas the threshold for omnivores was between 40% and 60% (Figure S6.6).

3.3.2 | Magnetic Island

At Magnetic Island, temporal changes in total fish density were strongly and positively associated with the cover of live hard corals (Figure 6b). Even small increases in hard coral cover, from 0% to 10%, were associated with steep gains in fish density (Figure S3.4, Table S4). Species richness increased rapidly with increasing benthic richness, but declined dramatically with SST anomaly (Figure S3.5). Similarly, species composition was correlated with the same two drivers as density, but with weak relationships (R^2 of 0.004 and 0.007, respectively, Figure S3.6). Without Pomacentridae, benthic richness was a more important positive driver of total density (Figure S3d, Table S5), and SST anomaly was the most important driver of species composition (Figure 5f).

Among the trophic groups, management zoning on Magnetic Island had a strong positive relationship with the density of benthic invertivores and corallivores (Figure 6b, Figure S4.10–S4.18, Table S6). SST anomaly, turbidity (kd490) and the cover of macroalgae had a neutral or negative effect on all trophic groups, while benthic richness was a positive driver for many trophic groups (Figure 6b). Carnivores, which included several target species of the recreational fishery, responded positively to benthic richness and mean SST, but had a negative relationship with SST anomaly, cyclone exposure and macroalgal cover (Figure S4.11). Farmers also had negative relationships with cyclone exposure and also responded negatively to the cover of turf and unconsolidated substrata, but increased with increasing slope, albeit at very low slope index values (Figure S4.13). There was a positive correlation between corallivores and parrotfish and hard coral cover (Figure S4.12,16). Piscivores were positively correlated with increasing prey density, but not NTMR protection (Figure S4.17). Planktivores were present in low abundance, and negatively associated with mean SST and rugosity.

3.3.3 | Whitsunday Islands

In the Whitsunday Islands, fish density was strongly positively correlated with increasing per cent cover of hard coral, and negatively correlated with increasing turf and macroalgae (Figure 6c; Figure S3.7, Table S4). Species richness increased with coral morphological diversity and declined with mean SST (Figure S3.8). Years with higher SST, higher turbidity and lower Chlorophyll-a also had higher proportions of planktivores and corallivores, while carnivorous species predominated during times of lower temperatures and turbidity and higher Chlorophyll-a (Figures 4d, 6c; Figure S3.9). Removing the Pomacentridae changed these relationships, whereby total density was positively associated with the cover of turf, unconsolidated substrata and soft coral (Figure S5g, Table S5). The relationship between species richness and mean SST became positive, and there was a stronger positive relationship with the cover of unconsolidated substrata, but SST anomaly had a negative effect on Compared species richness (Figure S5h). Macroalgae had a much greater influence on species composition with Pomacentridae removed, as well as mean SST and SST anomaly (Figure S5i).

NTMR protection was positively correlated with piscivores, but also with the Pomacentridae-dominated farmers, omnivores and planktivores, affecting more trophic groups than in the other three regions (Figure 6c; Figure S4.19–S4.27, Table S6). Benthic invertivores showed a negative correlation with mean SST and a positive correlation with cyclone exposure (Figure S4.19). Carnivores were

negatively correlated with hard coral cover, turf cover, cover of unconsolidated substrata and mean SST; there was no discernible effect of zoning on carnivores (Figure S4.20). Corallivores were positively correlated with live hard coral cover and benthic richness, and negatively correlated with slope steepness, macroalgal cover and turf cover (Figure S4.21). Farmers had a negative relationship with hard coral cover and turf cover, and positive associations were found between farmers and mean SST (Figure S4.22). Grazers responded negatively to increasing benthic richness and mean SST, and positively to increasing coral morphological diversity (Figure S4.23). Although omnivores increased over time, they responded negatively to SST anomaly and DHW (Figure S4.24). Parrotfish densities increased with increasing unconsolidated substrata, and declined with turbidity (kd490), mean SST and SST anomaly (Figure S4.25). However, turf cover had a positive relationship with parrotfish density (Figure S4.25). Piscivores declined with increasing benthic richness and were positively correlated with cyclone exposure (Figure S4.26). Planktivores responded positively to increases in hard coral cover and benthic richness, but had a negative association with coral morphological diversity, the cover of algal turf and unconsolidated substrata, rugosity and SST anomaly (Figure S4.27).

3.3.4 | Keppel Islands

Hard coral cover had a strong positive relationship with the temporal dynamics in fish density in the Keppel Islands, while turf cover and mean SST had a negative effect (Figure 6d; Figure S3.10, Table S4). Fish species richness had a positive association with DHW (Figure S3.11). Changes in species composition over time were governed by zoning, macroalgal cover, turbidity and mean SST, with periods in which the fish assemblage was relatively depauperate (higher values of PCO1) associated with periods of higher macroalgal cover and turbidity, and lower temperatures (Figure 4c, Figure 3.12). Without the Pomacentridae, the cover of unconsolidated substrata had a positive effect on total density (Figure S5, Table S5), species richness increased with rugosity and meant SST (Figure S5), and rugosity was the most influential driver of species composition (Figure S5).

The relationships between predictor variables and trophic groups were mixed, except for benthic richness and rugosity, which had only positive relationships with fish groups (Figure 5d, Figure S4.28–S4.36, Table S6). Benthic invertivores were associated with lower hard coral cover, but had (weak) positive relationships with cyclone exposure and slope (Figure 6a; Figure S4.28). Carnivores were most strongly correlated with rugosity, with which they had a positive relationship, and also showed a tendency to increase with increasing benthic richness, coral morphological diversity and slope, but to decline with increasing Chlorophyll-a, cover of macroalgae and cyclone exposure (Figure 6a; Figure S4.29). Coral morphological diversity had the strongest (positive) effect on corallivores, more so than hard coral cover, and even small increases in macroalgal cover had a negative effect on corallivore densities (Figure 6a; Figure S4.30). Cyclones and higher turf cover led to declines in farmers, but DHW had a positive relationship with farmer density (Figure S4.31). Grazers appeared to benefit from higher DHW and rugosity but declined with increasing hard coral cover and SST (Figure S4.32). Omnivores also preferred higher hard coral cover and rugosity but declined with increasing unconsolidated substratum (Figure S4.33). Parrotfish preferred higher turbidity (Figure S4.34), piscivores responded positively to NTMR protection, higher prey density and hard coral cover (Figure S4.35), and planktivores increased with increasing hard coral and declined with higher cover of turf and macroalgae (Figure S4.36). Similarly to the Palm Islands, hard coral cover affected farmers negatively, but omnivores and planktivores positively, while unconsolidated substrata were negatively correlated with all three Pomacentridae-dominated groups (Figure 6a).

4 | DISCUSSION

Coral reef fish assemblages on inshore GBR fringing reefs showed strong responses to regionally specific disturbance events, with periodic declines over 12–14 years. While increases were observed during disturbance-free years, an overall decline in density (by 33%–72%) and species richness (by 41%–75%) was seen over the study period, driven to a large extent by small-bodied fishes of the family Pomacentridae. Similar declines were observed on both NTMRs and fished reefs, suggesting that inshore NTMR networks provided only a marginal benefit against environmental disturbance events (but see Williamson, Ceccarelli, Evans, Jones, & Russ, 2014) beyond fishery target species. Key drivers of temporal change in fish assemblages most common across regions and trophic groups were living hard coral cover, temperature-related variables (mean SST, DHW), turbidity and the cover of algal turf. Therefore, while changes in fish assemblages over time were influenced by changes in their habitat, the BRT models indicate that they were also affected directly by physical variables such as temperature and water quality. Predicted increases in ocean temperatures (IPCC, 2021) and expected declines in water quality with increasing flooding caused by extreme weather events (Devlin et al., 2012) raise concerns for these inshore reefs and their fish assemblages. These assemblages typically consist of lower numbers of species at lower densities than those further offshore, making the inshore assemblages potentially more vulnerable to disturbances (McClure et al., 2019).

4.1 | Temporal dynamics and disturbance events

Environmental disturbance events over the last 12–14 years were usually followed by a decline in density and species richness of coral reef fish, as well as shifts in species composition. None of these metrics returned to their pre-disturbance state within the study period. Additionally, the phases of recovery were not long enough to

prevent an overall decline in fish total density and species richness over the monitoring period. The smallest overall decline occurred at the Palm Islands, where total density and species richness reached similar levels to the early years by the end of the study. The largest periodic declines occurred in the aftermath of cyclones at the Palm and Whitsunday Islands, and Magnetic Island, and severe floods causing mass coral mortality at the southernmost island location, the Keppel Islands. While cyclones and floods produced the greatest response in fish abundance and richness, our analyses indicate that it was not the direct effect of these events that were the most important drivers of change in fish communities, but rather the indirect effects of habitat loss in the form of hard coral declines. This was further corroborated by the close relationship between the fluctuation in coral cover and total fish density, which was driven by the numerically dominant Pomacentridae and therefore the bulk of the planktivorous, omnivorous and farmer trophic groups.

Compared with storms and floods, fish assemblages responded less to bleaching events that reduced the cover of living corals, likely due to the remaining skeletons continuing to provide structure, at least in the short term (Gerlach et al., 2021; Pratchett et al., 2011). Generally, the physical destruction of the complex structure of reefs has greater consequences for fish than coral mortality events that leave the structure intact (Emslie et al., 2014; Gerlach et al., 2021); structural complexity decline can cause losses in abundance of up to 75% and make local extirpations likely (Emslie et al., 2014). In addition, although many species will have been adversely affected by coral mortality, for example corallivores and some of the planktivores that rely on live corals for shelter, other trophic groups such as grazers increased in abundance (Russ, Questel, et al., 2015), offsetting losses and thereby reducing the decline in total density. In this way, 'winners and losers' alternate in cycles. Fish density and species richness recovered during concurrent periods of coral recovery (usually lasting at least 5 years) documented in Ceccarelli et al. (2020), indicating a period that was conducive to general reef recovery, and that both coral and fish assemblages on the GBR retain the capacity to recover during disturbance-free periods (Emslie et al., 2024; Plass-Johnson et al., 2018).

The species composition of fish assemblages shifted over the duration of the study at all four island groups, with the largest changes occurring after disturbance events. Importantly, species composition at all four island groups did not 'bounce back' to pre-disturbance configurations, remaining different from the 2007 assemblage at the end of the monitoring period. The Palm Islands demonstrated the greatest propensity to return towards the composition of the early years, possibly due to its wide range of different habitat types, exposure levels and high connectivity between them. Magnetic Island and the Keppel Islands had phases where the post-disturbance assemblage was generally depauperate, with losses across the entire fish assemblage, as is common when hard coral loss exceeds 50% (Pratchett et al., 2011). Magnetic Island is unique among the locations in this study in that it is a solitary island, rather than an interconnected group of islands, with a smaller area of available coral reef habitat than the other island groups. Turbidity is typically higher (Fabricius et al., 2005), and anthropogenic pressure through visitation and recreational fishing is high due to the close proximity of Magnetic Island to the mainland (Ceccarelli et al., 2023). Much of the shallow coral reef habitat around Magnetic Island is seasonally overgrown with brown macroalgae (e.g. *Sargassum* spp.), and habitat complexity of the benthos is lower than at other island groups (Ceccarelli et al., 2020). The trajectory of change in the Whitsunday Island group followed a near-linear pathway. Generally, assemblages shifted towards omnivorous, carnivorous and grazing species, while coral-dependent species declined. Such mixed responses, both taxonomically and geographically, appear typical in studies of disturbance impacts to reef fish assemblages (Fukunaga et al., 2022; Wilson et al., 2006). The changes to fish assemblages due to disturbance measured here are likely to differ from the changes in fish assemblages on reefs further offshore. McClure et al. (2019) suggested that inshore reefs are the most vulnerable to loss of species, traits and functional roles after disturbance events, because of their lower species richness and exposure to chronic environmental stresses near the coast.

Other studies also documented 'winners and losers' after cumulative disturbances, and in many cases, summary metrics such as total density and species richness masked changes in the proportional abundance of different species (Cheal et al., 2008, Wilson et al. 2009, Lamy et al., 2015, Ceccarelli et al., 2016, Triki & Bshary, 2019). As reefs degrade under chronic anthropogenic pressures, there is concern that the highly diverse coral reef fish assemblages of the past will become dominated by generalists, reflecting a decline in the diversity of benthic communities and habitats (Stuart-Smith, 2021). In other studies, species reshuffling occurred, but trophic characteristics and traits, and therefore functional redundancy, were retained despite repeated and chronic stress, maintaining the processes, if not the exact species composition, of coastal reefs (Cook et al., 2022). It is therefore concerning that the reefs in our study did display such significant declines in coarse summary metrics such as total density and species richness.

4.2 | Drivers

Disturbance-induced coral loss, regime shifts to macroalgal dominance and the decline in overall structural complexity are repeatedly correlated with declines in fish density, biomass and diversity (Graham & Nash, 2013; Pratchett et al., 2008; Wilson et al., 2006). In contrast, certain groups of fishes have been shown to increase after coral mortality, such as parrotfish that can benefit from the sudden increase in carbonate substratum covered in turf and blue-green algae (Clements et al., 2017, Nicholson & Clements, 2023, Russ et al. 2021). Here, we show that benthic habitat was certainly a driver for temporal changes in coral reef fish assemblages on inshore reefs of the GBR, but that physical forces also acted directly upon reef fish assemblages. Where the relationships we explored were weak (in the form of low R^2 values), we acknowledge that forces other than those we tested are also important drivers of change in reef fish assemblages, such as recruitment patterns (Sale, 2004),

connectivity (Gerlach et al., 2021), historical biogeographical and geomorphological factors (Bennett et al., 2018; Samoilys et al., 2019) or reef size (Dames et al., 2020). Furthermore, we offer any generalisations with caution, given that the temporal dynamics and drivers that affect inshore reefs are likely to be different from those that influence mid-shelf or outer shelf reefs, both on the GBR and elsewhere (Dubuc et al., 2023; Emslie et al., 2017; Emslie et al., 2019; Malcolm et al., 2010). However, GBR inshore reefs do serve as useful representatives for a large proportion of coastal reefs worldwide. Over 75% of the world's coral reefs occur within 20 km of the coast (UNEP-WCMC et al., 2021) and are therefore similarly vulnerable to overexploitation, land-based run-off and the impacts of environmental disturbance events exacerbated by climate change.

4.2.1 | Physical variables

Temperature variables were the most consistently influential physical drivers of temporal change in fish assemblages. Of these, mean SST and DHW were most frequently among the key drivers of change, with mostly negative effects, indicating thermal stress in coral reef fishes. These results therefore show that predicted climate change-driven increases in global ocean temperatures will not only have devastating effects on reef-building corals (Frieler et al., 2013), but will directly affect reef fish assemblages. However, in the Palm, Keppel and Whitsunday Islands, increasing SST had positive effects on farming damselfish. This trophic group also responded positively to DHW in the Palm Islands, while in the Keppel Islands, DHW was positively correlated with species richness and the density of farming damselfish and grazing fishes.

Water temperature can be positively correlated with fish species richness due to increased metabolic potential of many species (Allen et al., 2002; Parravicini et al., 2013). In our study, small-bodied fishes of the family Pomacentridae tended to respond positively to increasing mean temperature, but were negatively affected by SST anomalies. Fishes also have an upper-temperature threshold above which they experience sublethal and perhaps even lethal stress (Shultz et al. 2016). SST increases and changes in the upper limits of temperature anomalies with climate change have already altered the distribution and community interactions of marine species (Poloczanska et al., 2013).

Temperature tolerance can be species- or even size-dependent, potentially resulting in the re-assembly of fish communities over time (Clark et al., 2017). However, declines in density or biomass following heat stress can simply be due to vertical movements to deeper waters, rather than mortality; in such cases, repeated monitoring usually finds a rapid return to previous population abundance (Magel et al., 2020). Mellin et al. (2016) found a strong decline in the density of large-bodied species and those with small geographic ranges when certain temperature thresholds were exceeded. On the inshore GBR, where the maximum depth is 12 m and fish have no escape from shallow warming, this study suggests that with increasing water temperatures and recurrent bouts of heat stress, we may lose density of all fish groups except grazing and farming species. In some parts of the world, an increase, or a dominance, in farming damselfish is viewed as a sign of reef degradation (Han et al., 2016).

After temperature, fish assemblages were influenced most by water quality variables and the exposure to cyclones. Turbidity, as measured by kd490, was a key driver of species composition in all island groups except Magnetic Island, which was the most uniformly turbid region throughout the study period. Generally, highly turbid reefs are thought to be associated with lower habitat quality and lower richness and abundance of reef fishes (Bejarano & Appeldoorn, 2013). On the inshore GBR, periods of greater turbidity can be associated with the aftermath of disturbance events (Luter et al., 2021), which, in the Keppel Islands, led to a low-diversity fish assemblage and an increase in parrotfish numbers taking advantage of the additional bare substratum. However, the more equivocal results (e.g. higher diversity in the Whitsunday Islands) may be due to the nature of these inshore reefs, where even periods of high wind speeds can resuspend the terrigenous sediment from the shallow seafloor (Ceccarelli et al., 2020). Similar cautions can be made for the interpretation of the effects of primary water, which is highly turbid and usually associated with freshwater flood plumes, but can also be the result of periods of high wind. Physical impacts on fish from being thrown around by cyclone waves are the most likely direct effect from cyclones, the other possibility (which is beyond this paper's scope) is fish response to cyclone cooling. Changes in abundance could occur due to emigration to calmer areas (Bacheler et al., 2019), or mortality (Gavriel et al., 2023). Further research is needed to disentangle the relative importance of cyclonic waves and cooling from the effects of habitat loss.

While turbid water may help hide prey from predators (Hess et al., 2019) and lead to more detritus for detritivores and omnivores (Brown et al., 2017), it also blocks visual cues (Newport et al., 2021), reduces the feeding efficiency and productivity (Tebbett et al., 2023) of some species directly or through sediment deposition (Goatley et al., 2016) and smothers the benthic habitats of some species (Cook et al., 2022). Furthermore, when turbidity is increased in the wake of disturbance events, it may be the effects of these same disturbances, rather than the turbidity itself, that elicits a response. High nutrients and turbidity have been a feature of these inshore reefs for decades or perhaps centuries, and most coral reef fish are likely to have acclimated to the conditions before our study began. Furthermore, short-term turbidity changes may not be captured in our data because fish surveys were not conducted in visibility below ~5 m, and surveys were conducted over annual or multi-year scales.

Productivity gradients as measured by Chlorophyll-*a* can also explain variability in fish assemblages (Samoilys et al., 2019). Across the Pacific, productivity was associated with higher biomass not only of predators but also of planktivores (Williams et al., 2015). Here, Chlorophyll-*a* was not a universally positive driver of fish density, with negative (albeit weak) relationships with carnivores and parrotfish in the Keppel and Palm Islands, and grazers in the Whitsunday and Palm Islands.

4.2.2 | Habitat-based variables

The most important habitat-based drivers of change in coral reef fish assemblages were the cover of live hard coral, macroalgae, turf and unconsolidated substratum. Additionally, some fish groups responded to changes in habitat complexity. Overall, the total density of coral reef fish, and that of coral-dependent species, increased with increasing hard coral cover; this was highlighted by the almost ubiquitously parallel trajectories of hard coral cover and fish density, and confirmed by the results of the BRT models. Periods of higher hard coral cover in these regions occurred in the absence of disturbance events (Ceccarelli et al., 2020), and these were the periods in which fish density also recovered. Additional analyses to partition out the influence of small-bodied Pomacentridae revealed that these small-bodied planktivorous and omnivorous species are especially vulnerable to reductions in live coral cover. However, groups such as grazers and farmers, as well as carnivores and benthic invertivores, were negatively affected by higher hard coral cover in some instances. When hard coral cover is very high, the habitat can be relatively uniform, such as when reef slopes are dominated by monotypic stands of branching *Acropora* spp. (Diaz-Pulido et al., 2009). Previous studies have shown negative relationships between parrotfish and live hard corals (Russ, Questel, et al., 2015) and highlighted that certain families, such as goatfishes, wrasses and detritivorous surgeonfishes respond to different elements of the benthos, such as rubble and sand patches, soft corals or carbonate pavement covered in turf (Lowe et al., 2019; Russ et al., 2017; Russ et al., 2018; Russ, Bergseth, et al., 2015).

Reef fish recovery to pre-disturbance assemblage structure can be closely linked to coral recovery (Williamson, Ceccarelli, Evans, Jones, & Russ, 2014), or a new suite of macroalgal associated fish species may replace them if coral recovery fails (Evans et al., 2014; Robinson et al., 2019). Macroalgal dominance benefits certain species, such as some wrasse species (Fulton et al., 2019; Lowe et al., 2019), and macroalgal beds are known to play a positive role in the recruitment of lethrinids, siganids and *Choerodon* spp. (Evans et al., 2014; Wilson et al., 2008). Therefore, although a shift to macroalgal dominance can reduce overall fish diversity, it can bring some benefits to important fisheries species. However, our study showed that an increase in macroalgae caused declines in almost all trophic groups of fishes, whether this effect was among the most influential or not.

We found a negative association between the cover of unconsolidated substratum (sand, rubble) and fish density, which was often reversed towards a positive association in the absence of small-bodied Pomacentridae, likely due to the shift in dominance to Labridae and their subfamily Scarinae (parrotfish). This is also consistent with the observed declines in fish abundance after disturbance events that cause coral mortality and produce rubble. A spatial analysis of the same sites found some positive effects of increasing unconsolidated substratum, whereby a disturbance-mediated benthic shift towards patches of coral, macroalgae and rubble at small scales could increase the overall patchiness of the habitat, providing opportunities for species other than those that prefer live corals, and therefore increasing species richness overall (Ceccarelli et al., 2023). This pattern was corroborated by removing small-bodied fishes from the analysis. However, this temporal analysis suggests that over time, more rubble leads to an eventual erosion of the positive effect on species richness as overall fish density declines (Wilson et al., 2006), and it would appear that this is driven by the response of small-bodied species. Habitat degradation in the form of coral loss and a flattening of habitat complexity has been shown to benefit only few trophic groups, such as farmers, some benthic invertivores and parrotfish (Graham, 2014).

Living hard coral is most important for species that directly rely on it for food and shelter. At a whole-assemblage level, live coral is rarely found to be among the most important drivers; a global meta-analysis found that associations between fish and corals are generally positive but weak (Muruga et al., 2024). However, every time a major disturbance impacted the inshore GBR, coral reef fish density (and to a lesser extent, species richness) declined, due to either mortality or, most likely, temporary movement. The link between live coral and the species that depend on it can also break down when those species are capable of broadening their habitat and dietary choices following coral loss (Semmler et al., 2022). Furthermore, the relationship between fish species richness and coral cover varies with increasing or declining coral cover, with a suggested threshold at around 10% coral cover, below which the relationship is strongly positive and above which it asymptotes (see also Beldade et al., 2015). At global scales, it has been projected that a hypothetical loss of all coral would result in a halving of fish diversity (Strona et al., 2021).

Structural complexity was generally not one of the most important drivers in this study, although it is known to be a strong driver of reef fish assemblage structure and abundance (Bell & Galzin, 1984; Chabanet et al., 1997; Emslie et al., 2014; Graham & Nash, 2013; Messmer et al., 2011; Sabater & Tofaeono, 2007; Samoilys et al., 2019). This is true not just for overall three-dimensional habitat structure but also for the variety of growth forms of corals and other benthos (Gratwicke & Speight, 2005), as we found in this study. In their review, Graham and Nash (2013) found overwhelmingly positive associations between reef fishes and structural complexity, but, once broken down into family groups, the associations were not universally significant. Higher structural complexity can provide more niche space to mediate density-dependent competition, refuge for prey and therefore more predators, hiding places for ambush predators and shelter from high water flow rates (Gratwicke & Speight, 2005). Different trophic groups of coral reef fishes tend to respond differently to changes in their structural environment, based on their resource and habitat requirements and interactions with other organisms (Graham et al., 2017; Jennings & Polunin, 1996; Ruppert et al., 2017; Russ & Alcala, 1989).

4.3 | No-take marine reserves

Temporal changes in total density and species richness in NTMR and fished zones were generally similar. The Whitsunday Islands was

the only region where density and species richness were generally higher in NTMRs; in the Palm Islands, species richness was higher in fished zones. This is not necessarily surprising in an ecosystem where fisheries only target a small number of largely piscivorous species, and it is highly likely that the differences in fish metrics are due to other attributes of those particular sites, and not due to management zoning (but see below). For example, a spatial analysis of the fish assemblages at these sites found that routine wave exposure was one of the key structuring forces of species composition, along with benthic habitat variables such as coral, macroalgae and rubble (Ceccarelli et al., 2023). NTMRs did have different species composition from fished zones in the Palm, Keppel and Whitsunday Island groups, but the changes in composition over time largely occurred in parallel in the two zones. In the Palm and Whitsunday Islands, the separation between zones was clearly driven by a higher proportion of *Plectropomus maculatus* and *P. leopardus*, the primary fishery target species, in NTMRs. Here, the density of target species remained higher in NTMRs than in fished zones throughout the study period.

Management zoning was an important driver of density only for piscivores, which was expected for a system in which the main commercial and recreational fishery targets a small number of predatory species such as *Plectropomus* spp. and large snappers and emperors (Emslie et al., 2015; Williamson et al., 2004). In fact, the NTMR effect in the BRT models was somewhat diluted by the fact that *Plectropomus* spp. were combined with some snappers, emperors and other groupers, some of which are not as strongly targeted by fisheries as *Plectropomus* spp. alone. Studies of NTMR effects on *Plectropomus* spp. alone on inshore GBR coral reefs often show strong, positive NTMR effects on density, biomass and reproductive output, sometimes despite evidence of poaching (Emslie et al., 2015, Evans et al., 2008, Harrison et al., 2012, Williamson et al., 2004, Williamson, Ceccarelli, Evans, Hill, & Russ, 2014, Williamson, Ceccarelli, Evans, Jones, & Russ, 2014). In other systems, fishing, or the absence of successful management, can be an important driver of overall coral reef fish density and biomass (McClanahan & Arthur, 2001; Russ & Alcala, 1989; Sandin et al., 2008).

There are a number of necessary design principles that facilitate the achievement of common NTMR goals (Edgar et al., 2014), such as the recovery of exploited populations (Graham et al., 2011), biodiversity conservation and improving ecosystem resilience. It is widely agreed that NTMRS are most effective when they are no-take, effectively enforced and managed, old (>10 years), large (>100 km^2) and isolated from other areas by sand or deep water. The NTMR networks in the inshore island groups were up to 14 years old at the time of writing (Fernandes et al., 2005), but most of them are small, shallow and there is evidence that compliance is poor (Bergseth et al., 2015). For example, of the total reef slope area around Magnetic Island only 17% of this is protected within a series of six NTMRS that measure between 0.002 and 24 hectares (Williamson et al., unpubl. data). The Whitsunday Islands, where a larger effect of NTMRs was measured, has 24 NTMRs ranging up to over 200 hectares, protecting 20% of the reef slope habitats (Williamson et al., unpubl. data). While the NTMRS studied here are enough to protect target species (Williamson et al., 2004), their small effect of the fish assemblages as a whole may be due to their small size, imperfect compliance and largely shallow habitats. More research could explore the influence of regional NTRM network design within the GBR on their abilities to buffer fish assemblages from disturbance.

5 | CONCLUSIONS

Anthropogenically driven climate change is already causing changes in ocean temperatures, acidity and environmental disturbance regimes worldwide (Henley et al., 2024; Hughes et al., 2017). Increasing temperatures are leading to range shifts of species and communities from tropical to subtropical and temperate marine habitats (Horta e Costa et al., 2014), and repeated heatwaves have caused global coral bleaching events of increasing spatial extent, frequency and intensity (Hoegh-Guldberg et al., 2023). Acidification is reducing growth rates and stability in organisms that rely on, or produce, calcium carbonate structures (Wei et al., 2009). On the GBR, the past decade has seen an unprecedented frequency and intensity of disturbance events, and coral populations—the primary ecosystem engineers—have become increasingly erratic and unstable (Emslie et al., 2024). It is against this backdrop that we present the concerning decline of a reef fish assemblage that is, in addition, subject to the chronic anthropogenic pressures typical of the coastal setting of 75% of the world's coral reefs.

This study revealed long-term declines in total reef fish density (up to 72%) and species richness (up to 75%), as frequent acute disturbances subjected coral habitats to multiple successive shocks that eroded abundance and biodiversity, and limited recovery. Our findings are concerning and at odds with previous GBR studies that have generally shown stability in these metrics in the face of environmental disturbances, albeit on reefs further from the coast (Cheal et al., 2008, Ceccarelli et al., 2016, Wilson et al. 2009). It is possible that we are witnessing a step change in benthic and reef fish community dynamics in the face of increasingly frequent disturbances. Additionally, our removal of the Pomacentridae from the Whole assemblage points to a risk of losing the numerically dominant and species-rich, small-bodied fish planktivores and omnivores. Such fish make up a large part of the food of piscivores and omnivores, and their small body size makes them highly productive, and they are thus an important part of the food web. Small-bodied prey fish species can affect the abundances of carnivorous species, and their decline may lead to losses of commercially and recreationally important predatory species (Carbone et al., 2011; Graham et al., 2003; Williamson, Ceccarelli, Evans, Jones, & Russ, 2014).

Environmental disturbances can reduce fish density and richness quickly, but recovery is typically slower in coral reef systems. We show that long-term decline in the quality of benthic habitat and physical environmental conditions led to demonstrable shifts in reef fish assemblage structure. NTMRs had little effect on total fish density, and in fact, species richness was higher on fished reefs than on NTMR reefs at three of four island groups. This result is

not surprising, considering the fishery predominantly targets larger piscivorous species and top-down predation pressure can drive prey fish species abundance and assemblage structure (Graham et al., 2003). In fact, our results do show NTMR benefits to target species (piscivores), but on reefs that experience high levels of acute and chronic pressure, small NTMRs in shallow habitats may not be as effective as they could be, given that their primary purpose on the GBR is the conservation of biodiversity (Fernandes et al., 2005). Studies that specifically quantify NTMR effects on fishery target species, on the GBR and elsewhere, confirm their efficacy in boosting populations of these species (Rodríguez-Rodríguez & Martínez-Vega, 2022; Russ et al., 2008; Williamson, Ceccarelli, Evans, Jones, & Russ, 2014). There is also evidence of indirect effects of NTMRs on assemblage structure, trophic dynamics, ecosystem recovery potential and pest outbreaks (Allard et al., 2022; Kroon et al., 2021; Topor et al., 2019). NTMRs remain one of the only large-scale tools for protecting marine environments, but there is increasing evidence that without global action on climate change, spatial protection and management alone are not sufficient for safeguarding coral reefs in the Anthropocene.

AUTHOR CONTRIBUTIONS

Daniela M. Ceccarelli: Conceptualization; data curation; formal analysis; methodology; visualization; writing – original draft; writing – review and editing. **Murray Logan:** Data curation; formal analysis. **Richard D. Evans:** Conceptualization; data curation; formal analysis; investigation; methodology; project administration; writing – review and editing. **Geoffrey P. Jones:** Conceptualization; funding acquisition; investigation; methodology; project administration; resources; supervision; writing – review and editing. **Marji Puotinen:** Resources; writing – review and editing. **Caroline Petus:** Methodology; resources. **Garry R. Russ:** Conceptualization; funding acquisition; investigation; methodology; project administration; supervision; writing – review and editing. **Tane Sinclair-Taylor:** Visualization. **Maya Srinivasan:** Investigation; writing – review and editing. **David H. Williamson:** Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; writing – review and editing.

ACKNOWLEDGEMENTS

Research funding was provided by the Australian Research Council (ARC); the CRC Reef Research Centre; the Australian Government Department of Environment and Energy through the Marine and Tropical Sciences Research Facility (MTSRF), the National Environmental Research Program (NERP), the National Environmental Science Program (NESP) and the Reef 2050 Integrated Monitoring and Reporting Program (RIMReP). Additional support was provided by the Australian Institute of Marine Science (AIMS). We wish to thank the following people for assistance with the fieldwork and data collection: Rene Abesamis, Kris Boody, Lisa Bostrom-Einarsson, Andrew Bauman, Andrew Cole, Paul Costello, Jody Kreuger, Mike Emslie, David Feary, Hugo Harrison, Jean-Paul Hobbs, Tom Holmes, Jake Lowe, Tom Mannering, Philippa Mantel, Even Moland, Will Robbins, Marie Roman, Niklas Taylor, Rebecca Weeks, Colin Wen, Gemma Galbraith and Ben Cresswell. For assistance with field operations, we also wish to thank the staff at Explore Group Hamilton Island, Keppel Reef Scuba Adventures, Mars Charters and the Orpheus Island Research Station. Additional thanks to the ARC Centre of Excellence for Coral Reef Studies for their administrative support of the project, and to Drs. David Wachenfeld, Mike Emslie and Jordan Goetze for useful comments on the draft manuscript.

CONFLICT OF INTEREST STATEMENT

The authors state that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in Dryad at https://doi.org/10.5061/dryad.jsxksn0k6The code that supports the findings of this study are openly available in Zenodo at https://doi.org/10.5281/zenodo.3441725.

ORCID

Daniela M. Ceccarelli https://orcid.org/0000-0001-8067-8716
Murray Logan https://orcid.org/0000-0001-5102-3972
Richard D. Evans https://orcid.org/0000-0003-4364-4810
Marji Puotinen https://orcid.org/0000-0002-1383-697X
Caroline Petus https://orcid.org/0000-0002-2867-941X
Tane Sinclair-Taylor https://orcid.org/0000-0003-4240-0435
Maya Srinivasan https://orcid.org/0000-0002-8035-3417

REFERENCES

AIMS. (2024). Spatio-temporal dynamics of coral reef fish assemblages on inshore reefs of the great barrier reef.

Allard, H., Ayling, A. M., & Shears, N. T. (2022). Long-term changes in reef fish assemblages after 40 years of no-take marine reserve protection. *Biological Conservation*, *265*, 109405.

Allen, A. P., Brown, J. H., & Gillooly, J. F. (2002). Global biodiversity, biochemical kinetics, and the energetic-equivalence rule. *Science*, *297*, 1545–1548.

Alvarez-Romero, J., Devlin, M., da Silva, E., Petus, C., Ban, N., Pressey, R., Kool, J., Roberts, J., Cerdeira-Estrada, S., Wenger, A., & Brodie, J. (2013). A novel approach to model exposure of coastal-marine ecosystems to riverine flood plumes based on remote sensing techniques. *Journal of Environmental Management*, *119*, 194–207.

Anthony, K. R. N., Marshall, P. A., Abdulla, A., Beeden, R., Bergh, C., Black, R., Eakin, C. M., Game, E. T., Gooch, M., Graham, N. A. J., Green, A., Heron, S. F., van Hooidonk, R., Knowland, C., Mangubhai, S., Marshall, N., Maynard, J. A., McGinnity, P., McLeod, E., … Wear, S. (2015). Operationalizing resilience for adaptive coral reef management under global environmental change. *Global Change Biology*, *21*, 48–61.

Arias-González, J. E., Fung, T., Seymour, R. M., Garza-Pérez, J. R., Acosta-González, G., Bozec, Y.-M., & Johnson, C. R. (2017). A coral-algal phase shift in Mesoamerica not driven by changes in herbivorous fish abundance. *PLoS One*, *12*, e0174855.

Bacheler, N. M., Shertzer, K. W., Cheshire, R. T., & MacMahan, J. H. (2019). Tropical storms influence the movement behavior of a demersal oceanic fish species. *Scientific Reports*, *9*, 1481.

Baith, K., Lindsay, R., Fu, G., & McClain, C. R. (2001). SeaDAS: A data analysis system for ocean color satellite sensors. *Eos, Transactions American Geophysical Union*, *82*, 202.

Bejarano, I., & Appeldoorn, R. S. (2013). Seawater turbidity and fish communities on coral reefs of Puerto Rico. *Marine Ecology Progress Series*, *474*, 217–226.

Beldade, R., Mills, S. C., Claudet, J., & Côté, I. M. (2015). More coral, more fish? Contrasting snapshots from a remote Pacific atoll. *PeerJ*, *3*, e745.

Bell, J. D., & Galzin, R. (1984). Influence of live coral cover on coral-reef fish communities. *Marine Ecology Progress Series*, *15*, 265–274.

Bennett, S., Halford, A. R., Choat, J. H., Hobbs, J.-P. A., Santana-Garcon, J., Ayling, A. M., Harvey, E. S., & Newman, S. J. (2018). Geography and Island geomorphology shape fish assemblage structure on isolated coral reef systems. *Ecology and Evolution*, *8*, 6242–6252.

Benthuysen, J. A., Emslie, M. J., Currey-Randall, L. M., Cheal, A. J., & Heupel, M. R. (2022). Oceanographic influences on reef fish assemblages along the great barrier reef. *Progress in Oceanography*, *208*, 102901.

Bergseth, B. J., Russ, G. R., & Cinner, J. E. (2015). Measuring and monitoring compliance in no-take marine reserves. *Fish and Fisheries*, *16*, 240–258.

Brandl, S. J., Rasher, D. B., Côté, I. M., Casey, J. M., Darling, E. S., Lefcheck, J. S., & Duffy, J. E. (2019). Coral reef ecosystem functioning: Eight core processes and the role of biodiversity. *Frontiers in Ecology and the Environment*, *17*, 445–454.

Brooks, M. E., Kristensen, K., van Benthem, K. J., Magnusson, A., Berg, C. W., Nielsen, A., Skaug, H. J., Maechler, M., & Bolker, B. M. (2017). glmmTMB balances speed and flexibility among packages for zero-inflated generalized linear mixed modeling. *The R Journal*, *9*(2), 378–400.

Brown, C. J., Jupiter, S. D., Lin, H. Y., Albert, S., Klein, C., Maina, J. M., Tulloch, V. J. D., Wenger, A. S., & Mumby, P. J. (2017). Habitat change mediates the response of coral reef fish populations to terrestrial run-off. *Marine Ecology Progress Series*, *576*, 55–68.

Byrnes, J. E., Reed, D. C., Cardinale, B. J., Cavanaugh, K. C., Holbrook, S. J., & Schmitt, R. J. (2011). Climate-driven increases in storm frequency simplify kelp forest food webs. *Global Change Biology*, *17*, 2513–2524.

Carbone, C., Pettorelli, N., & Stephens, P. A. (2011). The bigger they come, the harder they fall: Body size and prey abundance influence predator–prey ratios. *Biology Letters*, *7*(2), 312–315.

Ceccarelli, D. M., Emslie, M. J., & Richards, Z. T. (2016). Post-disturbance stability of fish assemblages measured at coarse taxonomic resolution masks change at finer scales. *PLoS One*, *11*, e0156232.

Ceccarelli, D. M., Evans, R. D., Logan, M., Jones, G. P., Puotinen, M., Petus, C., Russ, G. R., Srinivasan, M., & Williamson, D. H. (2023). Physical, biological and anthropogenic drivers of spatial patterns of coral reef fish assemblages at regional and local scales. *Science of the Total Environment*, *904*, 166695.

Ceccarelli, D. M., Evans, R. D., Logan, M., Mantel, P., & Puotinen, M. (2020). Long-term dynamics and drivers of coral and macroalgal cover on inshore reefs of the great barrier reef Marine Park. *Ecological Applications*, *30*, 148–167.

Ceccarelli, D. M., Jones, G. P., & McCook, L. J. (2005). Foragers versus farmers: Contrasting effects of two behavioural groups of herbivores on coral reefs. *Oecologia*, *145*, 445–453.

Chabanet, P., Ralambondrainy, H., Amanieu, M., Faure, G., & Galzin, R. (1997). Relationships between coral reef substrata and fish. *Coral Reefs*, *16*, 93–102.

Cheal, A. J., Wilson, S. K., Emslie, M. J., Dolman, A. M., & Sweatman, H. (2008). Responses of reef fish communities to coral declines on the great barrier reef. *Marine Ecology Progress Series*, *372*, 211–223.

Chong-Seng, K. M., Mannering, T. D., Pratchett, M. S., Bellwood, D. R., & Graham, N. A. J. (2012). The influence of coral reef benthic condition on associated fish assemblages. *PLoS One*, *7*, e42167.

Cinner, J. E., Huchery, C., MacNeil, M. A., Graham, N. A. J., McClanahan, T. R., Maina, J., Maire, E., Kittinger, J. N., Hicks, C. C., Mora, C., Allison, E. H., D'Agata, S., Hoey, A., Feary, D. A., Crowder, L., Williams, I. D., Kulbicki, M., Vigliola, L., Wantiez, L., … Mouillot, D. (2016). Bright spots among the world's coral reefs. *Nature*, *535*, 416–419.

Clark, T. D., Roche, D. G., Binning, S. A., Speers-Roesch, B., & Sundin, J. (2017). Maximum thermal limits of coral reef damselfishes are size dependent and resilient to near-future ocean acidification. *Journal of Experimental Biology*, *220*, 3519–3526.

Clements, K. D., German, D. P., Piché, J., Tribollet, A., & Choat, J. H. (2017). Integrating ecological roles and trophic diversification on coral reefs: Multiple lines of evidence identify parrotfishes as microphages. *Biological Journal of the Linnean Society*, *120*, 729–751.

Connell, J. H. (1978). Diversity in tropical rain forests and coral reefs. *Science*, *199*, 1302–1310.

Cook, K. M., Yamagiwa, H., Beger, M., Masucci, G. D., Ross, S., Lee, H. Y. T., Stuart-Smith, R. D., & Reimer, J. D. (2022). A community and functional comparison of coral and reef fish assemblages between four decades of coastal urbanisation and thermal stress. *Ecology and Evolution*, *12*, e8736.

Crisp, S. K., Tebbett, S. B., & Bellwood, D. R. (2022). A critical evaluation of benthic phase shift studies on coral reefs. *Marine Environmental Research*, *178*, 105667.

Dallas, T. A., & Kramer, A. M. (2022). Temporal variability in population and community dynamics. *Ecology*, *103*, e03577.

Dames, V., Bernard, A., Floros, C., Mann, B., Speed, C., Maggs, J., Laing, S., Meekan, M., & Olbers, J. (2020). Zonation and reef size significantly influence fish population structure in an established marine protected area, iSimangaliso Wetland Park, South Africa. *Ocean and Coastal Management*, *185*, 105040.

Darling, E. S., Graham, N. A. J., Januchowski-Hartley, F. A., Nash, K. L., Pratchett, M. S., & Wilson, S. K. (2017). Relationships between structural complexity, coral traits, and reef fish assemblages. *Coral Reefs*, *36*, 561–575.

Dayton, P. K. (1971). Competition, disturbance, and community organization: The provision and subsequent utilization of space in a rocky intertidal community. *Ecological Monographs*, *41*, 351–389.

Detmer, A. R., Miller, R. J., Reed, D. C., Bell, T. W., Stier, A. C., & Moeller, H. V. (2021). Variation in disturbance to a foundation species structures the dynamics of a benthic reef community. *Ecology*, *102*, e03304.

Devlin, M., Petus, C., Teixeira da Silva, T. D., Wolff, N., Waterhouse, J., & Brodie, J. (2015). Water quality and river plume monitoring in the great barrier reef: An overview of methods based on ocean colour satellite data. *Remote Sensing*, *7*, 12909–12941.

Devlin, M., Schroeder, T., McKinna, L., Brodie, J., Brando, V., & Dekker, A. (2012). *Monitoring and mapping of flood plumes in the great barrier reef based on in-situ and remote sensing observations. Advances in environmental remote sensing to monitor global changes*. CRC Press.

Devlin, M. J., da Silva, E. T., Petus, C., Wenger, A., Zeh, D., Tracey, D., Álvarez-Romero, J. G., & Brodie, J. (2013). Combining in-situ water quality and remotely sensed data across spatial and temporal scales to measure variability in wet season chlorophyll-a: Great Barrier Reef lagoon (Queensland, Australia). *Ecological Processes*, *2*(1), 31. https://doi.org/10.1186/2192-1709-2-31

Diaz-Pulido, G., McCook, L. J., Dove, S., Berkelmans, R., Roff, G., Kline, D. I., Weeks, S., Evans, R. D., Williamson, D. H., & Hoegh-Guldberg, O. (2009). Doom and boom on a resilient reef: Climate change, algal overgrowth and coral recovery. *PLoS One*, *4*, e5239.

Done, T. J. (1992). Phase shifts in coral reef communities and their ecological significance. *Hydrobiologia*, *247*, 121–132.

Dubuc, A., Quimbayo, J. P., Alvarado, J. J., Araya-Arce, T., Arriaga, A., Ayala-Bocos, A., Julio Casas-Maldonado, J., Chasqui, L., Cortés, J., Cupul-Magaña, A., Olivier, D., Olán-González, M., González-Leiva, A., Reyes-Bonilla, H., Smith, F., Rivera, F., Rodríguez-Zaragoza, F. A., Rodríguez-Villalobos, J. C., Segovia, J., … Bejarano, S. (2023). Patterns of reef fish taxonomic and functional diversity in the eastern tropical Pacific. *Ecography*, *2023*, e06536.

Edgar, G. J., Stuart-Smith, R. D., Heather, F. J., Barrett, N. S., Turak, E., Sweatman, H., Emslie, M. J., Brock, D. J., Hicks, J., French, B., Baker, S. C., Howe, S. A., Jordan, A., Knott, N. A., Mooney, P., Cooper, A. T., Oh, E. S., Soler, G. A., Mellin, C., … Bates, A. E. (2023). Continent-wide declines in shallow reef life over a decade of ocean warming. *Nature*, *615*, 858–865.

Edgar, G. J., Stuart-Smith, R. D., Willis, T. J., Kininmonth, S., Baker, S. C., Banks, S., Barrett, N. S., Becerro, M. A., Bernard, A. T. F., Berkhout, J., Buxton, C. D., Campbell, S. J., Cooper, A. T., Davey, M., Edgar, S. C., Forsterra, G., Galvan, D. E., Irigoyen, A. J., Kushner, D. J., … Thomson, R. J. (2014). Global conservation outcomes depend on marine protected areas with five key features. *Nature*, *506*, 216–228.

Eggertsen, M., Chacin, D. H., Åkerlund, C., Halling, C., & Berkström, C. (2019). Contrasting distribution and foraging patterns of herbivorous and detritivorous fishes across multiple habitats in a tropical seascape. *Marine Biology*, *166*, 51.

Elith, J., Leathwick, J. R., & Hastie, T. (2008). A working guide to boosted regression trees. *The Journal of Animal Ecology*, *77*, 802–813.

Emslie, M. J., Ceccarelli, D. M., Logan, M., Blandford, M. I., Bray, P., Campili, A., Jonker, M. J., Parker, J. G., Prenzlau, T., & Sinclair-Taylor, T. H. (2024). Changing dynamics of great barrier reef hard coral cover in the Anthropocene. *Coral Reefs*, *43*, 747–762.

Emslie, M. J., Cheal, A. J., & Johns, K. A. (2014). Retention of habitat complexity minimizes disassembly of reef fish communities following disturbance: A large-scale natural experiment. *PLoS One*, *9*, e105384.

Emslie, M. J., Cheal, A. J., & Logan, M. (2017). The distribution and abundance of reef-associated predatory fishes on the great barrier reef. *Coral Reefs*, *36*, 829–846.

Emslie, M. J., Logan, M., & Cheal, A. J. (2019). The distribution of Planktivorous damselfishes (Pomacentridae) on the great barrier reef and the relative influences of habitat and predation. *Diversity*, *11*, 33.

Emslie, M. J., Logan, M., Williamson, D. H., Ayling, A. M., MacNeil, M. A., Ceccarelli, D., Cheal, A. J., Evans, R. D., Johns, K. A., Jonker, M. J., Miller, I. R., Osborne, K., Russ, G. R., & Sweatman, H. P. A. (2015). Expectations and outcomes of reserve network performance following Re-zoning of the great barrier reef Marine Park. *Current Biology*, *25*, 983–992.

Epstein, H. E., & Kingsford, M. J. (2019). Are soft coral habitats unfavourable? A closer look at the association between reef fishes and their habitat. *Environmental Biology of Fishes*, *102*, 479–497.

Evans, R. D., Russ, G. R., & Kritzer, J. P. (2008). Batch fecundity of Lutjanus carponotatus (Lutjanidae) and implications of no-take marine reserves on the great barrier reef, Australia. *Coral Reefs*, *27*, 179–189.

Evans, R. D., Wilson, S. K., Field, S. N., & Moore, J. A. Y. (2014). Importance of macroalgal fields as coral reef fish nursery habitat in north-west Australia. *Marine Biology*, *161*, 599–607.

Fabricius, K., De'ath, G., McCook, L., Turak, E., & Williams, D. M. (2005). Changes in algal, coral and fish assemblages along water quality gradients on the inshore great barrier reef. *Marine Pollution Bulletin*, *51*, 384–398.

Fabricius, K. E., De'ath, G., Puotinen, M. L., Done, T., Cooper, T. F., & Burgess, S. C. (2008). Disturbance gradients on inshore and offshore coral reefs caused by a severe tropical cyclone. *Limnology and Oceanography*, *53*, 690–704.

Feary, D. A., Burt, J. A., Bauman, A. G., Usseglio, P., Sale, P. F., & Cavalcante, G. H. (2010). Fish communities on the world's warmest reefs: What can they tell us about the effects of climate change in the future? *Journal of Fish Biology*, *77*, 1931–1947.

Fernandes, L., Day, J., Lewis, A., Slegers, S., Kerrigan, B., Breen, D., Cameron, D., Jago, B., Hall, J., Lowe, D., Innes, J., Tanzer, J., Chadwick, V., Thompson, L., Gorman, K., Simmons, M., Barnett, B., Sampson, K., De'ath, G., … Stapleton, K. (2005). Establishing representative no-take areas over 1/3 of the great barrier reef: Large-scale implementation of marine protected area theory with lessons for global application. *Conservation Biology*, *19*, 1733–1744.

Floeter, S. R., Behrens, M. D., Ferreira, C. E. L., Paddack, M. J., & Horn, M. H. (2005). Geographical gradients of marine herbivorous fishes: Patterns and processes. *Marine Biology*, *147*, 1435–1447.

Flores, F., Hoogenboom, M. O., Smith, L. D., Cooper, T. F., Abrego, D., & Negri, A. P. (2012). Chronic exposure of corals to fine sediments: Lethal and sub-lethal impacts. *PLoS One*, *7*, e37795.

Friedlander, A. M., Brown, E. K., Jokiel, P. L., Smith, W. R., & Rodgers, K. S. (2003). Effects of habitat, wave exposure, and marine protected area status on coral reef fish assemblages in the Hawaiian archipelago. *Coral Reefs*, *22*, 291–305.

Frieler, K., Meinshausen, M., Golly, A., Mengel, M., Lebek, K., Donner, S. D., & Hoegh-Guldberg, O. (2013). Limiting global warming to 2°C is unlikely to save most coral reefs. *Nature Climate Change*, *3*, 165–170.

Fukunaga, A., McKenna, S. A., Brown, E. K., McCutcheon, A. L., & Burns, J. H. R. (2022). Temporal patterns in coral reef fish assemblages with varying disturbance levels: A tale of two National Parks in Hawai'i. Frontiers in Marine *Science*, *9*, e1038365.

Fulton, C. J., Abesamis, R. A., Berkström, C., Depczynski, M., Graham, N. A. J., Holmes, T. H., Kulbicki, M., Noble, M. M., Radford, B. T., Tano, S., Tinkler, P., Wernberg, T., & Wilson, S. K. (2019). Form and function of tropical macroalgal reefs in the Anthropocene. *Functional Ecology*, *33*, 989–999.

Fulton, C. J., Bellwood, D. R., & Wainwright, P. C. (2005). Wave energy and swimming performance shape coral reef fish assemblages. *Proceedings of the Royal Society B: Biological Sciences*, *272*, 827–832.

Gavriel, T., Zvuloni, A., Levy, L., Avidan, C., Avidan, L., Buba, Y., Chaikin, S., Frid, O., Holzman, R., Lazarus, M., Malamud, S., Marom, S., Perevolotsky, T., Pickholtz, R., Salingre, S., Shapira, N., & Belmaker, J. (2023). An extreme storm decreases reef fish abundance and richness but does not impact spatial heterogeneity. *Coral Reefs*, *42*, 1395–1410.

Gerlach, G., Kraemer, P., Weist, P., Eickelmann, L., & Kingsford, M. J. (2021). Impact of cyclones on hard coral and metapopulation structure, connectivity and genetic diversity of coral reef fish. *Coral Reefs*, *40*, 999–1011.

Gilmour, J. P., Cook, K. L., Ryan, N. M., Puotinen, M. L., Green, R. H., & Heyward, A. J. (2022). A tale of two reef systems: Local conditions, disturbances, coral life histories, and the climate catastrophe. *Ecological Applications*, *32*(3), e2509. https://doi.org/10.1002/eap.2509

Goatley, C. H. R., González-Cabello, A., & Bellwood, D. R. (2016). Reef-scale partitioning of cryptobenthic fish assemblages across the great barrier reef, Australia. *Marine Ecology Progress Series*, *544*, 271–280.

Graham, N., Ainsworth, T., Baird, A., Ban, N., Bay, L., Cinner, J., De Freitas, D., Diaz-Pulido, G., Dornelas, M., Dunn, S., Fidelman, P., Foret, S., Good, T., Kool, J., Mallela, J., Penin, L., Pratchett, M., & Williamson, D. (2011). From microbes to people: Tractable benefits of No-take areas for coral reefs. *Oceanography and Marine Biology: An Annual Review*, *49*, 105–136.

Graham, N. A. J., Evans, R. D., & Russ, G. R. (2003). The effects of marine reserve protection on the trophic relationships of reef fishes on the great barrier reef. *Environmental Conservation*, *30*, 200–208.

Graham, N. A. J., Jennings, S., MacNeil, M. A., Mouillot, D., & Wilson, S. K. (2015). Predicting climate-driven regime shifts versus rebound potential in coral reefs. *Nature*, *518*, 94–97.

Graham, N. A. J., McClanahan, T. R., MacNeil, M. A., Wilson, S. K., Cinner, J. C., Huchery, C., & Holmes, T. H. (2017). Human disruption of coral reef trophic structure. *Current Biology*, *27*, 231–236.

Graham, N. A. J., & Nash, K. L. (2013). The importance of structural complexity in coral reef ecosystems. *Coral Reefs*, *32*, 315–326.

Graham, N. A. J. (2014). Habitat complexity: Coral structural loss leads to fisheries declines. *Current Biology*, *24*, R359–R361.

Gratwicke, B., & Speight, M. R. (2005). The relationship between fish species richness, abundance and habitat complexity in a range of shallow tropical marine habitats. *Journal of Fish Biology*, *66*, 650–667.

Green, A. L., Maypa, A. P., Almany, G. R., Rhodes, K. L., Weeks, R., Abesamis, R. A., Gleason, M. G., Mumby, P. J., & White, A. T. (2015). Larval dispersal and movement patterns of coral reef fishes, and implications for marine reserve network design. *Biological Reviews*, *90*, 1215–1247.

Grutter, A. S. (1995). Relationship between cleaning rates and ectoparasite loads in coral reef fishes. *Marine Ecology Progress Series*, *118*, 51–58.

Hadj-Hammou, J., McClanahan, T. R., & Graham, N. A. J. (2021). Decadal shifts in traits of reef fish communities in marine reserves. *Scientific Reports*, *11*, 23470.

Hajime, K. (2017). Validation of degree heating weeks as a coral bleaching index in the northwestern Pacific. *Coral Reefs*, *36*, 63–70.

Halford, A., Cheal, A. J., Ryan, D., & Williams, D. M. B. (2004). Resilience to large-scale disturbance in coral and fish assemblages on the great barrier reef. *Ecology*, *85*, 1892–1905.

Han, X., Adam, T. C., Schmitt, R. J., Brooks, A. J., & Holbrook, S. J. (2016). Response of herbivore functional groups to sequential perturbations in Moorea, French Polynesia. *Coral Reefs*, *35*, 999–1009.

Harrison, H. B., Williamson, D. H., Evans, R. D., Almany, G. R., Thorrold, S. R., Russ, G. R., Feldheim, K. A., van Herwerden, L., Planes, S., Srinivasan, M., Berumen, M. L., & Jones, G. P. (2012). Larval export from marine reserves and the recruitment benefit for fish and fisheries. *Current Biology*, *22*, 1023–1028.

Hastie, T., Tibshirani, R., & Friedman, J. (2011). *The elements of statistical learning, second edition: Data mining, inference, and prediction*. Springer.

Hatcher, B. G. (1988). Coral reef primary productivity: A beggar's banquet. *Trends in Ecology & Evolution*, *3*, 106–111.

Henley, B. J., McGregor, H. V., King, A. D., Hoegh-Guldberg, O., Arzey, A. K., Karoly, D. J., Lough, J. M., DeCarlo, T. M., & Linsley, B. K. (2024). Highest ocean heat in four centuries places great barrier reef in danger. *Nature*, *632*, 320–326.

Hess, S., Allan, B. J. M., Hoey, A. S., Jarrold, M. D., Wenger, A. S., & Rummer, J. L. (2019). Enhanced fast-start performance and anti-predator behaviour in a coral reef fish in response to suspended sediment exposure. *Coral Reefs*, *38*, 103–108.

Hixon, M. A. (1991). Predation as a process structuring coral reef fish communities. In P. F. Sale (Ed.), *The ecology of fishes on coral reefs* (pp. 475–508). Academic Press.

Hobson, E. S., & Chess, J. R. (1978). Trophic relationships among fishes and plankton in the lagoon at Enewetak atoll, Marshall Islands. *Fishery Bulletin*, *76*, 133–153.

Hoegh-Guldberg, O., Skirving, W., Dove, S. G., Spady, B. L., Norrie, A., Geiger, E. F., Liu, G., De La Cour, J. L., & Manzello, D. P. (2023). Coral reefs in peril in a record-breaking year. *Science*, *382*, 1238–1240.

Hoey, A. S., Brandl, S. J., & Bellwood, D. R. (2013). Diet and cross-shelf distribution of rabbitfishes (f. Siganidae) on the northern great barrier reef: Implications for ecosystem function. *Coral Reefs*, *32*, 973–984.

Horta e Costa, B, Assis, J., Franco, G., Erzini, K., Henriques, M., Gonçalves, E. J., & Caselle, J. E. (2014). Tropicalization of fish assemblages in temperate biogeographic transition zones. *Marine Ecology Progress Series*, *504*, 241–252.

Hu, C., Lee, Z., & Franz, B. A. (2012). Chlorophyll-a algorithms for oligotrophic oceans: A novel approach based on three-band reflectance difference. *Journal of Geophysical Research*, *117*, C01011.

Hughes, T. P., Anderson, K. D., Connolly, S. R., Heron, S. F., Kerry, J. T., Lough, J. M., Baird, A. H., Baum, J. K., Berumen, M. L., Bridge, T. C., Claar, D. C., Eakin, M. C., Gilmour, J. P., Graham, N. A. J., Hugo, H., Hobbs, J. P. A., Hoey, A. S., Hoogenboom, M., Lowe, R. J., … Wilson, S. K. (2018). Spatial and temporal patterns of mass bleaching of corals in the Anthropocene. *Science*, *359*, 80–83.

Hughes, T. P., Barnes, M. L., Bellwood, D. R., Cinner, J. E., Cumming, G. S., Jackson, J. B. C., Kleypas, J., van de Leemput, I. A., Lough, J. M., Morrison, T. H., Palumbi, S. R., van Nes, E. H., & Scheffer, M. (2017). Coral reefs in the Anthropocene. *Nature*, *546*, 82–90.

Hughes, T. P., Kerry, J. T., & Simpson, T. (2018). Large-scale bleaching of corals on the great barrier reef. *Ecology*, *99*, 501.

IPCC. (2021). *Climate change 2021: The physical science basis. Contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change*. IPCC.

Jennings, S., & Polunin, N. V. C. (1996). Impacts of fishing on tropical reef ecosystems. *Ambio*, *25*, 44–49.

Johansen, J. L., & Jones, G. P. (2013). Sediment-induced turbidity impairs foraging performance and prey choice of planktivorous coral reef fishes. *Ecological Applications*, *23*, 1504–1517.

Jones, G. P., Almany, G. R., Russ, G. R., Sale, P. F., Steneck, R. S., van Oppen, M. J. H., & Willis, B. L. (2009). Larval retention and connectivity among populations of corals and reef fishes: History, advances and challenges. *Coral Reefs*, *28*, 307–325.

Jones, G. P., McCormick, M. I., Srinivasan, M., & Eagle, J. V. (2004). Coral decline threatens fish biodiversity in marine reserves. *Proceedings of the National Academy of Sciences of the United States of America*, *101*, 8251–8253.

Jouffray, J.-B., Nyström, M., Norström, A. V., Williams, I. D., Wedding, L. M., Kittinger, J. N., & Williams, G. J. (2015). Identifying multiple coral reef regimes and their drivers across the Hawaiian archipelago. *Philosophical Transactions of the Royal Society B*, *370*, 20130268.

Jurgens, L. J., & Gaylord, B. (2018). Physical effects of habitat-forming species override latitudinal trends in temperature. *Ecology Letters*, *21*, 190–196.

Kramer, M., Bellwood, O., Fulton, C., & Bellwood, D. (2015). Refining the invertivore: Diversity and specialisation in fish predation on coral reef crustaceans. *Marine Biology*, *162*, 1779–1786.

Kroon, F. J., Barneche, D. R., & Emslie, M. J. (2021). Fish predators control outbreaks of crown-of-thorns starfish. *Nature Communications*, *12*, 6986.

Lamy, T., Legendre, P., Chancerelle, Y., Siu, G., & Claudet, J. (2015). Understanding the Spatio-temporal response of coral reef fish communities to natural disturbances: Insights from Beta-diversity decomposition. *PLoS One*, *10*, e0138696.

Lee, Z. P., Darecki, M., Carder, K. L., Davis, C. O., Stramski, D., & Rhea, W. J. (2005). Diffuse attenuation coefficient of downwelling irradiance: An evaluation of remote sensing methods. *Journal of Geophysical Research*, *110*, C02017.

Letourneur, Y., Kulbicki, M., & Labrosse, P. (1998). Spatial structure of commercial reef fish communities along a terrestrial runoff gradient in the northern lagoon of New Caledonia. *Environmental Biology of Fishes*, *51*, 141–159.

Levin, S. A., & Paine, R. T. (1974). Disturbance, patch formation, and community structure. *Proceedings of the National Academy of Sciences*, *71*, 2744–2747.

Lin, Y. V., Hsiao, W. V., Chen, W.-J., & Denis, V. (2022). Habitat change and its consequences on reef fish specialization in biogeographic transition zones. *Journal of Biogeography*, *49*, 1549–1561.

Lloyd, P., Plagányi, É. E., Weeks, S. J., Magno-Canto, M., & Plagányi, G. (2012). Ocean warming alters species abundance patterns and increases species diversity in an African sub-tropical reef-fish community. *Fisheries Oceanography*, *21*, 78–94.

Lowe, J. R., Williamson, D. H., Ceccarelli, D. M., Evans, R. D., & Russ, G. R. (2019). Responses of coral reef wrasse assemblages to disturbance and marine reserve protection on the great barrier reef. *Marine Biology*, *166*, 119.

Luckhurst, B. E., & Luckhurst, K. (1978). Analysis of the influence of substrate variables on coral reef fish communities. *Marine Biology*, *49*, 317–323.

Luter, H. M., Pineda, M.-C., Ricardo, G., Francis, D. S., Fisher, R., & Jones, R. (2021). Assessing the risk of light reduction from natural

sediment resuspension events and dredging activities in an inshore turbid reef environment. *Marine Pollution Bulletin*, *170*, 112536.
Madin, J. S. (2005). Mechanical limitations of reef corals during hydrodynamic disturbances. *Coral Reefs*, *24*, 630–635.
Magel, J. M. T., Dimoff, S. A., & Baum, J. K. (2020). Direct and indirect effects of climate change-amplified pulse heat stress events on coral reef fish communities. *Ecological Applications*, *30*, e02124.
Maia, H. A., Morais, R. A., Quimbayo, J. P., Dias, M. S., Sampaio, C. L. S., Horta, P. A., Ferreira, C. E. L., & Floeter, S. R. (2018). Spatial patterns and drivers of fish and benthic reef communities at São Tomé Island, tropical eastern Atlantic. *Marine Ecology*, *39*, e12520.
Malcolm, H. A., Jordan, A., & Smith, S. D. A. (2010). Biogeographical and cross-shelf patterns of reef fish assemblages in a transition zone. *Marine Biodiversity*, *40*, 181–193.
McClanahan, T. R., & Arthur, R. (2001). The effect of marine reserves and habitat on populations of east African coral reef fishes. *Ecological Applications*, *11*, 559–569.
McClure, E. C., Richardson, L. E., Graba-Landry, A., Loffler, Z., Russ, G. R., & Hoey, A. S. (2019). Cross-shelf differences in the response of herbivorous fish assemblages to severe environmental disturbances. *Diversity*, *11*, 23.
McClure, E. C., Sievers, K. T., Abesamis, R. A., Hoey, A. S., Alcala, A. C., & Russ, G. R. (2020). Higher fish biomass inside than outside marine protected areas despite typhoon impacts in a complex reefscape. *Biological Conservation*, *241*, 108354.
McCook, L. J., Ayling, T., Cappo, M., Choat, J. H., Evans, R. D., De Freitas, D. M., Heupel, M., Hughes, T. P., Jones, G. P., Mapstone, B., Marsh, H., Mills, M., Molloy, F. J., Pitcher, C. R., Pressey, R. L., Russ, G. R., Sutton, S., Sweatman, H., Tobin, R., … Williamson, D. H. (2010). Adaptive management of the great barrier reef: A globally significant demonstration of the benefits of networks of marine reserves. *Proceedings of the National Academy of Sciences*, *107*, 18278–18285.
McManus, J. W., & Polsenberg, J. F. (2004). Coral–algal phase shifts on coral reefs: Ecological and environmental aspects. *Progress in Oceanography*, *60*, 263–279.
Mellin, C., MacNeil, M. A., Cheal, A. J., Emslie, M. J., & Caley, M. J. (2016). Marine protected areas increase resilience among coral reef communities. *Ecology Letters*, *19*, 629–637.
Mellin, C., Matthews, S., Anthony, K. R. N., Brown, S. C., Caley, M. J., Johns, K. A., Osborne, K., Puotinen, M., Thompson, A., Wolff, N. H., Fordham, D. A., & MacNeil, M. A. (2019). Spatial resilience of the great barrier reef under cumulative disturbance impacts. *Global Change Biology*, *25*, 2431–2445.
Mendes, T. C., Quimbayo, J. P., Bouth, H. F., Silva, L. P. S., & Ferreira, C. E. L. (2019). The omnivorous triggerfish Melichthys Niger is a functional herbivore on an isolated Atlantic oceanic Island. *Journal of Fish Biology*, *95*, 812–819.
Messmer, V., Jones, G. P., Munday, P. L., Holbrook, S. J., Schmitt, R. J., & Brooks, A. J. (2011). Habitat biodiversity as a determinant of fish community structure on coral reefs. *Ecology*, *92*, 2285–2298.
Micheli, F., Heiman, K. W., Kappel, C. V., Martone, R. G., Sethi, S. A., Osio, G. C., Fraschetti, S., Shelton, A. O., & Tanner, J. M. (2016). Combined impacts of natural and human disturbances on rocky shore communities. *Ocean and Coastal Management*, *126*, 42–50.
Morais, R. A., & Bellwood, D. R. (2019). Pelagic subsidies underpin fish productivity on a degraded coral reef. *Current Biology*, *29*, 1521–1527.e1526.
Moritz, C., Brandl, S. J., Rouzé, H., Vii, J., Pérez-Rosales, G., Bosserelle, P., Chancerelle, Y., Galzin, R., Liao, V., Siu, G., Taiarui, M., Nugues, M. M., & Hédouin, L. (2021). Long-term monitoring of benthic communities reveals spatial determinants of disturbance and recovery dynamics on coral reefs. *Marine Ecology Progress Series*, *672*, 141–152.
Moustaka, M., Langlois, T. J., McLean, D., Bond, T., Fisher, R., Fearns, P., Dorji, P., & Evans, R. D. (2018). The effects of suspended sediment on coral reef fish assemblages and feeding guilds of north-west Australia. *Coral Reefs*, *37*, 659–673.
Munday, P. L. (2004). Habitat loss, resource specialization, and extinction on coral reefs. *Global Change Biology*, *10*, 1642–1647.
Munday, P. L., Jones, G. P., Pratchett, M. S., & Williams, A. J. (2008). Climate change and the future for coral reef fishes. *Fish and Fisheries*, *9*, 261–285.
Muruga, P., Siqueira, A. C., & Bellwood, D. R. (2024). Meta-analysis reveals weak associations between reef fishes and corals. *Nature Ecology & Evolution*, *8*, 676–685.
Nash, K. L., Graham, N. A. J., Wilson, S. K., & Bellwood, D. R. (2013). Cross-scale habitat structure drives fish body size distributions on coral reefs. *Ecosystems*, *16*, 478–490.
Negri, A. P., Flores, F., Röthig, T., & Uthicke, S. (2011). Herbicides increase the vulnerability of corals to rising sea surface temperature. *Limnology and Oceanography*, *56*, 471–485.
Negri, A. P., & Hoogenboom, M. O. (2011). Water contamination reduces the tolerance of coral larvae to thermal stress. *PLoS One*, *6*, e19703.
Newport, C., Padget, O., & de Perera, T. B. (2021). High turbidity levels alter coral reef fish movement in a foraging task. *Scientific Reports*, *11*, 5976.
Nicholson, G. M., & Clements, K. D. (2023). Fine-scale analysis of substrata grazed by parrotfishes (Labridae:Scarini) on the outer-shelf of the great barrier reef, Australia. *Marine Biology*, *170*, 121.
Nyström, M., Folke, C., & Moberg, F. (2000). Coral reef disturbance and resilience in a human-dominated environment. *Trends in Ecology & Evolution*, *15*, 413–417.
O'Leary, J. K., Micheli, F., Airoldi, L., Boch, C., De Leo, G., Elahi, R., Ferretti, F., Graham, N. A. J., Litvin, S. Y., Low, N. H., Lummis, S., Nickols, K. J., & Wong, J. (2017). The resilience of marine ecosystems to climatic disturbances. *Bioscience*, *67*, 208–220.
Olivier, D., Reyes-Bonilla, H., & Saldívar-Lucio, R. (2022). Multidecadal changes in fish composition and traits diversity in a marine park in the Gulf of California. *Biodiversity and Conservation*, *31*, 3197–3216.
Olsen, Y. S., Mattio, L., Zavala Perez, A., Babcock, R. C., Thompson, D., Haywood, M. D. E., Keesing, J., & Kendrick, G. A. (2018). Drivers of species richness and abundance of marine macrophytes on shallow tropical reefs of north-Western Australia. *Journal of Biogeography*, *46*, 170–184.
Otero, E., & Carbery, K. K. (2005). Chlorophyll a and turbidity patterns over coral reefs systems of La Parguera natural reserve, Puerto Rico. *Revista de Biología Tropical*, *53*, 25–32.
Paine, R. T., & Levin, S. A. (1981). Intertidal landscapes: Disturbance and the dynamics of pattern. *Ecological Monographs*, *51*, 145–178.
Parravicini, V., Kulbicki, M., Bellwood, D. R., Friedlander, A. M., Chabanet, P., Floeter, S. R., & Mouillot, D. (2013). Global patterns and predictors of tropical reef fish species richness. *Ecography*, *37*, 1254–1262.
Pearce, A. F., & Feng, M. (2013). The rise and fall of the "marine heat wave" off Western Australia during the summer of 2010/2011. *Journal of Marine Systems*, *111–112*, 139–156.
Pelletier, M. C., Ebersole, J., Mulvaney, K., Rashleigh, B., Gutierrez, M. N., Chintala, M., Kuhn, A., Molina, M., Bagley, M., & Lane, C. (2020). Resilience of aquatic systems: Review and management implications. *Aquatic Sciences*, *82*, 44.
Petus, C., Collier, C., Devlin, M., Rasheed, M., & McKenna, S. (2014). Using MODIS data for understanding changes in seagrass meadow health: A case study in the great barrier reef (Australia). *Marine Environmental Research*, *98*, 68–85.
Pinca, S., Kronen, M., Magron, F., McArdle, D., Vigliola, L., Kulbicki, M., & Andréfouët, S. (2012). Relative importance of habitat and fishing in influencing reef fish communities across seventeen Pacific Island countries and territories. *Fish and Fisheries*, *13*, 361–379.
Plass-Johnson, J. G., Teichberg, M., Bednarz, V. N., Gärdes, A., Heiden, J. P., Lukman, M., Miñarro, S., Kegler, H., Weiand, L., Wild, C., Reuter, H., & Ferse, S. C. A. (2018). Spatio-temporal patterns in the coral reef communities of the Spermonde archipelago, 2012–2014, II: Fish Assemblages Display Structured Variation Related to Benthic Condition. Frontiers in Marine Science **5**.

Poloczanska, E. S., Brown, C. J., Sydeman, W. J., Kiessling, W., Schoeman, D. S., Moore, P. J., Brander, K., Bruno, J. F., Buckley, L. B., Burrows, M. T., Duarte, C. M., Halpern, B. S., Holding, J., Kappel, C. V., O'Connor, M. I., Pandolfi, J. M., Parmesan, C., Schwing, F., Thompson, S. A., & Richardson, A. J. (2013). Global imprint of climate change on marine life. *Nature Climate Change*, *3*, 919–925.

Polunin, N. V. C. (1996). Trophodynamics of reef fisheries productivity. In N. V. C. Polunin & C. M. Roberts (Eds.), *Reef fisheries* (pp. 113–135). Springer.

Pratchett, M. S., Graham, N. A. J., & Cole, A. J. (2013). Specialist corallivores dominate butterflyfish assemblages in coral-dominated reef habitats. *Journal of Fish Biology*, *82*, 1177–1191.

Pratchett, M. S., Hoey, A. S., Wilson, S. K., Messmer, V., & Graham, N. A. J. (2011). Changes in biodiversity and functioning of reef fish assemblages following coral bleaching and coral loss. *Diversity*, *3*, 424–452.

Pratchett, M. S., Munday, P. L., & Wilson, S. K. (2008). Effects of climate-induced coral bleaching on coral-reef fishes: Ecological and economic consequences. *Oceanography and Marine Biology: An Annual Review*, *46*, 251–296.

Puotinen, M., Maynard, J. A., Beeden, R., Radford, B., & Williams, G. J. (2016). A robust operational model for predicting where tropical cyclone waves damage coral reefs. *Scientific Reports*, *6*(1), 26009. https://doi.org/10.1038/srep26009

R Core Team. (2024). *R: A language and environment for statistical computing*. R foundation for statistical computing.

Ridgeway, G. 2017. Gbm: Generalized boosted regression models. R package version 2.1.3. http://CRAN.R-project.org/package=gbm

Robertson, D. R. (1982). Fish feces as fish food on a Pacific coral reef. *Marine Ecology Progress Series*, *7*, 253–265.

Robinson, J. P. W., Wilson, S. K., Jennings, S., & Graham, N. A. J. (2019). Thermal stress induces persistently altered coral reef fish assemblages. *Global Change Biology*, *25*, 2739–2750.

Rodríguez-Rodríguez, D., & Martínez-Vega, J. (2022). Chapter three - ecological effectiveness of marine protected areas across the globe in the scientific literature. In C. Sheppard (Ed.), *Advances in marine biology* (pp. 129–153). Academic Press.

Roff, G., Bejarano, S., Priest, M., Marshell, A., Chollett, I., Steneck, R. S., Doropoulos, C., Golbuu, Y., & Mumby, P. J. (2019). Seascapes as drivers of herbivore assemblages in coral reef ecosystems. *Ecological Monographs*, *89*, e01336.

Ruppert, J. L. W., Vigliola, L., Kulbicki, M., Labrosse, P., Fortin, M., & Meekan, M. G. (2017). Human activities as a driver of spatial variation in the trophic structure of fish communities on Pacific coral reefs. *Global Change Biology*, *24*, e67–e79.

Russ, G. (1984). Distribution and abundance of herbivorous grazing fishes in the central great barrier reef. I. Levels of variability across the entire continental shelf. *Marine Ecology Progress Series*, *20*, 23–34.

Russ, G. R., & Alcala, A. C. (1989). Effects of intense fishing pressure on an assemblage of coral reef fishes. *Marine Ecology Progress Series*, *56*, 13–27.

Russ, G. R., Bergseth, B. J., Rizzari, J. R., & Alcala, A. C. (2015). Decadal-scale effects of benthic habitat and marine reserve protection on Philippine goatfish (F. Mullidae). *Coral Reefs*, *34*, 773–787.

Russ, G. R., Cheal, A. J., Dolman, A. M., Emslie, M. J., Evans, R. D., Miller, I., Sweatman, H., & Williamson, D. H. (2008). Rapid increase in fish numbers follows creation of world's largest marine reserve network. *Current Biology*, *18*, R514–R515.

Russ, G. R., Lowe, J. R., Rizzari, J. R., Bergseth, B. J., & Alcala, A. C. (2017). Partitioning no-take marine reserve (NTMR) and benthic habitat effects on density of small and large-bodied tropical wrasses. *PLoS One*, *12*, e0188515.

Russ, G. R., Payne, C. S., Bergseth, B. J., Rizzari, J. R., Abesamis, R. A., & Alcala, A. C. (2018). Decadal-scale response of detritivorous surgeonfish to no-take marine reserve protection and changes in benthic habitat. *Journal of Fish Biology*, *93*, 887–900.

Russ, G. R., Questel, S. L. A., Rizzari, J. R., & Alcala, A. C. (2015). The parrotfish–coral relationship: Refuting the ubiquity of a prevailing paradigm. *Marine Biology*, *162*, 2029–2045.

Russ, G. R., Rizzari, J. R., Abesamis, R. A., & Alcala, A. C. (2021). Coral cover a stronger driver of reef fish trophic biomass than fishing. *Ecological Applications*, *31*, e02224.

Sabater, M. G., & Tofaeono, S. P. (2007). Scale and benthic composition effects on biomass and trophic group distribution of reef fishes in American Samoa. *Pacific Science*, *61*, 503–520.

Sale, P. F. (2002). *Coral reef fishes. Dynamics and diversity in a complex ecosystem*. Academic Press.

Sale, P. F. (2004). Connectivity, recruitment variation, and the structure of reef fish communities. *Integrative and Comparative Biology*, *44*, 390–399.

Sale, P. F., Cowen, R. K., Danilowicz, B. S., Jones, G. P., Kritzer, J. P., Lindeman, K. C., Planes, S., Polunin, N. V. C., Russ, G. R., Sadovy, Y. J., & Steneck, R. S. (2005). Critical science gaps impede use of no-take fishery reserves. *Trends in Ecology & Evolution*, *20*, 74–80.

Samoilys, M. A., Halford, A., & Osuka, K. (2019). Disentangling drivers of the abundance of coral reef fishes in the Western Indian Ocean. *Ecology and Evolution*, *9*, 4149–4167.

Sandin, S. A., Smith, J. E., DeMartini, E. E., Dinsdale, E. A., Donner, S. D., Friedlander, A. M., Konotchick, T., Malay, M., Maragos, J. E., Obura, D., Pantos, O., Paulay, G., Richie, M., Rohwer, F., Schroeder, R. E., Walsh, S., Jackson, J. B. C., Knowlton, N., & Sala, E. (2008). Baselines and degradation of coral reefs in the northern Line Islands. *PLoS One*, *3*, e1548.

Sano, M. (2000). Stability of reef fish assemblages: Responses to coral recovery after catastrophic predation by Acanthaster planci. *Marine Ecology Progress Series*, *198*, 121–130.

Sartori, G., Taylor, M. L., Sebastian, P., & Prasetyo, R. (2021). Coral reef carnivorous fish biomass relates to oceanographic features depending on habitat and prey preference. *Marine Environmental Research*, *172*, 105504.

Seidl, R., Müller, J., & Wohlgemuth, T. (2022). Disturbance and biodiversity. In T. Wohlgemuth, A. Jentsch, & R. Seidl (Eds.), *Disturbance ecology* (pp. 79–96). Springer International Publishing.

Semmler, R. F., Sanders, N. J., CaraDonna, P. J., Baird, A. H., Jing, X., Robinson, J. P. W., Graham, N. A. J., & Keith, S. A. (2022). Reef fishes weaken dietary preferences after coral mortality, altering resource overlap. *Journal of Animal Ecology*, *91*, 2125–2134.

Shultz, A. D., Zuckerman, Z. C., & Suski, C. D. (2016). Thermal tolerance of nearshore fishes across seasons: Implications for coastal fish communities in a changing climate. *Marine Biology*, *163*, 83.

Skirving, W., Marsh, B., De La Cour, J., Liu, G., Harris, A., Maturi, E., Geiger, E., & Eakin, C. M. (2020). CoralTemp and the coral reef watch coral bleaching heat stress product suite version 3.1. *Remote Sensing*, *12*, 3856.

Sousa, W. P. (1979). Disturbance in marine intertidal Boulder fields: The nonequilibrium maintenance of species diversity. *Ecology*, *60*, 1225–1239.

Sousa, W. P. (1984). The role of disturbance in natural communities. *Annual Review of Ecology and Systematics*, *15*, 353–391.

Strona, G., Lafferty, K. D., Fattorini, S., Beck, P. S. A., Guilhaumon, F., Arrigoni, R., Montano, S., Seveso, D., Galli, P., Planes, S., & Parravicini, V. (2021). Global tropical reef fish richness could decline by around half if corals are lost. *Proceedings of the Royal Society B: Biological Sciences*, *288*, 20210274.

Stuart-Smith, R. D. (2021). Climate change: Large-scale abundance shifts in fishes. *Current Biology*, *31*, R1445–R1447.

Stuart-Smith, R. D., Brown, C. J., Ceccarelli, D. M., & Edgar, G. J. (2018). Ecosystem restructuring along the great barrier reef following mass coral bleaching. *Nature*, *560*, 92–96.

Stuart-Smith, R. D., Edgar, G. J., Barrett, N. S., Kininmonth, S. J., & Bates, A. E. (2015). Thermal biases and vulnerability to warming in the world's marine fauna. *Nature*, *528*, 88–92.

Stuart-Smith, R. D., Mellin, C., Bates, A. E., & Edgar, G. J. (2021). Habitat loss and range shifts contribute to ecological generalization among reef fishes. *Nature Ecology & Evolution*, *5*, 656–662.

Tebbett, S. B., Bellwood, D. R., Bassett, T., Cuttler, M. V. W., Moustaka, M., Wilson, S. K., Yan, H. F., & Evans, R. D. (2023). The limited role of herbivorous fishes and turf-based trophic pathways in the functioning of turbid coral reefs. *Reviews in Fish Biology and Fisheries*, *34*, 439–460.

Tootell, J. S., & Steele, M. A. (2016). Distribution, behavior, and condition of herbivorous fishes on coral reefs track algal resources. *Oecologia*, *181*, 13–24.

Topor, Z. M., Rasher, D. B., Duffy, J. E., & Brandl, S. J. (2019). Marine protected areas enhance coral reef functioning by promoting fish biodiversity. *Conservation Letters*, *12*, e12638.

Triki, Z., & Bshary, R. (2019). Fluctuations in coral reef fish densities after environmental disturbances on the northern great barrier reef. *PeerJ*, *7*, e6720.

Turner, M. G. (2010). Disturbance and landscape dynamics in a changing world. *Ecology*, *91*, 2833–2849.

UNEP-WCMC, WorldFish Centre, WRI, and T. C. U. D. (2021). *Global distribution of coral reefs, compiled from multiple sources including the millennium coral reef mapping project. Version 4.1, updated by UNEP-WCMC. Includes contributions from IMaRS-USF and IRD (2005), IMaRS-USF (2005) and Spalding et al. (2001).* UN environment Programme world conservation monitoring Centre.

van der Heide, T., Angelini, C., de Fouw, J., & Eklöf, J. S. (2021). Facultative mutualisms: A double-edged sword for foundation species in the face of anthropogenic global change. *Ecology and Evolution*, *11*, 29–44.

Watch, N. C. R. (2018). *NOAA Coral Reef Watch Version 3.1 Daily Global 5-km Satellite Coral Bleaching Degree Heating Week Product, June 3, 2013–June 2, 2014*. NOAA Coral Reef Watch.

Waterhouse, J., Gruber, R., Logan, M., Petus, C., Howley, S. L., Tracey, D., James, C., Mellors, J., Tonin, H., Skuza, M., Costello, P., Davidson, J., Gunn, K., Lefevre, C., Moran, D., Robson, B., Shanahan, M., Zagorskis, I., & Shellberg, J. (2021). *Marine monitoring program: Annual report for inshore water quality monitoring 2019–20*. Report for the Great Barrier Reef Marine Park Authority.

Waterhouse, J., Lønborg, C., Logan, M., Petus, C., Tracey, D., Lewis, S., Howley, C., Harper, E., Tonin, H., Skuza, M., Doyle, J., Costello, P., Davidson, J., Gunn, K., Wright, M., Zagorskis, I., Kroon, F., & Gruber, R. (2018). *Marine monitoring program: Annual report for inshore water quality monitoring 2016–2017*. Report for the Great Barrier Reef Marine Park Authority.

Wei, G., McCulloch, M. T., Mortimer, G., Deng, W., & Xie, L. (2009). Evidence for ocean acidification in the great barrier reef of Australia. *Geochimica et Cosmochimica Acta*, *73*, 2332–2346.

Wenger, A. S., Williamson, D. H., da Silva, E. T., Ceccarelli, D. M., Browne, N., Petus, C., & Devlin, M. J. (2016). The limitations of no-take marine reserves in protecting coral reefs from reduced water quality. *Conservation Biology*, *30*, 142–153.

Williams, D. M. (1982). Patterns in the distribution of fish communities across the central great barrier reef. *Coral Reefs*, *1*, 35–43.

Williams, I. D., Baum, J. K., Heenan, A., Hanson, K. M., Nadon, M. O., & Brainard, R. E. (2015). Human, oceanographic and habitat drivers of central and Western Pacific coral reef fish assemblages. *PLoS One*, *10*, e0120516.

Williamson, D. H., Ceccarelli, D. M., Evans, R. D., Hill, J. K., & Russ, G. R. (2014). Derelict fishing line provides a useful proxy for estimating levels of non-compliance with no-take marine reserves. *PLoS One*, *9*, e114395.

Williamson, D. H., Ceccarelli, D. M., Evans, R. D., Jones, G. P., & Russ, G. R. (2014). Habitat dynamics, marine reserve status, and the decline and recovery of coral reef fish communities. *Ecology and Evolution*, *4*, 337–354.

Williamson, D. H., Russ, G. R., & Ayling, A. M. (2004). No-take marine reserves increase abundance and biomass of reef fish on inshore fringing reefs of the great barrier reef. *Environmental Conservation*, *31*, 149–159.

Wilson, S. K., Dolman, A. M., Cheal, A. J., Emslie, M. J., Pratchett, M. S., & Sweatman, H. P. A. (2009). Maintenance of fish diversity on disturbed coral reefs. *Coral Reefs*, *28*, 3–14.

Wilson, S. K., Burgess, S. C., Cheal, A. J., Emslie, M., Fisher, R., Miller, I., Polunin, N. V. C., & Sweatman, H. P. A. (2008). Habitat utilization by coral reef fish: Implications for specialists vs. generalists in a changing environment. *Journal of Animal Ecology*, *77*, 220–228.

Wilson, S. K., Graham, N. A. J., & Polunin, N. V. C. (2007). Appraisal of visual assessments of habitat complexity and benthic composition on coral reefs. *Marine Biology*, *151*, 1069–1076.

Wilson, S. K., Graham, N. A. J., Pratchett, M. S., Jones, G. P., & Polunin, N. V. C. (2006). Multiple disturbances and the global degradation of coral reefs: Are reef fishes at risk or resilient? *Global Change Biology*, *12*, 2220–2234.

Wolfe, K., Kenyon, T. M., & Mumby, P. J. (2021). The biology and ecology of coral rubble and implications for the future of coral reefs. *Coral Reefs*, *40*, 1769–1806.

Zgliczynski, B. J., & Sandin, S. A. (2017). Size-structural shifts reveal intensity of exploitation in coral reef fisheries. *Ecological Indicators*, *73*, 411–421.

Zinke, J., Gilmour, J. P., Fisher, R., Puotinen, M., Maina, J., Darling, E., Stat, M., Richarts, Z. T., McClanahan, T. R., Beger, M., Moore, C., Graham, N. A. J., Feng, M., Hobbs, J. P. A., Evans, S., Field, S., Shedrawi, G., Babcock, R. C., & Wilson, S. K. (2018). Gradients of disturbance and environmental conditions shape coral community structure for south-eastern Indian Ocean reefs. *Diversity and Distributions*, *24*, 605–620.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Ceccarelli, D. M., Logan, M., Evans, R. D., Jones, G. P., Puotinen, M., Petus, C., Russ, G. R., Sinclair-Taylor, T., Srinivasan, M., & Williamson, D. H. (2024). Regional-scale disturbances drive long-term decline of inshore coral reef fish assemblages in the Great Barrier Reef Marine Park. *Global Change Biology*, *30*, e17506. https://doi.org/10.1111/gcb.17506

Received: 7 January 2024 | Revised: 21 May 2024 | Accepted: 27 June 2024

DOI: 10.1002/eap.3027

ARTICLE

ECOLOGICAL APPLICATIONS
ECOLOGICAL SOCIETY OF AMERICA

Ecological success of no-take marine protected areas: Using population dynamics theory to inform a global meta-analysis

Jess K. Hopf[1] | **Victoria Quennessen**[1,2] | **Jacob Ridgway**[1] | **Caren Barceló**[3] | **Fabio Prior Caltabellotta**[1] | **Sarah Farnsworth Hayroyan**[4] | **Derek Garcia**[1] | **Montana McLeod**[1,2] | **Sarah E. Lester**[5] | **Kerry Nickols**[4] | **Mallarie Yeager**[6] | **J. Wilson White**[1,2]

[1]Coastal Oregon Marine Experiment Station, Oregon State University, Newport, Oregon, USA

[2]Department of Fisheries, Wildlife, and Conservation Sciences, Oregon State University, Newport, Oregon, USA

[3]Wildlife, Fish, and Conservation Biology, University of California, Davis, California, USA

[4]College of Science, California State University Monterey Bay, Marina, California, USA

[5]Department of Biological Science, Florida State University, Tallahassee, Florida, USA

[6]Habitat Conservation Division, Alaska Region, National Marine Fisheries Service, NOAA, Juneau, Alaska, USA

Correspondence
Jess K. Hopf
Email: jess.k.hopf@gmail.com

Present addresses
Jacob Ridgway, Natural Resources and Environmental Sciences, University of Illinois Urbana-Champaign, Urbana, Illinois, USA; Caren Barceló, Center for Urban Waters, University of Washington Puget Sound Institute, Tacoma, Washington, USA; Fabio Prior Caltabellotta, Coastal Marine Fish Science Unit, Washington Department of Fish and Wildlife, Montesano, Washington, USA; and Montana McLeod, Washington Department of Fish and Wildlife, Olympia, Washington, USA.

Funding information
David and Lucile Packard Foundation

Handling Editor: Timothy E. Essington

Abstract

Adaptively managing marine protected areas (MPAs) requires accurately assessing whether established MPAs are achieving their goals of protecting and conserving biomass, especially for harvested populations. Ecological MPA assessments commonly compare inside of the MPA to a reference point outside of and/or before implementation (i.e., calculating "response ratios"). Yet, MPAs are not simple ecological experiments; by design, protected populations interact with those outside, and population dynamic responses can be nonlinear. This complicates assessment interpretations. Here, we used a two-patch population model to explore how MPA response ratios (outside–inside, before–after, and before–after-control-impact [BACI]) for fished populations behave under different conditions, like whether the population is receiving a sustainable larval supply or if it is declining despite protection from harvest. We then conducted a Bayesian evaluation of MPA effects on fish and invertebrate populations based on data collected from 82 published studies on 264 no-take MPAs worldwide, using the results of an earlier global meta-analysis as priors. We considered the effects of calculating different summary metrics on these results, drawing on the theoretical insights from our population model as a comparative framework. We demonstrate that not all response ratio comparison types provide the same information: For example, outside–inside and BACI comparisons can fail to detect population decline within MPAs, whereas before–after comparisons likely detect that pattern. Considering these

limitations, we nonetheless found that MPAs globally are producing positive outcomes, with on average greater biomass, density, and organism size within their boundaries than reference sites. However, only a small portion of studies (18 of 82) provided the temporal data necessary to determine that protection, on average, has led to increased abundance of populations within MPAs over time. These findings demonstrate the importance of considering the underlying system dynamics when assessing MPA effects. Assuming that large outside–inside or BACI response ratios always reflect large and net positive conservation effects may lead to misleading conclusions, we recommend that: (1) when assessing specific MPA effects, empirical findings be considered alongside theoretical knowledge relevant to that MPA system, and (2) management should respond to the local conditions and outcomes, rather than a blanket expectation for positive MPA effects.

KEYWORDS
adaptive management, before–after-impact-control, marine protected area, marine reserves, meta-analysis, modeling, population dynamics

INTRODUCTION

Marine protected areas (MPAs) are important tools for managing and conserving marine ecosystems globally. In particular, no-take MPAs in which all extractive and destructive activities are banned are typically established to conserve biomass and protect species from direct human activities (Grorud-Colvert et al., 2021; Horta e Costa et al., 2016). The global coverage of MPAs is rapidly increasing (UNEP-WCMC, IUCN, and NGS, 2018), and likely to continue in the future due to recent international commitments to protect biodiversity (IPBES, 2019). The last two decades have consequently seen a rise in the number of studies evaluating the effects of MPAs on marine ecosystems, as well as meta-analyses synthesizing these studies (Appendix S1: Table S1; Woodcock et al., 2017). Long term, large-scale monitoring and assessments are also underway for multiple MPA networks globally (e.g., CDFW, 2022; Emslie et al., 2020). As these studies and monitoring programs inform the adaptive management of current MPAs, and decision making about future MPAs, accurate assessments of the ecological effects of MPAs relative to their stated goals and objectives are critical.

Through spatial closure, MPAs are expected to protect and conserve species within their boundaries that have been impacted directly by human activity (IUCN WCPA, 2018). Indeed, numerous studies have demonstrated that MPAs increase local densities and biomass, average individual size, species richness, and benthic cover of habitat-forming species, and that these effects are especially strong for harvested species (Appendix S1: Table S1 summarizes a non-exhaustive list of such prior work). In some cases, these species-level recoveries may also lead to local ecosystem recovery and larger-scale population effects through spillover and larval export (Di Lorenzo et al., 2020; Kerwath et al., 2013). There is also a rich empirical and theoretical literature documenting how ecological responses inside of MPAs are affected by features of the system, such as MPA characteristics, species and ecosystem traits, and local fisheries management (e.g., White et al., 2011, 2024). However, there has been little consideration of how the estimated magnitude and direction of those ecological responses may be impacted by the *assessment approach* used.

Practical assessments of the formal goals of MPAs—to protect and conserve species and ecosystems—require evaluation metrics that reflect achieving those goals. Two such metrics of MPA success are (1) that increases in ecological variables (e.g., local population density or biomass) are observed within the MPA relative to a reference point and (2) that ecological measures, at a minimum, do not decline within the MPA following implementation. The first metric indicates that protection is occurring, relative to any larger-scale factors affecting both the MPA and the reference point, and the second metric indicates that there is successful long-term conservation of the local population. While more complex approaches can be used (e.g., Osenberg et al., 2011; Ovando et al., 2021), the effects of MPAs are often distilled into a *response ratio* value, typically calculated as the logarithm of the ratio of the response variable (e.g., population density) inside of the MPA to a reference site outside, to data collected before MPA implementation, or both. Positive log

response ratios are typically taken to indicate success in achieving an MPA's conservation goals. The use of response ratios is particularly common in meta-analyses, which require comparisons across studies with different sampling approaches and techniques (Hedges et al., 1999). Previous meta-analyses demonstrate that empirical studies overwhelmingly use spatial comparisons between the MPA and a relevant reference site (outside–inside), compared with comparisons across time (before–after) or both (before–after-control-impact, aka "BACI") (Halpern, 2003; Lester et al., 2009). Reflecting this, meta-analyses tend to focus on calculating outside–inside comparisons, sometimes intentionally excluding temporal data (Appendix S1: Table S1). While this outside–inside focus is often unavoidable (e.g., funding or logistics dictate that sampling begins after MPA implementation), it may create biases in MPA assessments (Claudet, 2018; Osenberg et al., 2011). Furthermore, as a summary metric, response ratios can provide little, and sometimes erroneous, insight into the underlying system dynamics and whether the MPA is achieving longer-term conservation goals (Moffitt et al., 2013).

The comparison approach used by MPA studies is based on the concept of detecting ecological impacts, such as the effects of a localized habitat disturbance (Schmitt & Osenberg, 1996). However, MPAs are not simple ecological experiments; by design, they have effects outside of their boundaries (Di Lorenzo et al., 2020; Grorud-Colvert et al., 2014; Ovando et al., 2021), are impacted by external factors (e.g., increased fishing pressure outside; Hopf et al., 2016b), and the dynamic responses can be nonlinear (Hopf et al., 2016a; White et al., 2013). For example, non-protected (reference) areas may be better off than expected due to larval export or adult spill-over from MPAs (e.g., Le Port et al., 2017), worse due to displaced fishing effort (e.g., Suuronen et al., 2010), or one may also off-set the other (Halpern et al., 2004). This confounds the use of these areas as independent controls. Indeed, ecological theory demonstrates that outside–inside and before–after response ratios are smaller for species with longer larval dispersal distances or larger adult home ranges, all else being equal (Moffitt et al., 2013).

The dynamics of a system also affect comparison metrics differently: Outside–inside MPA comparisons are more robust to high larval recruitment variability and acute disturbance events (Hopf et al., 2022; Hopf & White, 2023), but are unlikely to detect that a local population is declining despite protection (Hopf et al., 2022; Moffitt et al., 2013). Conversely, comparisons calculated over time can detect a population trajectory, but are more influenced by population fluctuations unrelated to protection. BACI-style designs are considered more robust to system heterogeneity (Halpern et al., 2004; Schmitt & Osenberg, 1996; Stewart-Oaten et al., 1986), yet they can be sensitive to periodic variations in the system (Hopf et al., 2022), reflecting a tendency to have higher false-positive detections with population dynamics that are autocorrelated (Rassweiler et al., 2021). As different comparison types are likely to reflect different characteristics of a system, it is therefore important to understand the theoretical benefits and limitations of each type.

To help inform the synthesis of observed ecological MPA effects, we used a two-patch population model of a harvested species to demonstrate how the magnitude and build-up of MPA effects—measured as log-response ratios (logRR; Hedges et al., 1999)—can vary when calculated using different comparison types (outside–inside, before–after, and BACI) and biological response variables (biomass density, abundance density, and mean individual size). Importantly, we also show how logRR values can vary under different scenarios, such as whether the population is demographically open or closed, if fishing is reallocated at the time of implementation, or if the population is declining despite no-take protection (indicating that conservation goals may not be fully met). We focus on MPA effects on single species (as opposed to community-scale or indirect effects), as there is the clearest mechanistic link between the cessation of fishing and the increase in abundance and size at the level of individual populations. Using these model insights as a comparative framework, we then evaluate MPA effects for single species based on a meta-analysis of data collected from published studies on no-take MPAs from around the world. Overall, we propose that assessing MPA effects requires considering the interplay between context dynamics (MPA, environmental, and population traits), sampling approach (comparison and variable types), and the criterion being used to assess effectiveness. By considering the strengths and challenges of different comparison types and measurement variables, we make a more conservative and informed estimate of the effectiveness of no-take MPAs to protect and conserve populations within their boundaries.

METHODS

Population model

To demonstrate how logRR can vary by comparison types, measurement variables, and under different environmental or management scenarios, we used an age-structured, density-dependent, two-patch (one fished local population and one protected) model of Blue Rockfish (*Sebastes mystinus*; Sebastidae), a common, harvested, nearshore rocky reef and kelp forest fish on the US west

coast. Throughout this paper, we refer to the groups of individuals within an MPA patch as the "local population," "MPA population," or "protected population," as distinct from a population that spans across MPAs and fished areas. We assume the spatial scale of the patches is large enough that adult fish do not move between them. The overall structure of the baseline model follows recent work examining the effect of environmental variability on MPA monitoring (Hopf et al., 2022; Kaplan et al., 2019; Nickols et al., 2019). Parameter descriptions and values can also be found in Appendix S1: Table S2.

Population dynamics over time tracked the state variables abundance ($N_{a,i,t}$) and biomass ($B_{a,i,t}$), of fish age a, in patch i, in year t. Recruitment to patch i at time t ($N_{1,i,t}$), is a product of larvae arriving ($L_{i,t}$), and recruit survival ($s_{1,i,t}$):

$$N_{1,i,t} = s_{1,i,t} L_{i,t}.$$

Our baseline scenario considered the case where patches have stable abundances prior to MPA establishment. Then, following implementation, fishing pressure is removed from the protected patch, allowing biomass to increase within MPA boundaries. This reflects the case where protection is successful and long-term conservation of harvested species is occurring within the MPA.

As the broader population consequences of increasing biomass within MPAs depend on scale, we consider both open and closed population scenarios. In the demographically open population, patches received an equal, constant, sustainable supply of arriving larvae ($L_{i,t}$). The parameter value for $L_{i,t}$ is arbitrary as our model is dimensionless with outcomes measured relative to $t = 0$ (initial conditions). This open scenario reflects a case where an MPA and a reference site are embedded within a larger metapopulation, with most larval production occurring outside of the two study sites (e.g., some portions of the California Channel Islands; Watson et al., 2010). Here, MPA effects are expected to be seen within the MPA, but not outside. At the other extreme, the closed population scenario, where larval production is a function of total adult biomass across both sites, reflects the case where an MPA contributes substantially to broader metapopulation dynamics through larval export (e.g., Harrison et al., 2012). In the closed population scenario, larval arrival ($L_{i,t}$) from a well-mixed larval pool was the summed product of fecundity of all fish age a (f_a) that was distributed proportional to the area in patch i (A_i):

$$L_{i,t} = A_i \sum_{i=1}^{2} \sum_{a=a_{\text{mat}}}^{a_{\max}} f_a N_{a,i,t-1},$$

where a_{mat} and $a_{\max}$ are the age of maturity and maximum age, respectively.

In all scenarios, post-settlement density-dependent survival ($s_{1,i,t}$) followed the Beverton–Holt functional form:

$$s_{1,i,t} = \frac{\alpha}{1 + \frac{\alpha L_{i,t}}{\beta}}.$$

We (1) set the slope at origin (α) so that the population collapses if fishing decreases the average lifetime egg production to below 25% of the unfished maximum (Botsford et al., 2019) and (2) set the theoretical maximum density of recruits (β) set to a constant value (1000). As with $L_{i,t}$ from the open scenario, the parameter value for β is arbitrary.

Once recruited, we assumed that fish remained within their local patch. Post-recruitment yearly survival depended on natural mortality rate M and, in non-MPA patches, fishing mortality rate F for fish over the minimum capture age (a_c), with units of years^{-1} for both mortality rates:

$$s_{a,i,t} = \begin{cases} e^{-M}, & a \in [2, a_c) \\ e^{-(M+F)}, & a \geq a_c \end{cases}.$$

Prior to MPA implementation F was identical in both patches. We used a medium fishing pressure estimated for Blue Rockfish in the Channel Islands, California, USA (Nickols et al., 2019). Following MPA implementation, F was set to zero in the MPA patch and left unchanged in the fished patch (but see the alternative scenarios below).

We included process error as "pink," or $1/f$, noise, common in many natural systems (Denny et al., 2004; Vasseur & Yodzis, 2004). Noise from randomly generated pink noise time-series, $\epsilon(t)$, were applied independently to each patch in each time step, reflecting spatial–temporal variability between patches (but see the alternative scenarios below).

Total patch abundance density (accounting for area) at time t was, therefore,

$$N_{T,i,t} = \frac{1}{A_i} \epsilon_{i,t} \sum_{1}^{a_{\max}} s_{a,i,t} N_{a-1,i,t-1},$$

and biomass density was

$$B_{T,i,t} = \frac{1}{A_i} \epsilon_{i,t} \sum_{1}^{a_{\max}} w_a s_{a,i,t} N_{a-1,i,t-1},$$

where w_a is fish biomass at age a, as a function of length at age $a(L_a)$. L_a was used to calculate average individual size for local populations in each patch.

Because field sampling rarely captures the true population density, we also included measurement error in our model, where the sampled population abundances were drawn from a negative binomial distribution with a mean equal to the modeled density; this distribution was used because the variance in blue rockfish densities is greater than the mean (Hopf & White, 2023). We estimated the negative binomial distribution shape parameter (aggregation parameter: k) using publicly available blue rockfish data (Hopf & White, 2023).

In addition to the baseline, we also considered three alternative scenarios that are representative of some of the conditions that could confound the detection of increases in biological variables during ecological monitoring:

1. A *fishery squeeze scenario* in which fishing pressure (F) following MPA establishment was increased proportional to the area that remains open to fishing.
2. A *declining population scenario* where the density of incoming recruits linearly declines 50% over 50 years, reflecting a moderate decline in the population due to extrinsic factors (e.g., environmental degradation). The declining scenario represents a scenario where protection is occurring, but the MPA is not achieving the goal of conserving the local population long term.
3. A *correlated noise scenario* where the same pink noise time-series was applied to both patches, which assumes all patches experience similar environmental fluctuations (results presented in Appendix S1).

We simulated 2000 replicates of each scenario, and all scenarios had a 200-year burn-in period prior to MPA implementation, long enough to reach a stable distribution of abundance.

We calculated modeled response ratios over time for abundance density, biomass density, and mean fish size ("biological variables") for all scenarios by comparing inside of the MPA to outside at the same point in time ($t \geq 0$; "*outside–inside*"), inside of the MPA before implementation ($t = 0$) to after ($t > 0$; "*before–after*"), and the ratio after-inside/before-inside to after-outside/before-outside (BACI). Simulated response ratios were then natural log transformed to calculate logRR values.

All population model simulations were implemented in MATLAB 2022b (The MathWorks Inc., 2022).

Literature meta-analysis

We undertook a comprehensive meta-analysis of the peer-reviewed scientific literature documenting ecological effects of designated no-take MPAs published between 2006 and June 2020 (i.e., the literature spanning the period after the Lester et al. (2009) meta-analysis, up to the time we began our analysis). We were unable to include the data from the Lester et al. (2009) meta-analysis as those data were aggregated across taxa rather than analyzed at the species level. As such, we took a Bayesian approach, using the Lester et al. (2009) results as priors and updating the posterior estimates of MPA effects using data collected since then (see details below).

In December 2020, we searched the Web-of-Science database for articles that included "marine protected area" and associated search terms (see Appendix S1 for further details). Our initial search resulted in 7213 studies, of which 490 were manually selected based on title and abstract context. These studies were then read in detail to assess if they matched our selection criteria. Our filtering approach largely followed Lester et al. (2009): We only included studies that measured variables before–after, outside–inside, or both, for fully protected, individual no-take MPAs with suitable paired-reference sites. "Before" data was classified as before the MPA was enforced or during the first year of enforcement. "After" data was the most recent data available in the study, representing the longest duration of protection. Whether the study included time-series data was also noted. Studies must have measured at least one of three biological variables: abundance density, biomass density, and average organism size. While studies may have collected data at higher taxonomic levels, for the final analysis we only included species-level data. As population dynamics depend on species-specific demographic time lags, there is no simple way to scale model results to higher taxonomic levels. Studies that selectively presented only positive MPA effects, as declared in the studies' methods or elsewhere, were not included.

The resulting database used in our analysis consisted of 708 "entries" (data points at the level of unique combinations of location—species—state variable—comparison type) from 82 studies, for which we extracted the relevant data. Where data were only available in plots, we extracted values using an online plot digitizer (WebPlotDigitizer v4.6; https://automeris.io/WebPlotDigitizer.html). We then calculated the logRR value (Hedges et al., 1999) as per the comparison used in the study (i.e., outside–inside, before–after, or BACI). Since zero-valued data points result in undefined or infinite logRR values, entries containing zeros were not included (this was 121 of the 728 entries). For each species we assigned harvest status (harvested or not), based on the status provided in the study. If no status was provided, we assigned status based on expert opinion and primary literature searches. Further details of the meta-analysis criteria and data collected are in Appendix S1, and datasets are available in JKHopf (2024) at https://doi.org/10.5281/zenodo.12697206.

To provide updated estimates of literature-based MPA effects, we took a Bayesian approach using effect estimates (measured as percentage change) from Appendix S1: Table S1 in Lester et al., 2009 as priors to estimate mean logRR values for the three biological variables. As Lester et al. (2009) pooled data by biological variable, we used these data as priors for estimates of the mean (μ) in all models, with weakly informative priors for interaction terms ($\beta_0, \beta_1, \beta_2, \beta_3$) and SD (σ) (Table 1). For each of the biological variables, we estimated (1) overall logRR, (2) logRR as predicted by the categorical predictors Harvest Status (harvested or not) and Comparison Type (outside–inside, before–after, or BACI), and (3) logRR as predicted by Harvest Status and MPA age (Table 1). To avoid bias toward more frequently studied MPAs, we averaged logRR values across individual MPAs at the relevant level of analysis. Sample sizes were low for entries that had only collected before–after data, especially those measuring biomass density and size (Appendix S1: Figure S34). Therefore, we supplemented the before–after dataset with before–after data extracted from BACI entries when testing for the effects of Harvest Status × Comparison Type. There were too few data to test for the effects of MPA age at the level of comparison type (Appendix S1: Figure S35).

For each model, we estimated posterior distributions using Markov chain Monte Carlo (No-U-Turn sampler variant) with four chains of 5000 iterations each and a burn-in of 5000 iterations. We confirmed model convergence using visual inspections of chain convergence (trace, density, and autocorrelation plots; Appendix S1: Figures S1–S27), following best practices (Johnson et al., 2022). All Bayesian analyses were done in R (R Core Team, 2022) using the "rstan" (Stan Development Team, 2022) and "rstanarm" (Goodrich et al., 2023) packages.

All code is publicly available in JKHopf (2024) at https://doi.org/10.5281/zenodo.12697206.

RESULTS

Modeled response ratios

Our open-population, baseline model scenario for a harvested species—where patches received a sustainable larval supply, fishing pressure was not reallocated, and patches were stable prior to MPA establishment—represented a case in which the predicted logRR was not affected by the comparison type used (Figure 1). In this scenario, all three biological metrics (abundance, age structure, size) used in calculating logRR captured patch dynamics well: Local population density remained constant outside of the MPA while increasing steadily inside of the MPA (Figure 1). Consequently, logRR increased asymptotically over time. Response ratio magnitudes, however, depended on the biological variable measured: logRR of biomass density was largest, followed by abundance density, and then average individual size (Figure 1). Note that the magnitude of the response ratio for individual size was limited in our model by the asymptotic maximum size fish can reach, which reflects the decelerating growth in size with age that most fishes exhibit.

TABLE 1 Model and prior distributions (by biological variable) used in Bayesian estimation of log-response ratios (logRR) for marine protected area (MPA) effects.

Model name	Model	Prior distributions
Basic	$\text{LogRR}_i \mid \mu, \sigma \sim N(\mu, \sigma^2)$	Biomass density: $\mu \sim N(0.567, 0.371)$[a] Abundance density: $\mu \sim N(0.282, 0.324)$[a] Size: $\mu \sim N(0.096, 0.097)$[a] All: $\sigma \sim \text{Exp}(1)$[b]
Harvested × Comparison type	$\text{LogRR}_i \mid \mu, \sigma \sim N(\mu_i, \sigma^2)$ with $\mu_i = \beta_0 + \beta_1 \text{HarvestStatus}_i + \beta_2 \text{ComparisonType}_i$	Biomass density: $\beta_0 \sim N(0.567, 0.371)$[a] Abundance density: $\beta_0 \sim N(0.282, 0.324)$[a] Size: $\beta_0 \sim N(0.096, 0.097)$[a] All: $\beta_1, \beta_2, \beta_3 \sim N(0, 2.5)$[b] $\sigma \sim \text{Exp}(1)$[b]
MPA age × Harvested	$\text{LogRR}_i \mid \mu, \sigma \sim N(\mu_i, \sigma^2)$ with $\mu_i = \beta_0 + \beta_1 \text{MPAage}_i + \beta_2 \text{HarvestStatus}_i + \beta_3 \text{MPAage}_i \text{HarvestStatus}_i$	Biomass density: $\beta_0 \sim N(0.567, 0.371)$[a] Abundance density: $\beta_0 \sim N(0.282, 0.324)$[a] Size: $\beta_0 \sim N(0.096, 0.097)$[a] All: $\beta_1, \beta_2, \beta_3 \sim N(0, 2.5)$[b] $\sigma \sim \text{Exp}(1)$[b]

[a]Calculated from mean and SD of data in Appendix S1: Table S1 in Lester et al. (2009).
[b]Weakly informative prior.

When patch dynamics differed from those in our baseline scenario, the response ratios were affected. Importantly, logRR values sometimes described different temporal trends depending on how they were calculated, and the different comparisons did not always capture both of the metrics of MPA conservation success we described in the introduction: higher values inside of the MPA relative to outside, and non-decreasing values inside of the MPA (Figure 2). We demonstrated this with our example alternative scenarios, focusing on

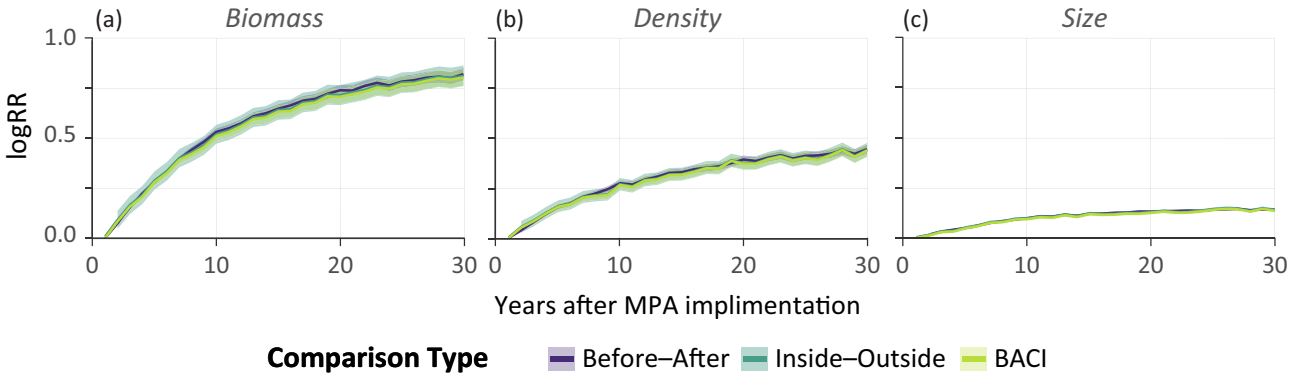


FIGURE 1 Modeled log response ratios (logRR) of a harvested species over time using different comparison ratios (colors), and biological measurement metrics (biomass density, abundance density, individual size). Baseline scenario: Open population, no correlation in variance, and no fishery squeeze. BACI, before–after-control-impact; MPA, marine protected areas.

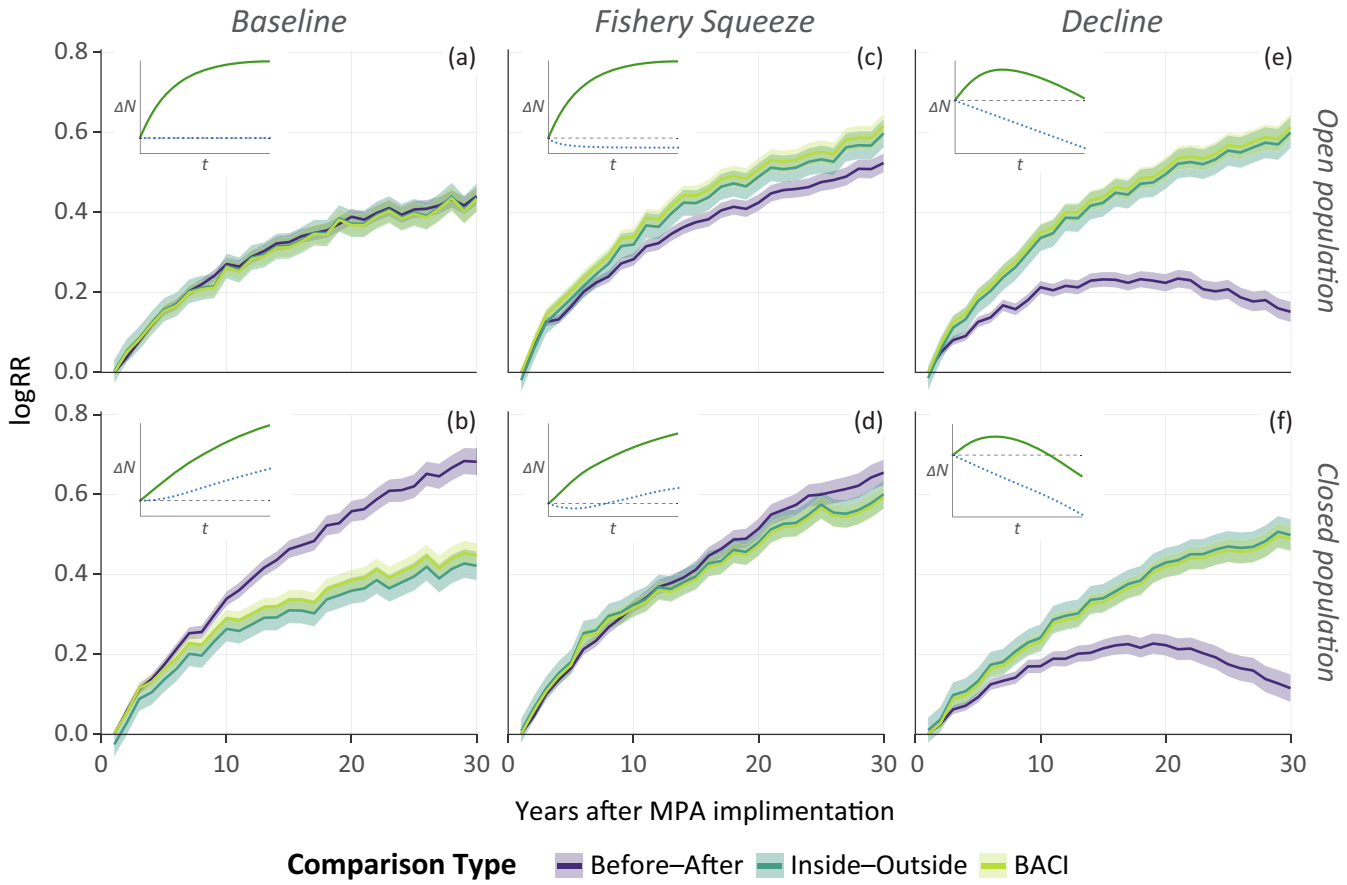


FIGURE 2 Modeled log-response ratio (logRR) of the *abundance density* of a harvested species over time using different comparison ratios (colors), for a range of scenarios. Solid lines indicate the mean with SE envelopes (shading) for 2000 replicate runs. In all scenarios, both patches experience independent pink noise. Inset plots show average modeled trends of patch abundance densities (ΔN) over time (t), relative to the time of marine protected areas (MPA) implementation (dashed horizontal line) for the MPA (green solid line) and fished (blue dotted line) patches. BACI, before–after-control-impact.

abundance density only (see Appendix S1: Figures S28 and S29 for biomass density and size results, which have similar trends). When interpreting the trajectories in Figure 2, a manager may not have access to the full time-series of observations depicted in the figure, but instead may only be able to sample one point in time along the trajectory, and must make adaptive management decisions accordingly.

In all scenarios considered, before–after comparisons most accurately reflected the true local population trajectory within the MPA (Figure 2). Scenarios that increased the difference between the protected and fished populations led to higher logRR values with outside–inside and BACI comparisons, than with before–after comparisons. This was exemplified by our open population, fishery squeeze scenario, where reallocated fishing pressure resulted in an initial decline (at the minimum) in biomass density outside of the MPA, enhancing the difference between the two patches (Figure 2c). This difference, however, was offset by net larval export in the closed population scenario, which led to densities in the fished area recovering over time due to larval export from the MPA (Figure 2d). Except for before–after comparisons, which are not affected by outside densities, logRR increased marginally slower in the closed population, reflecting the decreased difference between patch densities (Figure 2b,d,f).

Patterns of overall population decline (despite protection) were only captured with before–after comparisons, at least in the first 30 years (Figure 2e,f). Critically, BACI performed similarly to outside–inside in the declining scenario: The difference between patches was greater than the rate of decline over the 30-year simulation period (insets in Figure 2e,f).

Our modeled results were also true when patches experienced correlated pink noise (Appendix S1: Figures S30–S32). CIs, however, were smaller for outside–inside and BACI comparisons when noise was correlated, as patches fluctuated synchronously over time.

Meta-analysis: MPA studies

In our meta-analysis of MPA studies from 2006 to 2020, we found that most studies (86.6%) were focused on, or included, outside–inside comparisons, followed by BACI (18.3%) and before–after (3.8%) (Figure 3). Almost half of the studies (45.1%) also included some time-series data. Notably, 36.6% of studies with outside–inside data also included time-series data; these data were unable to be used in a true BACI comparison, however, as data collection began after the

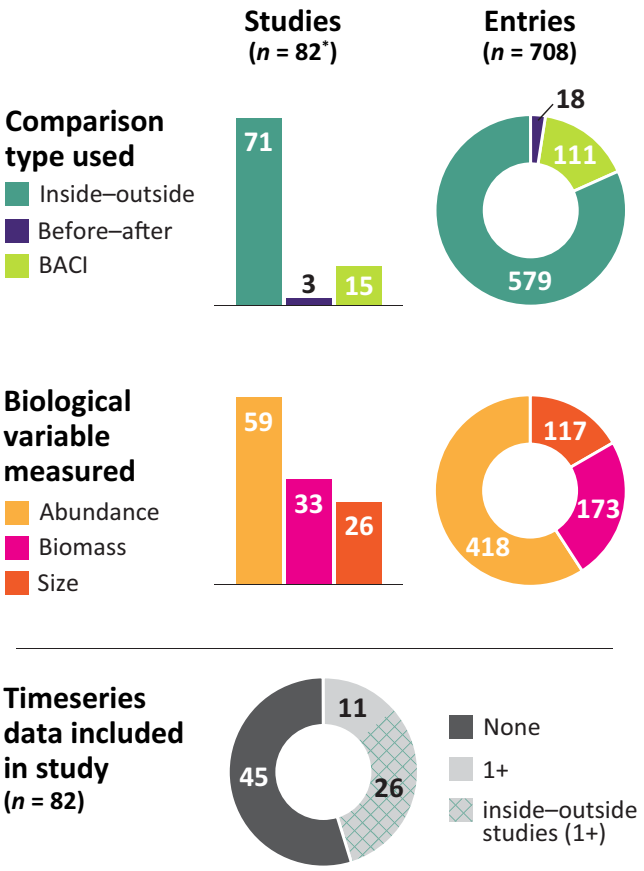


FIGURE 3 Number of studies and number of entries from the meta-analysis that included a given comparison type and biological (response) variable, and the number of entries that did or did not include time-series data. Note that the total number of studies is less than plot totals as some studies included multiple comparison types. BACI, before–after-control-impact.

MPA was established. Most studies included abundance density data (71.2%), followed by biomass density (40.2%) and then organism size (31.7%).

Reflecting the study bias toward outside–inside, most entries (data points) were collected on outside–inside comparisons (81.8%), followed by BACI (24.4%) and before–after (2.5%) (Figure 3). Likewise, most entries used abundance data (59%), followed by biomass (24.4%) and size data (16.5%) (Figure 3).

Meta-analysis: MPA effects

In general, we found a positive MPA effect for all three response variables. The estimated posterior mean logRR values were positive across all metrics, when not accounting for comparison type (Figure 4, Appendix S1: Figures S36–S39). Biomass density had the largest effect, followed by abundance density and then size, as predicted by our baseline population model.

The overall positive MPA effect was driven by harvested species, with posterior predicted distribution of logRR values consistently higher for harvested species than non-harvested species across all biological variables and comparison types (Figure 5, Appendix S1: Figures S40–S45). Posterior mean logRR values for non-harvested species were close to zero except for biomass outside–inside and BACI comparisons, both of which had low sample sizes ($n \leq 2$; Appendix S1: Figure S34). For abundance and size, outside–inside had the highest predicted posterior logRR, followed by BACI and then before–after. Conversely, outside–inside had the lowest mean logRR for biomass. Despite positive posterior means, all posterior-predicted logRR distributions had considerable density below zero (30.1% for biomass, 37.4% for abundance, and 39.9% for size). Additionally, there was greater confidence in the mean logRR values for size than for biomass or abundance, as indicated by the widths of the posterior distributions (Figure 5).

We found little evidence for an effect of MPA age on logRR, for any of the three biological variables considered (Figure 6, Appendix S1: Figures S46–S48). Estimated posterior mean slope values for fitted linear models were close to zero, with non-harvested species having marginally higher, but less confident, slope estimates than harvested species (Figure 6). Intercept values were estimated with low confidence, with estimated posterior density spanning across zero for all biological variables: Intercepts greater than zero were consistently estimated for harvested species, and less than zero for non-harvested species.

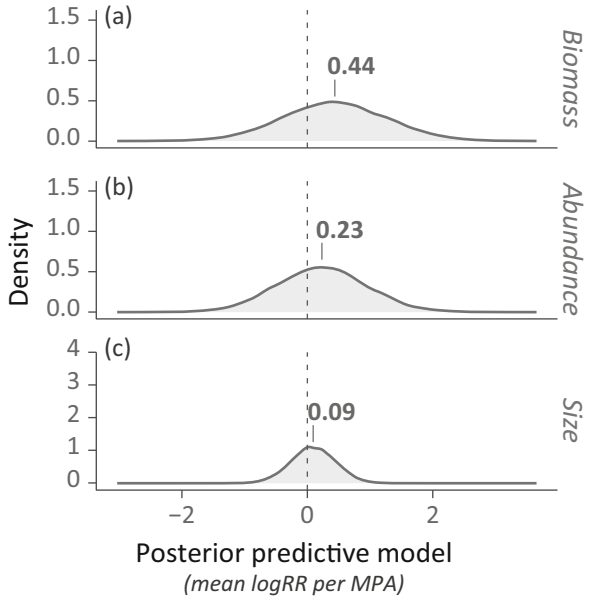


FIGURE 4 Predicted overall marine protected area (MPA) effects. Posterior predictive distributions of log response ratio (logRR) by biological (response) variable (rows). Text annotations indicate estimated posterior means.

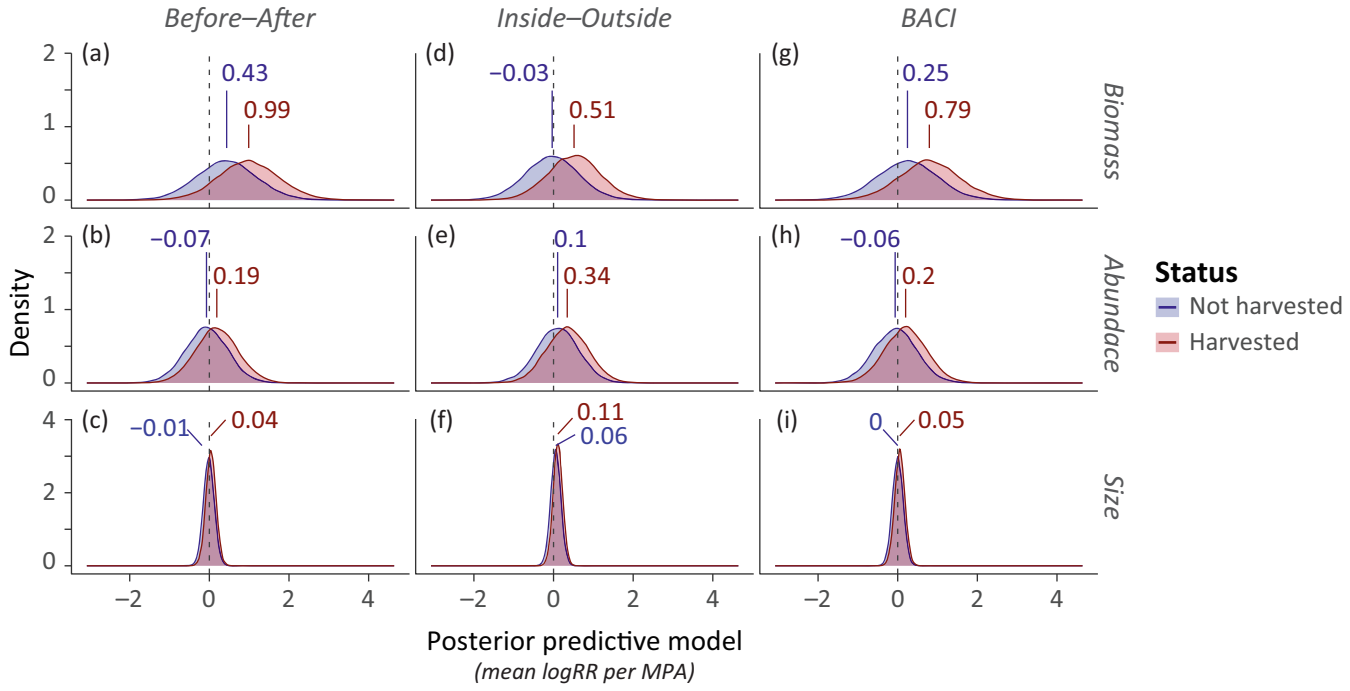


FIGURE 5 Predicted marine protected area (MPA) effects. Posterior predictive distributions of log response ratio (logRR) by harvest status (colors), comparison type (columns) and biological (response) variable (rows). Text annotations indicate estimated posterior means. Note that before–after data for all biological variables has been supplemented with before–after data extracted from before–after-control-impact (BACI) studies (see *Methods* for further details).

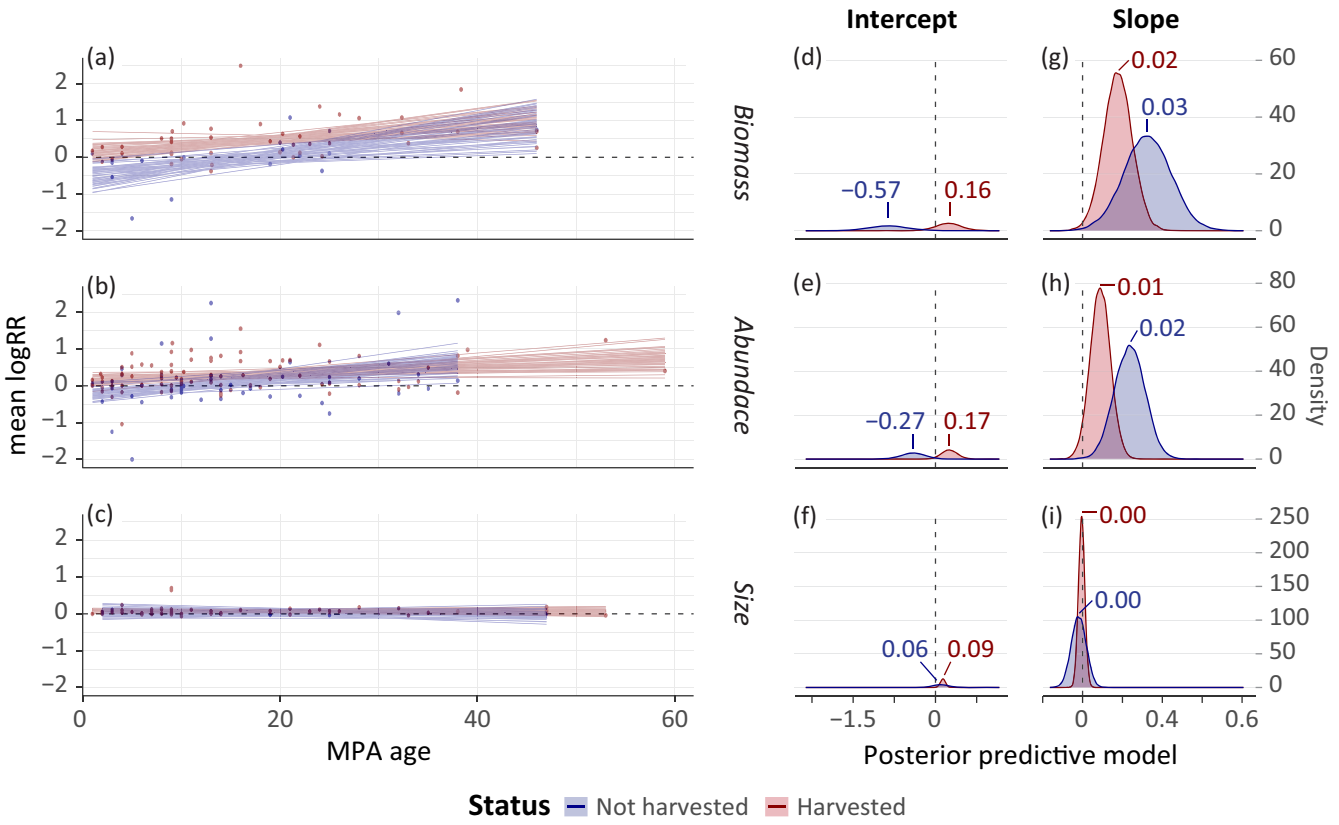


FIGURE 6 Estimated effects of marine protected areas (MPA) age on biological responses. (a–c) Mean log response ratio (logRR) for biomass, abundance, or size versus MPA age, with separate models for harvested (red) and non-harvested species (blue). Points indicate collected meta-analysis data (MPA × age average), and lines indicate sampled posterior model fits for a linear regression ($n = 50$ samples). (d–i) The corresponding posterior predictive distributions of coefficients (d–f: Intercept; g–i: Slope), with text annotations indicating the mean of each posterior.

DISCUSSION

Accurate assessments of MPA effects are required to inform the adaptive management, and future planning, of MPAs. Here, we have focused on the MPA objectives to increase and conserve local populations. Reflecting previous meta-analyses (e.g., Giakoumi et al., 2017; Lester et al., 2009; Sciberras et al., 2013), we found that no-take MPAs globally are providing positive outcomes within their boundaries, especially for harvested species. However, we show that these benefits may be smaller and more uncertain than previously reported in Lester et al. (2009), particularly when considered in the context of how we expect observed effects to change under different dynamics (MPA, environmental, and population traits) and sampling approaches (comparison types and biological variables measured).

Through simulating sampling of MPAs under a range of ecological scenarios, we were able to demonstrate that not all response ratio comparison types provided the same information. Critically, both outside–inside and BACI approaches failed to reflect patterns of long-term population decline within the MPA (Figure 2). The implications of this depend on the question being addressed: If the goal is to evaluate whether an MPA only achieved greater density, biomass, or average individual size than fished areas (i.e., protection is achieved), then all comparison metrics reflected that information accurately. However, as MPAs typically aim to also conserve populations over the long term (Grorud-Colvert et al., 2021; IUCN WCPA, 2018), it is also important to assess whether local populations are not declining (i.e., they are preserved or being restored). When addressing this question, we showed how BACI or outside–inside comparisons failed to provide insight into whether an MPA may be preventing decline. Furthermore, due to stochasticity and disturbances, a positive before–after effect is not absolute evidence of local population growth, only long-term time-series data can clarify this. However, before–after comparisons are more likely to provide insight into population trends.

In our global meta-analysis of empirical data, all three of the response ratios had positive posterior means for all three biological variables (at least for harvested species).

Our simulation results allow us to interpret the before–after results as evidence for where MPA protection is likely associated with an overall increase in the local population following implementation, while the other two types of response ratios reflect scenarios where biomass is greater inside of the MPA than outside but provide no evidence that those MPAs are preserving or restoring local populations. Thus, assuming that large outside–inside or BACI response ratios always reflect large and net positive MPA effects may lead to misleading conclusions about MPAs and possibly poor adaptive management. This is especially important as the majority of empirical studies use outside–inside data to evaluate MPA success (Appendix S1: Table S1; Figure 3; Lester et al., 2009).

Additionally, our simulated response ratios calculated using biomass density had notably larger increases in magnitude over time than abundance density or size. This is to be expected, as biomass increases reflect both changes in numerical abundance and the population size distribution after protection. Changes in average size, however, are limited by the maximum size for species with determinate or asymptotic growth and could be muted if there is an increase in the recruitment of smaller individuals that balances out the growth of larger individuals due to greater longevity. These patterns were reflected in our meta-analysis: The posterior estimate of MPA effects was highest overall for data that measured biomass, regardless of comparison type or harvest status, and the posterior mean response ratios were all near zero for size.

It is important to note that though the posterior mean response ratios for all three biological variables were positive for fished species, indicating a positive MPA effect, the posterior predictive distributions all had considerable (>30%) probability density below zero, reflecting large uncertainty that any given MPA would be expected to have a positive effect. In fact, our posteriors had a central tendency very similar to the corresponding priors, but much wider uncertainty bounds (Appendix S1: Figures S36–S48). There are a few potential explanations for this. First, the data from Lester et al. (2009) that we used for our priors were only available aggregated across taxa, not species, and may have had lower variability by virtue of that averaging process. Second, this could be an example of the repeatability crisis observed in some scientific fields, in which repeated studies of the same phenomenon produce results with weaker effect sizes and less statistical confidence (Filazzola & Cahill, 2021). We argue that this is unlikely as different MPAs are not true replicates of one another, and the actual "MPA effect" would be expected to differ because of differing ecological and management contexts. Rather, we suggest that the greater uncertainty could reflect the placement of more MPAs in more places, possibly with poorer management, or more studies reporting results on a broader suite of species (as opposed to a few species of specific interest to fisheries), leading to a broader array of outcomes. Publication bias toward positive MPA results may also contribute to more certainty in previous positive MPA assessments (Woodcock et al., 2017), and we did not include any study that acknowledged reporting only positive MPA effects. Nonetheless, our results highlight the need for localized adaptive management to respond to the local conditions and outcomes, rather than a blanket expectation for positive MPA effects.

The confounding effects of MPAs beyond their borders (through larval export, adult spillover, fishery displacement etc.) have long been recognized as a potential bias in quantifying MPA effects (e.g., Claudet et al., 2010; Lester et al., 2009; Osenberg et al., 2011; White et al., 2011), especially when considering outside–inside data. Positive MPA effects result in a self-contradictory approach to detecting those effects: MPAs are expected to perform better than the reference site, but they are also expected to produce spillover and larval export, which makes it harder to detect increasing MPA effects, as demonstrated by our modeled closed population scenario (Figure 2). How much and under what scenarios these biases are likely to happen has not been previously explored alongside empirical data. While we have taken steps toward resolving this, we have not considered the full gamut of scenarios possible. For example, we did not explore the implications of adult spillover, although it would likely lead to response ratios similar to those in our closed-population scenario (Moffitt et al., 2013). Likewise, we focused on a single species (blue rockfish) for our model. Numerous studies have demonstrated how MPA effects are likely to, and do, vary with MPA characteristics, species and ecosystem traits, local fisheries management, and stochasticity (e.g., reviewed in White et al., 2011). However, the tendency of outside–inside, and to a lesser extent BACI, to less faithfully reflect the underlying MPA trend is likely to be consistent across most cases, as previous modeling studies have demonstrated that outside–inside sampling is the least sensitive to temporal fluctuations in MPA dynamics (Hopf et al., 2022; Hopf & White, 2023). As the species and ecosystems protected, and the specific goals of each MPA are unique to each case, we recommend that modeling of expected trends and effect sizes be undertaken to accompany the analysis of monitoring data for a specific MPA (e.g., Kaplan et al., 2019) to ensure that MPA goals are properly quantified and met.

A surprising outcome from our modeling results is that BACI comparisons performed similarly to

outside–inside comparisons and did not always reflect the underlying temporal dynamics faithfully. By accounting for spatial and temporal variations, even simple BACI designs (which we have considered here) are expected to provide more reliable measures of MPA effects than outside–inside or before–after (Osenberg et al., 2011; Schmitt & Osenberg, 1996; Stewart-Oaten et al., 1986). This expectation implicitly assumes that changes over time due to management intervention will be on the same order of magnitude as, or greater than, changes occurring over space, since the BACI comparison calculates the ratio of changes at spatial and temporal scales. However, in our modeled scenarios, this condition did not hold: The outside–inside difference was notably greater than the before–after difference. To see this, compare the difference between the MPA (green line) and the fished population (blue line), to change within the MPA in the insets of Figure 2. This difference in magnitude of change between space and time resulted in BACI values following outside–inside more closely. This may not occur in scenarios where protected populations recover quickly, but to low densities (e.g., a lightly-fished fast-growing species). More work is required to elucidate this and may partly explain why predicted BACI logRR values were closer to before–after values in our empirical meta-analysis. A solution to this BACI challenge is to separately analyze the before–after data to gain insight into the possible population trends, if this is of importance to the MPA assessment.

It is important to emphasize that our conclusions about outside–inside versus before–after comparisons reflect the reality of many monitoring programs: Sampling is limited to only occasional snapshots of the system, rather than a continuous time-series. It is under those conditions that a large outside–inside response ratio could be deceptive when assessing longer-term conservation goals (Hopf et al., 2022; Moffitt et al., 2013; Rassweiler et al., 2021). If a time-series was used to calculate the outside–inside ratios, then population trends could also be detected. Thus, a key takeaway from our findings is that long-term time-series data, ideally from both MPA and reference area(s) and spanning implementation, are required to make robust and more complete assessments of MPA effects. Indeed, a large portion of the studies in our meta-analysis included at least one temporal data set longer than two time points. While the analysis of these data is outside of the scope of this study, it warrants further study.

The results of our analysis of the effect of MPA age did not match the general expectation that there would be a positive effect of MPA age on harvested species, and no effect on non-harvested species. Instead, there was a greater positive effect of age on non-harvested species, and overall high uncertainty in the slope of the regression, which explained little of the variation in the data. We propose this result arose because our dataset was sampling multiple different systems with different species traits and population dynamics, at different times in the post-implementation trajectory. For example, in some scenarios one would expect an initial decline in abundance post-implementation, prior to an increase in abundance or biomass, because of age-structured transient dynamics or fishery squeeze (Hopf et al., 2016b; Nickols et al., 2019; White et al., 2013). A better approach to understanding the effects of MPA age would be to compare different MPAs protecting the same or similar species, as Claudet et al. (2010) have done in the Mediterranean Sea. Given that limitation to our study, we do not make further inferences about MPA age effects in our dataset.

Our study demonstrates the importance of considering the assessment goals and the underlying system dynamics when assessing MPA effects and, importantly, demonstrates how they may affect summary metrics. Because it is unfeasible to model the expected dynamics for each unique system and scenario considered in our meta-analysis, we have considered the broader implications of our model findings; that MPA effects are likely to be smaller than suggested in previous meta-analyses that only considered outside–inside comparisons or did not separate analysis by comparison type. Furthermore, the failure to detect population declines using outside–inside comparisons has only been recognized theoretically (Hopf et al., 2022; Moffitt et al., 2013) and is typically overlooked when evaluating empirical data. This is problematic as a key indicator of successful MPA management is maintaining a persistent population (local or global; Botsford et al., 2001), which many studies may incorrectly assume is also occurring if positive increases are observed within MPAs compared with outside. When assessing specific MPAs, we recommend considering empirical findings in conjunction with theoretical knowledge relevant to the context of that MPA system, as previously called for by others (e.g., White et al., 2011; Woodcock et al., 2017).

AUTHOR CONTRIBUTIONS

Jess K. Hopf, Sarah Farnsworth Hayroyan, Sarah E. Lester, Kerry Nickols, and J. Wilson White conceived the ideas and designed methodology. Jess K. Hopf, Victoria Quennessen, Jacob Ridgway, Caren Barceló, Fabio Prior Caltabellotta, Sarah Farnsworth Hayroyan, Derek Garcia, and Montana McLeod collected the data. Jess K. Hopf and J. Wilson White analyzed the data. Jess K. Hopf and J. Wilson White led the writing of the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

ACKNOWLEDGMENTS

We acknowledge the COVID-19 pandemic for fostering the desire for collaboration to ease the pain of social isolation. We thank Thon Chao for assistance with data collection, and Easton White, one anonymous referee, and editor Timothy Essington for thoughtful comments that improved the manuscript. Most of the work for this project was performed remotely across many countries, and we acknowledge and pay our respects to the traditional custodians of those lands. Specifically, we acknowledge that the White Lab offices at The Hatfield Marine Science Center in Newport, OR, are located within the traditional homelands of the Siletz tribe. Following the establishment of the Coast Reservation by Executive Order in 1855, Siletz people were violently removed from their traditional homelands. Today, living descendants of these people are a part of the Confederated Tribes of the Siletz Indians and the Confederated Tribes of Grand Ronde Community of Oregon. In the spirit of reconciliation, we commit to self-education and discussion. This is publication 537 of the Partnership for Interdisciplinary Study of Coastal Oceans (PISCO), funded primarily by the David and Lucile Packard Foundation.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data, script files, and model code (Hopf, 2024) are available in Zenodo at https://doi.org/10.5281/zenodo.12697206.

ORCID

Jess K. Hopf https://orcid.org/0000-0003-2207-2366
Victoria Quennessen https://orcid.org/0000-0003-3626-5089
J. Wilson White https://orcid.org/0000-0003-3242-2454

REFERENCES

Botsford, L. W., A. H. Hastings, and S. D. Gaines. 2001. "Dependence of Sustainability on the Configuration of Marine Reserves and Larval Dispersal Distance." *Ecology Letters* 4: 144–150.

Botsford, L. W., J. W. White, and A. Hastings. 2019. *Population Dynamics for Conservation*. New York, NY: Oxford University Press.

CDFW. 2022. *California's Marine Protected Area Network Decadal Management Review*. Monterey, CA: California Department of Fish and Wildlife.

Claudet, J. 2018. "Six Conditions under which MPAs Might Not Appear Effective (When They Are)." *ICES Journal of Marine Science* 75: 1172–74.

Claudet, J., C. W. Osenberg, P. Domenici, F. Badalamenti, M. Milazzo, J. M. Falcón, I. Bertocci, et al. 2010. "Marine Reserves: Fish Life History and Ecological Traits Matter." *Ecological Applications* 20: 830–39.

Denny, M. W., B. Helmuth, G. H. Leonard, C. D. G. Harley, L. J. H. Hunt, and E. K. Nelson. 2004. "Quantifying Scale in Ecology: Lessons from Awave-Swept Shore." *Ecological Monographs* 74: 513–532.

Di Lorenzo, M., P. Guidetti, A. Di Franco, A. Calò, and J. Claudet. 2020. "Assessing Spillover from Marine Protected Areas and Its Drivers: A Meta-Analytical Approach." *Fisheries* Fisheries 21: 906–915.

Emslie, M. J., P. Bray, A. J. Cheal, K. A. Johns, K. Osborne, T. Sinclair-Taylor, and C. A. Thompson. 2020. "Decades of Monitoring Have Informed the Stewardship and Ecological Understanding of Australia's Great Barrier Reef." *Biological Conservation* 252: 108854.

Filazzola, A., and J. F. Cahill. 2021. "Replication in Field Ecology: Identifying Challenges and Proposing Solutions." *Methods in Ecology and Evolution* 12: 1780–92.

Giakoumi, S., C. Scianna, J. Plass-Johnson, F. Micheli, K. Grorud-Colvert, P. Thiriet, J. Claudet, et al. 2017. "Ecological Effects of Full and Partial Protection in the Crowded Mediterranean Sea: A Regional Meta-Analysis." *Scientific Reports* 7: 8940.

Goodrich, B., J. Garby, I. Ali, and S. Brilleman. 2023. "rstanarm: Bayesian Applied Regression Modeling Via Stan." R Package Version 2.21.4. https://mc-stan.org/rstanarm.

Grorud-Colvert, K., J. Claudet, B. N. Tissot, J. E. Caselle, M. H. Carr, J. C. Day, A. M. Friedlander, et al. 2014. "Marine Protected Area Networks: Assessing whether the Whole Is Greater than the Sum of Its Parts." *PLoS One* 9: e102298.

Grorud-Colvert, K., J. Sullivan-Stack, C. Roberts, V. Constant, B. Horta e Costa, E. P. Pike, N. Kingston, et al. 2021. "The MPA Guide: A Framework to Achieve Global Goals for the Ocean." *Science* 373: eabf0861.

Halpern, B. S. 2003. "The Impact of Marine Reserves: Do Reserves Work and Does Reserve Size Matter?" *Ecological Applications* 13: 117–137.

Halpern, B. S., S. Gaines, and R. Warner. 2004. "Confounding Effects of the Export of Production and the Displacement of Fishing Effort from Marine Reserves." *Ecological Applications* 14: 1248–56.

Harrison, H. B., D. H. Williamson, R. D. Evans, G. R. Almany, S. R. Thorrold, G. R. Russ, K. A. Feldheim, et al. 2012. "Larval Export from Marine Reserves and the Recruitment Benefit for Fish and Fisheries." *Current Biology* 22: 1023–28.

Hedges, L. V., J. Gurevitch, and P. S. Curtis. 1999. "The Meta-Analysis of Response Ratios in Experimental Ecology." *Ecology* 80: 1150–56.

Hopf, J. K., J. E. Caselle, and J. W. White. 2022. "Recruitment Variability and Sampling Design Interact to Influence the Detectability of Protected Area Effects." *Ecological Applications* 32: e2511.

Hopf, J. K., G. P. Jones, D. H. Williamson, and S. R. Connolly. 2016a. "Synergistic Effects of Marine Reserves and Harvest Controls on the Abundance and Catch Dynamics of a Coral Reef Fishery." *Current Biology* 26: 1543–48.

Hopf, J. K., G. P. Jones, D. H. Williamson, and S. R. Connolly. 2016b. "Fishery Consequences of Marine Reserves: Short-Term Pain for Longer-Term Gain." *Ecological Applications* 26: 818–829.

Hopf, J. K., and J. W. White. 2023. "Extreme Events Delay the Detection of Marine Protected Area Effects: Implications for Monitoring and Management." *Biological Conservation* 285: 110250.

Horta e Costa, B., J. Claudet, G. Franco, K. Erzini, A. Caro, and E. J. Gonçalves. 2016. "A Regulation-Based Classification System for Marine Protected Areas (MPAs)." *Marine Policy* 72: 192–98.

IPBES. 2019. "Global Assessment eport of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services," edited by E. S. Brondízio, J. Settele, S. Díaz and H. T. Ngo. Bonn, Germany: IPBES Secretariat. 1144 pp. ISBN: 978-3-947851-20-1 https://doi.org/10.5281/ZENODO.6417333

IUCN WCPA. 2018. "Applying IUCN's Global Conservation Standards to Marine Protected Areas (MPA), to Secure Ocean Health & Sustainable Development." Version 1.0. p. 4.

JKHopf. 2024. "JKHopf/MPA_MetaAnalysis: Publication Release v1 (Version v1)." Zenodo. https://doi.org/10.5281/zenodo.12697206.

Johnson, A. A., M. Q. Ott, and M. Dogucu. 2022. *Bayes Rules!: An Introduction to Applied Bayesian Modeling*. Boca Raton, FL: CRC Press.

Kaplan, K. A., L. Yamane, L. W. Botsford, M. L. Baskett, A. Hastings, S. Worden, and J. W. White. 2019. "Setting Expected Timelines of Fished Population Recovery for the Adaptive Management of a Marine Protected Area Network." *Ecological Applications* 29: 1202–20.

Kerwath, S. E., H. Winker, A. Götz, and C. G. Attwood. 2013. "Marine Protected Area Improves Yield without Disadvantaging Fishers." *Nature Communications* 4: 2347.

Le Port, A., J. C. Montgomery, A. N. H. Smith, A. E. Croucher, I. M. McLeod, and S. D. Lavery. 2017. "Temperate Marine Protected Area Provides Recruitment Subsidies to Local Fisheries." *Proceedings of the Royal Society B: Biological Sciences* 284: 20171300.

Lester, S. E., B. S. Halpern, K. Grorud-Colvert, J. Lubchenco, B. I. Ruttenberg, S. D. Gaines, S. Airam, and R. R. Warner. 2009. "Biological Effects within no-Take Marine Reserves: A Global Synthesis." *Marine Ecology Progress Series* 384: 33–46.

Moffitt, E., J. White, and L. Botsford. 2013. "Accurate Assessment of Marine Protected Area Success Depends on Metric and Spatiotemporal Scale of Monitoring." *Marine Ecology Progress Series* 489: 17–28.

Nickols, K. J., J. W. White, D. Malone, M. H. Carr, M. S. Marissa, L. B. Alan, and H. Louis. 2019. "Setting Ecological Expectations for Adaptive Management of Marine Protected Areas." *Journal of Applied Ecology* 56: 2376–85.

Osenberg, C. W., J. S. Shima, S. L. Miller, and A. C. Stier. 2011. "Ecology: Assessing Effects of Marine Protected Areas: Confounding in Space and Possible Solutions." In *Marine Protected Areas: A Multidisciplinary Approach* edited by J. Claudet, 143–167. Cambridge, UK: Cambridge University Press.

Ovando, D., J. E. Caselle, C. Costello, O. Deschenes, S. D. Gaines, R. Hilborn, and O. Liu. 2021. "Assessing the Population-Level Conservation Effects of Marine Protected Areas." *Conservation Biology* 35: 1861–70.

R Core Team. 2022. *R: A Language and Environment for Statistical Computing*. Vienna: R Foundation for Statistical Computing.

Rassweiler, A., D. K. Okamoto, D. C. Reed, D. J. Kushner, D. M. Schroeder, and K. D. Lafferty. 2021. "Improving the Ability of a BACI Design to Detect Impacts within a Kelp-Forest Community." *Ecological Applications* 31(4): e02304.

Schmitt, R. J., and C. W. Osenberg. 1996. *Detecting Ecological Impacts: Concepts and Applications in Coastal Habitats*. Amsterdam, The Netherlands: Elsevier Science.

Sciberras, M., S. R. Jenkins, M. J. Kaiser, S. J. Hawkins, and A. S. Pullin. 2013. "Evaluating the Biological Effectiveness of Fully and Partially Protected Marine Areas." *Environmental Evidence* 2: 4.

Stan Development Team. 2022. "RStan: The R Interface to Stan." R Package Version 2.21.7. https://mc-stan.org/.

Stewart-Oaten, A., W. W. Murdoch, and K. R. Parker. 1986. "Environmental Impact Assessment: "Pseudoreplication" in Time ?" *Ecology* 67: 929–940.

Suuronen, P., P. Jounela, and V. Tschernij. 2010. "Fishermen Responses on Marine Protected Areas in the Baltic Cod Fishery." *Marine Policy* 34: 237–243.

The MathWorks Inc. 2022. *MATLAB Version: 9.13.0 (R2022b)*. Natick, MA: The MathWorks Inc.

UNEP-WCMC, IUCN, and NGS. 2018. *Protected Planet Report 2018*. Cambridge, Gland and Washington, DC: UNEP-WCMC, IUCN and NGS.

Vasseur, D. A., and P. Yodzis. 2004. "The Color of Environmental Noise." *Ecology* 85: 1146–52.

Watson, J. R., S. Mitarai, D. A. Siegel, J. E. Caselle, C. Dong, and J. C. McWilliams. 2010. "Realized and Potential Larval Connectivity in the Southern California Bight." *Marine Ecology Progress Series* 401: 31–48.

White, J. W., L. W. Botsford, M. L. Baskett, L. A. Barnett, R. J. Barr, and A. Hastings. 2011. "Linking Models with Monitoring Data for Assessing Performance of No-Take Marine Reserves." *Frontiers in Ecology and the Environment* 9: 390–99.

White, J. W., L. W. Botsford, A. Hastings, M. L. Baskett, D. M. Kaplan, and L. A. K. Barnett. 2013. "Transient Responses of Fished Populations to Marine Reserve Establishment." *Conservation Letters* 6: 180–191.

White, J. W., B. E. Spiecker, M. J. Yeager, and J. E. Caselle. In press. "Marine Protected Areas and Temperate Reef Fishes." In *Ecology of Marine Fishes: California and Associated Waters*, 2nd ed., edited by L. G. Allen and D. Pondella. Baltimore, MD: Johns Hopkins University Press.

Woodcock, P., B. C. O'Leary, M. J. Kaiser, and A. S. Pullin. 2017. "Your Evidence or Mine? Systematic Evaluation of Reviews of Marine Protected Area Effectiveness." *Fish and Fisheries* 18: 668–681.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Hopf, Jess K., Victoria Quennessen, Jacob Ridgway, Caren Barceló, Fabio Prior Caltabellotta, Sarah Farnsworth Hayroyan, Derek Garcia, et al. 2024. "Ecological Success of No-Take Marine Protected Areas: Using Population Dynamics Theory to Inform a Global Meta-Analysis." *Ecological Applications* 34(7): e3027. https://doi.org/10.1002/eap.3027

From: Blake Hermann <[redacted]>
Sent: Tuesday, October 15, 2024 08:14 AM
To: FGC <FGC@fgc.ca.gov>
Cc: Ashcraft, Susan@FGC <[redacted]>; Wertz, Stephen@Wildlife <[redacted]>; Shuman, Craig@Wildlife <[redacted]>
Subject: Petition2023-15MPA Clarification/Amendment Letter

Hello all,

See attached comment letter containing an update, stakeholder feedback responses, and amendments regarding the petition I submitted requesting allowing limited-take HMS or pelagic fisheries in 3 Channel Islands MPAs.This can be attached at the next FGC, MRC, or both meetings, wherever it is more applicable. This has also been sent to federal staff at NMFS, CINMS, and PFMC to keep everyone involved with this petition's process updated and up to date.

Thank you,

Blake Hermann

Clarification and Amendments Regarding Petition2023-15MPA

Dear Fish and Game Commission, CDFW, CINMS and PFMC staff,

This comment letter serves as an amendment, update, and reply for those interested regarding this Petition2023-15's requesting a change in take access in 3 MPAs at the Channel Islands State/Federal MPA network.

I would first like to thank CDFW, for completing the binning phases of the petition process, and the FGC, and MRC for their supportive efforts in this first-time evaluation process. Nearing a year following public submittal there has been much feedback regarding this petition, both positive and negative in nature, from the public, and both state and federal bodies. This letter will act as a supplemental add-on to the original petition, further clarifying examples that were perhaps not explained well enough by providing some additional stakeholder rationale, input and answers to a some concerns the have been raised. Additionally, this letter contains a few amendments regarding the original petition.

Several discussions with groups or individuals coming from commercial, recreational, conversationalist, and environmental sectors concerning the petition have continued outside of official meetings. More has certainly come to light after submittal that, as the petitioner, I feel should be acknowledged when decisions are finally made.

Commercial Swordfish:

One of the largest conflicts that comes up with the three mentioned Channel Islands MPAs and the commercial swordfish fishery is the 3 MPA's current no-take allowance, which includes the retrieval of legally taken fish.

The harpoon swordfish fishery takes a swordfish by locating a basking fish on the surface and attempting to hit it with a hand thrust harpoon. Once hit, fish are left to tire on a set of gear marked with a flag, if not immediately retrievable. This soak time varies greatly, from 1-8 hours, but it is typically no longer than 2 or 3 hours. In that time, fish could pull gear several miles, 1-5 on average in my experience participating in the fishery. This movement occasionally brings gear into an MPA before being retrievable. Even if fish are taken miles away, there is still a random chance the legally taken fish on harpoon gear ends up inside the closure come retrieval time. There is nothing we can do to stop a swordfish from swimming where it wants to go while on gear.

Similarly, federally authorized deep-set-buoy-gear (DSBG) sets 10 flags with 10 hooks at 1000ft in open waters for swordfish. Swordfish hooked with this method can move gear similarly to harpoon fish in terms of distance. This is because if a hooked fish does not come to the boat immediately, it normally does not, the gear is placed back in the water to let the fish tire and to monitor the remaining set, leaving legally hooked fish the possibility to move into a closure as well.

Both of these problems are more prevalent around the Channel Islands and the three MPAs mentioned in 2023-15MPA because these MPAs extend an additional 3nm offshore into federal waters, overlapping more with the more offshore swordfish-fishery grounds. Today, retrieving a

dead harpoon fish or fighting/retrieving a hooked fish inside these no-take closures is illegal, something I believe must be resolved some way. This is especially the case for harpoon fish, as unlike DSBG fish that could be cutoff or released with a tag, harpoon fish cannot be let go once hit.

This problem is compounded in the commercial swordfish fishery due to the fishery's reliance on calm waters to eyeball or locate a basking swordfish. Of the northern Channel Islands one MPAs in particular, The Footprint, sits in the lee of the islands, the place where the islands act as a physical weather barrier from the normal westerly wind and swell. This calm section was historically important and remains an essential area to the swordfish fishery more than other fisheries because of its reliance on spotting vs hooking a fish. These weather pockets force the fishery to operate in the lee area regardless of the MPA's presence. The result is a higher effort around the MPA, not because there is any more swordfish there than other places, but because that is the only zone that has fishable conditions most days at the Northern Channel Islands. This closer proximity to the MPA due to weather leads to higher chances of interactions where legally taken fish tow gear into the closures as mentioned above. We can see this higher landing rate and therefore higher chance of interactions by observing commercial block catch data showing the blocks containing and surrounding the Footprint, blocks 707 and 708 are especially productive due to the calmer waters. These two blocks alone captured 2.82% of state swordfish landings, locally comprising 15.63% of the swordfish produced by the Santa Barbara Port Area over the last 18 years (MFDE[1]), particularly high values for an HMS.

It is understandable that opening these MPAs simply on the idea that the weather is better than other zones is not a valid reason on its own, but that is not the point. The point is that this calm zone, and the higher effort inside of it, results in higher chances of gear unintentionally moving into the closure. This unique combination of factors gives even more reason to resolve this problem now during this adaptive management process.

As a result, the FGC, CDFW, PFMC, and CINMS should take this interaction into account in order to better consider the individual actions for allowing the harpoon and federal DSBG fishery to operate in or, at the very least retrieve, legally taken swordfish within the 3 requested MPAs because of this gear movement problem. An option can be amended and added onto the original petition if required, but as harpoon and DSBG were included in the original request for allowable methods of take, the individual actions for the gears in each of the three requested MPAs should already exist.

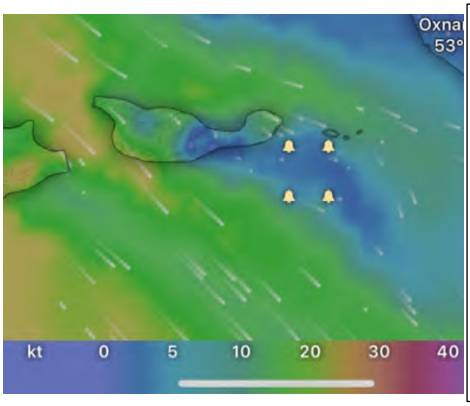


Image depicting average day in the Northern Channel Islands with The Footprint MPA outlined. Displayed wind "lee" for commercial swordfish is predominately around the closure forcing effort and gear interactions with the MPA to be higher (conditions are "fishable" under 10kts, blue color).

Wind model used in the NOAA HRRR model mid-day (12:00) during peak effort time.

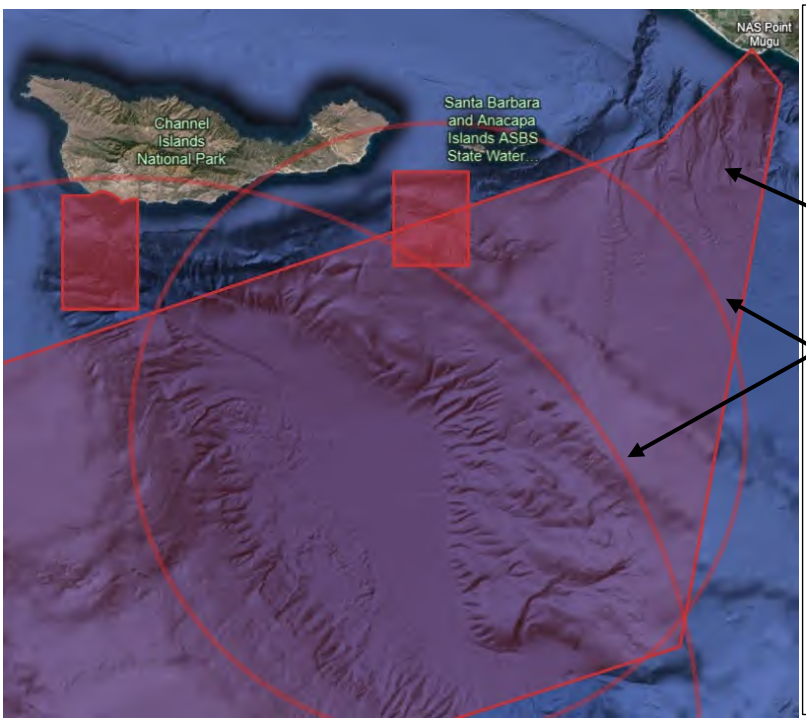
1. MFDE under only swordfish landings from 1/1/2008 to 12/31/2023. The Santa Barbara Port Area was used for the local filters to include Ports around the Channel Islands (petition's area of concern).

Local Naval Closures:

From my talks with general HMS fishermen at as many talks as I could attend locally, the issue of military operations off the southern side of the 4 northern Channel Islands was brought up enough time to look into and warrant discussion. The primary argument brought up is, while HMS cover large areas and are fishable outside of the MPAs, military operations close off most and sometimes all fishable area for HMS around the Channel Islands around the northern Channel Islands for local fleets except small areas largely taken up by the two existing MPAs, The Footprint and Gull Island.

While on the water targeting HMS, I have removed from and forced into a different area where no or less HMS are realistically present (more inshore, into foul weather, or into an MPA). There are two types of naval closures on the southern side of the Channel Islands, total range closures and radius closures. Some days one or the other is active and some days both are active depending on the exercise. The location of closure radiuses from operations does vary, but the missile range closure is constant polygon. This zone covers a large area of offshore waters on the southern side of the islands, where HMS effort locally occurs. Included is an image of the points provided to me by the Naval Warfare Center Pt. Mugu depicting the range closure when they are in a live fire event, shaded in light red. The hollow circles depict radius closures from boat coordinates and restricted distances from said positions are enforced by aircraft. Note, a 1.5 nm corridor from land was still permitted for basic transit, so closures did not go all the way to the island shore. The Footprint and Gull Island MPAs have also been included depicting which areas fall inside and outside the missile range.

Event frequency does vary from 0 to 6 days a week, and closure radiuses from boats change based on the activity and number of vessels participating. Currently the only way of acquiring event data is with direct talks with Naval officers <24hr before an event, and in some cases the day of on the radio.



Naval closures at the Northern Channel Islands overlaid with The Footprint and Gull Island MPAs.

The Point Mugu Naval Missile Range closure is the entire light red shaded area.

The two circles are closed radii from vessels operating in the same area, radii closures did leave a 1.5 nm corridor open from the island.

Adaptive Management, the MLPA, and the Master Plans:

A general comment of concern has been that the petition attempts to reduce protections of the network, does not align with adaptive management, the MLPA, or MPA Master Plans and should be rejected.

Adaptive Management: It should be noted that the adaptive management of the MPA Network is not a one-way street. Adaptive management is defined by Fish and Game Code section 2852(a)[2] as, "a management policy that seeks to improve management of biological resources, particularly in areas of scientific uncertainty, by viewing program actions as tools for learning…" It is a practice where, as conditions change or we learn more about something, in this case the MPA network, we actively amend management regulations to reflect what currently is known to be a reasonable management method. That being said, consistently increasing protected areas or the level of protection for all species in an area every management cycle is not the only direction this process is allowed to go in order to manage the network. If sufficient evidence is provided and goals can still be met, adaptive management can certainly be used to decrease restrictions in cases where we still accomplish the same goals, something Petition2023-15MPA claims is possible due to the lack of or how little pelagic/HMS interactions are with MPA goals. If we can still accomplish the stated goals of the network in these specific MPAs while allowing some take of HMS or pelagic species, the network can certainly still be considered improved as a result. The latest example of adaptive management lowering regulation was the repealing of the Cowcod Conservation Areas (CCAs) and implementation of the smaller Groundfish Exclusion Areas (GEAs) after the cowcod population was considered rebuilt and healthy.

The MLPA: The goals of the MLPA and accompanying plans are clear. The largest goal being to preserve local ecosystems, allowing them to grow undisturbed as much as possible by people, resulting in higher levels in local species' abundance and biodiversity for future generations to observe. From the onset of this petition, it has been a foundational idea that allowing take of pelagic or HMS inside these areas will both, not significantly affect local species abundance or populations, as they would still be protected, and that the HMS populations would not be significantly affected by such a change. The argument of lowering protections in a petition like this is understood at face value, but the goal of the petition is to examine if we can accomplish the same or a satisfactory level of the stated goals under these lower protections, and if this is indeed the case, how lower are these protections in reality?

MPA Master Plans: Appendix G of the 2008 Master Plan[3] discusses the idea of species affected by MPAs, mentioning pelagic and HMS groups are overall less affected. Additionally, as the original petition mentions, the current 2016 MPA Master Plan for the southern section outlines within its goals[4] that areas of protection providing limited pelagic take or HMS take be provided. This is something we do not see around the Channel Islands in nearly comparable amounts to the rest of the state network, this effect is worsened by the federal expansions at the Channel Islands encroaching more into offshore waters where more pelagic fishing occurs. Previous FGC MPA discussions provided additional input on MPAs and HMS interactions where the commission stated that MPAs are intended to protect (local) ecosystems, not individual species, especially those that are highly mobile or pelagic[5]. Both FGC comments, and statements from the 2008 and 2016 Master

2. https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=FGC&sectionNum=2852.
3. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=113013&inline#:~:text=Species%20with%20a%20strong%20tendency,their%20entire%20range%20of%20movement.
4. http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=112492&inline (pg. F-5 (Goal 2, specifically point 4))
5. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=207757&inline (pg. 9)

Plans support the idea that HMS are both not as affected by these MPAs and that areas allowing take of just HMS be included in the network.

All of the above evidence and precedent came to light after the establishment of the Channel Islands network in 2002, so it is somewhat understandable why the decisions were made back then to leave these areas as no-take zones, we simply did not know as much then as we do now. However, 20 years later with all of this more modern evidence and precedent elsewhere in the 40% of the coastal network that is limited take, it is justifiable to reevaluate the Channel Islands Network and adaptively manage it to our current scientific understanding for pelagic/HMS allowed areas.

Kelp Restoration and Climate Resiliency:

A final comment of concerns mentions granting limited take access to these areas for Pelagic finfish or HMS will negatively impact local species such as groundfish or those important to kelp restoration and therefore climate resiliency, including but not limited to sheepshead and spiny lobster.

The preferred option of only allowing take of HMS was preferred with species interactions specifically in mind. The more selective list of HMS avoids pelagic finfish species, like yellowtail, that could be targeted with methods that are more likely to interfere with non-pelagic species (weighted, bottom contact dropper loops). HMS effort for tuna or billfish consists primarily of surface casting a jig/bait, trolling baits on the surface, or fishing in the middle of the water column. It is very unlikely those targeting HMS species this way will have many interactions with non-pelagic species such as groundfish. Additionally, pelagic or HMS fishing is done primarily offshore, away from nearshore kelp ecosystems, and away from nearshore areas spiny lobster and sheepshead frequent.

Included in the original petition was an additional option and sub-option for only “surface fishing methods” and nearshore closures respectively. If the preferred option of full water column access with no nearshore closures is still seen as concerning even with its limited interactions with non-HMS, the water column limiting option and/or nearshore closure sub-option can certainly be used.

Water Column Limited Fisheries (Amendment):

Since submittal, talks with officials revealed rather than using surface fishing methods as the allowed take reason, simply aligning with existing closures such as the GEAs and using rather the restriction of “bottom contact gears” will be better applicable. The new term, “bottom-contact-hook-and-line,” would need to be defined in state codes (along with bottom contact gears) to avoid hook-and-line bottom usage as hook-and-line on its own is not a bottom contact fishery per the only existing federal definitions of bottom contact gears. Restriction of bottom contact gears and additional restriction of bottom-contact-hook-and-line would allow for more selective take of HMS, not affect HMS effort significantly, and better protect local non-HMS from incidental catch. Therefore, it is proposed that the petitions options be slightly amended to allow hook-and-line except that of bottom-contact-hook-and-line, and restrict bottom contact gears, vs in the original petition where the allowing surface fishing methods was mentioned in the options.

Due to the regulatory complexity of this change, new definitions, and more complex gear explanations, it is still the petitioner preference to <u>not</u> restrict take to water column specific

variants of hook-and-line (options 3 and 4 in the petition) but the choice will still remain if the department prefers it for other reasons.

Nearshore Closures (Amendment):

In the original petition there was also the sub-option to include nearshore MPAs at two of the three MPAs mentioned, Gull Island and Santa Barbara Island. The Footprint MPA did not include nearshore option as no section of The Footprint is attached to land or is nearshore. My personal petitioner preference of these nearshore choices is still that they are not needed if the preferred Option 2 is selected, but the choice is there if desired. It has been raised that the original nearshore closure boarder for the Santa Barbara Island MPA in the original petition used the island's 1 nautical mile radius line. This line is not straight, could lead to confusion, and does not align with MPA design criteria of the MLPA (no curves or odd shapes). Therefore, it is now proposed to use a straight line like what is used for all current nearshore closures rather than the original 1 nm line. The coordinates for this line separating the nearshore and offshore regions at Santa Barbara Island MPA will now be the following:

A straight line from 33° 28.500' N. -118° 59.300' W. to 33° 26.500' N. -119° 02.200' W

The choice to make the nearshore closures either stricter in take allowances or into nearshore no-take areas remains the same. Of the two sub-options, the more-strict limited-take choice is still preferred over a no-take area if nearshore MPAs are implemented. For the possible nearshore limited-take region, feedback and an oversight on my own part (leaving out spear) has led to a rework and amendment of the proposed nearshore MPAs allowable methods of take. See amended Table 2, the Table from the original petition, below (red = new language ~~cross~~ = removed language).

Table 2: Proposed Coordinates and options for the Nearshore limited or no take areas for Gull Island and Santa Barbara Island (Amended)	
Gull Island Nearshore MPA	Santa Barbara Island Nearshore MPA
The nearshore-offshore boarder would be bound by a straight line running from 33° 58.000' N. lat. 119° 53.000' W. long, to 33° 55.800' N. lat. 119° 48.000' W. long. within the existing MPA. Regulation within nearshore area: ~~Recreational and commercial take of (pelagic finfish or HMS, depending on the state's choice) is allowed via surface casting, kite fishing, and surface trolling. The commercial take of swordfish by harpoon is allowed. (preferred).~~ The recreational take of (either Pelagic Finfish or Highly Migratory Species (option dependent)) by spear is allowed. The commercial take of swordfish by harpoon is allowed. The possession of Coastal Pelagic Species is allowed. (Only needed if HMS option is selected) Or A no-take region (not preferred)	~~The 1nm boundary of SBI within the current MPA~~ The nearshore-offshore boarder would be bound by a straight line running from 33° 28.500' N. -118° 59.300' W. to 33° 26.500' N. -119° 02.200' W within the existing MPA. Regulation within nearshore area: ~~Recreational and commercial take of (pelagic finfish or HMS, depending on the state's choice) is allowed via surface casting, kite fishing, and surface trolling. The commercial take of swordfish by harpoon is allowed. (preferred).~~ The recreational take of (either Pelagic Finfish or Highly Migratory Species (option dependent)) by spear is allowed. The commercial take of swordfish by harpoon is allowed. The possession of Coastal Pelagic Species is allowed. (Only needed if HMS option is selected) Or A no-take region (not preferred)

The proposed nearshore regions would now only allow take by easily enforceable, selective, non-hook-and-line methods. Recreational spear of pelagic finfish or HMS, and commercial harpoon swordfish are easily recognizable, completely selective in their methods of take, and offer zero bycatch. The methods would make the more non-pelagic prevalent nearshore regions simple to enforce and significantly mitigate any impacts on non-pelagic species if there are concerns with allowing hook-and-line methods nearshore.

Clarification and Amendment Review:

Clarification: Uncontrollable gear movement of commercial swordfish fisheries (Harpoon and DSBG) poses a problem with existing MPAs, namely those in the original petition due to their offshore expansion into federal waters creating more of an overlap with offshore pelagic/HMS fisheries. Individual actions concerning these methods allowance should be more strongly considered because of this problem and some solution should be reached.

Clarification: Large, periodic naval closures offshore restrict most HMS/pelagic fishing areas local to the southern parts of the Channel Islands when active, increasing congestion of both recreational and commercial fisheries toward the open areas just outside of the MPAs.

Clarification: Petition does in fact conform to the goals of adaptive management per its established definitions, has goals aligned by the MLPA, and both Master Plans outline goals concerning allowable pelagic or HMS take and lack of MPA effects on pelagic and HMS.

Amendment: To better conform to existing federal regulations and to make enforcement easier, the mention of "allowance of surface fishing methods" in Options 3 and 4 of the original petition will be replaced with "restriction of bottom contact gears." Due to regulatory complexity the restriction of bottom-contact-gears in options 3 and 4, it is still not preferred by the petitioner but is still listed as a choice for the department to pick if desired. Option 2 followed by 1 are still the first and second preference. Bottom contact gears would need to be defined in state regulation as a specific list of gear types/configurations as well as bottom-contact-hook-and-line. The original 2 unamended options and 2 amended options would read:

Option 1 (unchanged): **(Petitioner's 2nd Preferred Option)**

- The recreational take of pelagic finfish is allowed.
- The commercial take of pelagic finfish by hook-and-line and swordfish by harpoon is allowed.
- The use of Deep-Set-Buoy-Gear (DSBG) is allowed in federal waters (federal consideration only)

Option 2 (unchanged): **(Petitioner's 1st Preferred Option)**

- The recreational take of highly migratory species is allowed.
- The commercial take of highly migratory species by hook-and-line and swordfish by harpoon is allowed.
- The possession of coastal pelagic species is allowed.
- The use of Deep-Set-Buoy-Gear (DSBG) is allowed in federal waters (federal consideration only)

Option 3 (amended): **(Petitioner's 4th Preferred Option)**

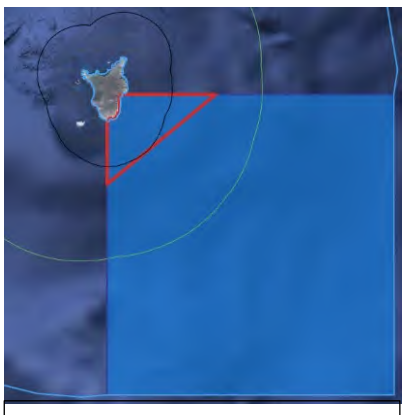
- The recreational take of pelagic finfish is allowed, except through the use of bottom-contact-hook-and-line and bottom contact gears which is restricted.
- The commercial take of pelagic finfish by hook-and-line and swordfish by harpoon is allowed, except through the use of bottom-contact-hook-and-line and bottom contact gears which is restricted.

Option 4 (amended): **(Petitioner's 3rd Preferred Option)**

- The recreational take of highly migratory species is allowed, except through the use of bottom contact hook-and-line and bottom contact gears which is restricted.
- The commercial take of highly migratory species by hook-and-line and swordfish by harpoon is allowed, except through the use of bottom-contact-hook-and-line and bottom contact gears which is restricted.
- The possession of coastal pelagic species is allowed.

Amendment: To align the proposed nearshore closure of Santa Barbara Island MPA to the required MPA design criteria outlined in the MLPA, the removal of the 1nm line for the proposed nearshore/offshore boarder is replaced with the aforementioned straight line running from 33° 28.500' N. -118° 59.300' W. to 33° 26.500' N. -119° 02.200' W to separate a possible nearshore/offshore State MPA.

Old – Non MLPA conforming



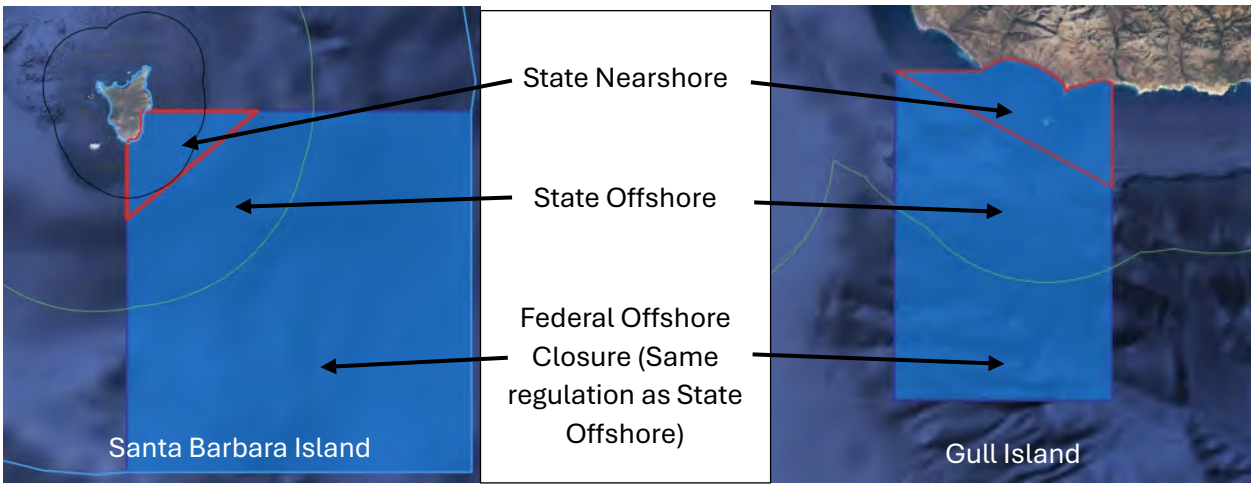
New – Conforms to MLPA design criteria for MPAs

Methods of take in the nearshore regions has also been amended. See the final amended version of table 2 below.

Table 2: Proposed Coordinates and options for the Nearshore limited or no take areas for Gull Island and Santa Barbara Island (Amended)	
Gull Island Nearshore MPA	Santa Barbara Island Nearshore MPA
The nearshore-offshore boarder would be bound by a straight line running from 33° 58.000' N. lat. 119° 53.000' W. long, to 33° 55.800' N. lat. 119° 48.000' W. long. within the existing MPA.	The nearshore-offshore boarder would be bound by a straight line running from 33° 28.500' N. -118° 59.300' W. to 33° 26.500' N. -119° 02.200' W within the existing MPA.

Regulation within nearshore area: The recreational take of (either Pelagic Finfish or Highly Migratory Species (option dependent)) by spear is allowed. The commercial take of swordfish by harpoon is allowed. The possession of Coastal Pelagic Species is allowed*. (*Only needed if HMS option is selected) (Preferred) Or A no-take region (not preferred)	Regulation within nearshore area: The recreational take of (either Pelagic Finfish or Highly Migratory Species (option dependent)) by spear is allowed. The commercial take of swordfish by harpoon is allowed. The possession of Coastal Pelagic Species is allowed*. (*Only needed if HMS option is selected) (Preferred) Or A no-take region (not preferred)

The overall configuration of a possible nearshore/offshore system would involve a nearshore State MPA, an offshore State MPA, and a Federal offshore MPA with the same regulations as the State offshore MPA (DSBG is the exception, being a federally exclusive choice). The nearshore/offshore closure option adds an extra layer of complexity to the system and is not preferred in general, but this amended option would be the best fit if a nearshore region was desired. Below are generated images of possible nearshore/offshore state/federal configurations in the petition.



As of now those are the answers to most of the feedback received, new information that has come to light, and amendments to the original petition.

Thank you,
Blake Hermann
Petitioner (2023-15MPA)

Exhibit 21

Agenda Item 2, Marine Protected Areas Petitions Evaluation

Received by the California Fish and Game Commission for the November 6-7, 2024 Marine Resources Committee Meeting

Public Comments

1. Email from Chris Smith, received 10/17/24
2. Email from Cameron Cribben, received 10/24/24
3. Email from Josh Hernandez, received 10/24/24
4. Email from Mike Isaacman, received 10/09/24
5. Email from Brian Kiyohara, received 10/24/24
6. Email from Gary Sanserino, received 10/19/24
7. Email from Randy Toussaint, received 10/24/24
8. Email from Guy Westgaard, received 10/19/24
9. Email from David Clutts, received 10/21/24
10. Email from Nathan Perez, received 10/23/24
11. Email from Sarah Wallace, received 10/24/24

[redacted]**FGC**

From: Chris Smith [redacted]
Sent: Thursday, October 17, 2024 5:17 PM
To: fgc@fgc.ca.gov
Subject: MPA Expansion

Good evening,

I'm writing in opposition to propose MPA additions and expansions across the state. The available science indicates that there is no increase in fish abundance outside the closed areas. This was the stated intention when the closure were initially proposed.

California has robust fisheries and a healthy ecosystem especially compared to other parts of the country and world. We do not need additional unfair limits to access and fishing activity. Closing more areas would concentrate fishermen and pressure on the remaining open areas which would impact livelihoods and threaten biodiversity in certain areas. As a commercial fishermen I take great pride in my work and being an active participant in managing our fisheries. This would severely threaten my ability to support my family, my culture and my way of life. Importing seafood from foreign unregulated fisheries is not the answer. Allowing access and active management and conservation is the answer.

Best regards,

Chris Smith
F/V Pez Blanco

From: cameron cribben <[redacted]>
Sent: Thursday, October 24, 2024 05:47 AM
To: FGC <FGC@fgc.ca.gov>
Subject: Fwd: Opposition to Proposed Closure of Point Loma Ocean Waters – MPA Expansion

Begin forwarded message:

From: Paris Cribben <[redacted]>
Date: October 24, 2024 at 5:44:36 AM PDT
To: cameron cribben <[redacted]>
Subject: RE: Opposition to Proposed Closure of Point Loma Ocean Waters – MPA Expansion

Dear Members of the California Department of Fish and Wildlife,

I am writing to express my strong opposition to the proposed closure of Point Loma ocean waters as part of the Marine Protected Areas (MPA) expansion. As a San Diego-based fisherman with over 12 years of experience fishing for California spiny lobster, I believe that the proposed closure will negatively affect not only my livelihood but also the broader fishing community that depends on these waters.

The California spiny lobster fishery is one of the most sustainable and well-regulated in the state. I have been part of this fishery for more than a decade, working with local fishermen and adhering to strict regulations designed to ensure long-term sustainability. These include trap limits, size restrictions, and seasonal closures—all of which are enforced to maintain a healthy lobster population. The additional closure of Point Loma, an area vital to our operations, would unnecessarily restrict access to one of the most productive fishing grounds for this species.

Throughout my career, I have seen firsthand the positive impact of California's responsible fishery management practices. The spiny lobster population has remained stable, and our industry has been proactive in supporting conservation efforts. Closing Point Loma's waters to commercial and recreational lobster fishing is not only redundant but also harmful to the hardworking men and women who rely on these waters for their livelihood.

Additionally, the economic impact of this closure would be devastating to local businesses. Many of us have deep ties to the San Diego community, working with seafood distributors, restaurants, and markets that depend on a steady supply of local, sustainably caught spiny lobster. Limiting our access to these critical waters could force some of us out of business and disrupt the local seafood economy.

It is also important to consider that closures like this could lead to increased fishing pressure in other, less-regulated areas, potentially harming the very marine ecosystems we all seek to protect. A balanced approach is crucial to maintain both environmental conservation and economic sustainability, and I believe we already have that balance under the current regulations.

As someone who has spent countless hours on the water and has a deep respect for the ocean and its resources and would like to pass on his lobster permit to his young son in the future, I strongly urge the Department to reconsider this proposal. The closure of Point Loma waters is unnecessary and will disproportionately impact the livelihoods of responsible, local fishermen who have long been stewards of these waters.

Thank you for considering my comments. I hope you will consider the voices of the local fishing community when making your final decision.

Sincerely,

Cameron Cribben

California Spiny Lobster Fisherman, San Diego, CA

From: Josh Hernandez <[redacted]>
Sent: Thursday, October 24, 2024 03:41 PM
To: FGC <FGC@fgc.ca.gov>
Subject: MpA

Hi my name is Josh Hernandez I am a commercial fisherman from Dana Point, CA. I am emailing in regards to the proposed MPA closure.

I oppose the p Id 2023 -24mpa.

I oppose this closure because there is already a large closure area that closes ninety % of Laguna Beach. Closing more of our local

Coastline would only force the already crowded fishery into a smaller space. Also the reason for making the closure has to do with kelp restoration. The area that might get closed has a kelp forest that is currently thriving, even with continuous fishing efforts. The kelp will come and go whether the area is being fished or not, as we have seen throughout our lives in various areas.

Thank you for your time

Josh Hernandez

From: Michael Isaacman <[redacted]>
Sent: Wednesday, October 9, 2024 09:56 AM
To: FGC <FGC@fgc.ca.gov>
Subject: Petition 2023-33MPA Opposition

Hi,

My name is Michael Isaacman and I live in La Jolla, CA and I am writing to oppose and express concerns with Petition 2023-33MPA, specifically for Cabrillo SMR and the proposals for the expanded state marine reserve in San Diego, CA.

I frequently spearfish in that area and this petition would be a devastating loss to the spearfishing community. When spearfishing we only take fish that are within size and take limits and feel that this is the most ethical way to harvest the fish we love.

Please oppose this expansion of prohibited fishing areas as this kelp forrest is currently very healthy and full of exceptional fish.

Thank you.

Regards,
Mike

From: Brian Kiyohara <[redacted]>
Sent: Thursday, October 24, 2024 06:00 AM
To: FGC <FGC@fgc.ca.gov>
Subject: Fw: Opposition to Proposed MPA Expansion

Begin forwarded message:

On Thursday, October 24, 2024, 5:59 AM, Paris Cribben <[redacted]> wrote:

Dear California Fish and Game Commission,

I am writing to express my strong opposition to the proposed closure of the ocean waters off Point Loma as part of the California Marine Protected Areas initiative. As a California spiny lobster fisherman for over 33 years, I have seen firsthand the value of sustainable fishing practices that not only support our local economy but also feed our community.

Fishing is not just a job for many of us in Point Loma; it is a way of life. The ocean provides for us, our families, and our neighbors. The proposed closure threatens to disrupt the livelihoods of hardworking fishermen who rely on these waters to sustain their families and contribute to the local economy. Point Loma is a vibrant community that thrives on the fresh seafood we provide, and our spiny lobster catches are a key part of that.

Moreover, our fishing practices have evolved to prioritize sustainability and environmental stewardship. We work diligently to adhere to regulations that protect marine ecosystems while ensuring that our local community continues to have access to fresh, locally sourced seafood. Closing these waters does not guarantee better conservation; instead, it can create economic hardships and undermine the traditions and values that define our coastal way of life.

I urge the MPA to consider the voices of local fishermen and the importance of maintaining access to these waters. Instead of implementing blanket closures, we should explore collaborative management strategies that involve the local fishing community in decision-making processes. This approach would not only promote conservation but also support the livelihoods that depend on responsible fishing practices.

Thank you for considering my perspective as a lifelong fisherman dedicated to preserving both our marine resources and our community's way of life.

Sincerely,

Brian Kiyohara
California Spiny Lobster Fisherman
Point Loma, CA

From: Gary Sanserino <[redacted]>
Sent: Saturday, October 19, 2024 04:25 PM
To: FGC <FGC@fgc.ca.gov>
Subject: Support for Laguna Beach MPA boundary adjustment

Attn: Marine Resources Committee, Nov. 6-7 meeting

Please support the expansion of the Marine Protection Act in the Laguna Beach area as proposed. This area is highly fished. The game and plant life Need a safe area so that it can recover and serve this in future generations well.

Gary Sanserino

From: Tracy <[redacted]>
Sent: Thursday, October 24, 2024 01:58 PM
To: FGC <FGC@fgc.ca.gov>
Subject: Opposition to Proposed Closure of Point Loma Ocean Waters – MPA Expansion

RE: Opposition to Proposed Closure of Point Loma Ocean Waters – MPA Expansion

Dear Members of the California Department of Fish and Wildlife,

I am writing to formally oppose the proposed closure of Point Loma ocean waters as part of the Marine Protected Areas (MPA) expansion. As a commercial fisherman who has been fishing California spiny lobsters and other species in these waters for the past 35 years, I know firsthand the impact this closure will have not only on my livelihood but also on the local economy. I also own a local fish market and a fish processing operation, both of which will suffer significantly if this proposal moves forward.

The California spiny lobster fishery, along with the other fisheries I participate in, has been carefully regulated for years to ensure sustainability. We have strict seasonal limits, trap restrictions, and size regulations that ensure we are not overfishing and are leaving the ecosystem in a balanced state. We fishermen, processors, and market owners have long been partners in conservation efforts, and it's important to highlight that these existing measures are already achieving the goal of resource preservation. The proposed closure of Point Loma's waters is not necessary from a sustainability standpoint and would impose undue hardship on those of us who have invested decades in responsible fishing practices.

In addition, the closure will have no meaningful benefit for the state of California, either environmentally or economically. In fact, it will be detrimental. If Point Loma is closed off, it will force many fishermen, myself included, to scale back or cease operations. This means that California will lose out on substantial tax revenues from fish sales, licensing fees, and the economic activity generated by businesses like my market and processing operation. No income or benefit will be generated by the state from a closure that puts responsible fishermen out of work.

The ripple effect will be felt across the entire community. My market employs several local workers, and our processing operation supports even more jobs. We sell directly to restaurants, distributors, and consumers, all of whom want fresh, local seafood. If Point Loma's waters are closed, we will not be able to meet demand, and consumers will be forced to turn to imported or less sustainable options. This is a direct loss for the local seafood industry and for the state, which will lose revenue and jobs as a result.

In addition, closures such as this one could lead to increased fishing pressures in other, less regulated areas, potentially causing harm to fisheries and ecosystems that currently benefit from the sustainable practices of those fishing in Point Loma.

The fishing industry in San Diego has been a cornerstone of the local economy for generations, and we take pride in our role as stewards of the marine environment. The proposed closure of Point Loma will undermine decades of responsible fisheries management and hurt hardworking, local businesses without delivering the intended benefits.

I strongly urge you to reconsider this proposal and to take into account the full economic and environmental consequences before moving forward. The local fishing community, including myself, stands ready to collaborate on solutions that protect both the ocean and our livelihoods.

Thank you for your time and consideration.

Sincerely,

Randy Toussaint

From: Guy Westgaard <[redacted]>
Sent: Saturday, October 19, 2024 10:58 PM
To: FGC <FGC@fgc.ca.gov>
Subject: YES on Laguna Beach MPA boundary adjustment No

You have created enough protected space within the city of Laguna beach and should leave what is currently available for our children and grandchildren children to fish and harvest from the sea as we have done for generations. With respect to the sea and all it has to offer. Guy and his family and families in the future.

From: David Clutts <[redacted]>
Sent: Monday, October 21, 2024 11:20 AM
To: FGC <FGC@fgc.ca.gov>
Subject: Letter of Opposition to Swami's, Py Loma MPA expansion

Dear California Fish & Wildlife,

I am writing to express my opposition to the proposed expansions of both the Swami's Marine Protected Area (MPA) and the Point Loma MPA.

Swami's already experiences minimal recreational fishing pressure. Access to the current fishing area from the shore is critical, and the expansion would complicate enforcement due to the difficulty in determining the new boundary lines. Expanding the MPA further would significantly limit fishing opportunities in Solana Beach, which has been a vital fishing area for decades. Closing additional area makes little sense while the Army corps of engineers routinely covers much of the reef with the sand replenishment at Solana beach. Therefore, I respectfully urge the California Department of Fish & Wildlife to deny the proposed expansion of the Swami's MPA.

Similarly, I oppose the expansion of the Point Loma MPA. This area contains some of the last remaining healthy kelp beds that can support fishing activities in southern San Diego County. The argument presented by the organization petitioning for the expansion, claiming it is necessary to save the kelp, is unfounded. Fishermen have protected and sustained these kelp beds as valuable fishing grounds for over a century. Expanding the MPA will only displace fishing pressure to other areas, disrupting a balanced ecosystem and limiting sustainable fishing opportunities.

I strongly urge the Department to deny the expansion of the Point Loma MPA, as it will negatively impact both the environment and the fishing community.

Thank you for your consideration.

Sincerely,
David Clutts
Member: San Diego Freedivers, Norcal skindivers, Richmond Pelican Skindivers

Spear fisherman, Fisherman, Diver, Scuba Diver

DAVID CLUTTS

Broker Associate

C: [redacted] (San Diego) | C: [redacted] (Northern CA)

[redacted]

www.TeamClutts.com

1424 Camino Del Mar | Del Mar | CA | 92014

David Clutts]
[redacted]
10/21/2024

California Department of Fish and Wildlife
[Address if available]

Dear California Fish & Wildlife,

I am writing to express my opposition to the proposed expansions of both the Swami's Marine Protected Area (MPA) and the Point Loma MPA.

Swami's already experiences minimal recreational fishing pressure. Access to the current fishing area from the shore is critical, and the expansion would complicate enforcement due to the difficulty in determining the new boundary lines. Expanding the MPA further would significantly limit fishing opportunities in Solana Beach, which has been a vital fishing area for decades. Closing additional area makes little sense while the Army corps of engineers routinely covers much of the reef with the sand replenishment at Solana beach. Therefore, I respectfully urge the California Department of Fish & Wildlife to deny the proposed expansion of the Swami's MPA.

Similarly, I oppose the expansion of the Point Loma MPA. This area contains some of the last remaining healthy kelp beds that can support fishing activities in southern San Diego County. The argument presented by the organization petitioning for the expansion, claiming it is necessary to save the kelp, is unfounded. Fishermen have protected and sustained these kelp beds as valuable fishing grounds for over a century. Expanding the MPA will only displace fishing pressure to other areas, disrupting a balanced ecosystem and limiting sustainable fishing opportunities.

I strongly urge the Department to deny the expansion of the Point Loma MPA, as it will negatively impact both the environment and the fishing community.

Thank you for your consideration.

Sincerely,
David Clutts
Member: San Diego Freedivers, Norcal skindivers, Richmond Pelican Skindivers

Spear fisherman, Fisherman, Diver, Scuba Diver

From: Nathan Perez <[redacted]>
Sent: Wednesday, October 23, 2024 10:06 AM
To: FGC <FGC@fgc.ca.gov>
Subject: Mlpa

Nathan Perez
Captain F/V Bear Flag 2
Ph: [redacted]
E: [redacted]

Hello,

My name is Nathan Perez, I participate in the commercial swordfish fishery in Southern California operating FV Bear Flag 2 and participating in the swordfish fishery for over 15 years. I am emailing today to voice my support for Petition 15MPA and call to deny or modify petition 34.

Petition 34 should be disallowed or at the very minimum allow for harpoon swordfish still inside the Farnsworth as it is just as enforceable as recreational spear.

For petition 15, allowing Highly Migratory Species limited take, especially harpoon swordfish and deep-set buoy gear, for commercial fisheries is something we can allow inside of these areas. Allowing this will still protect the nonpelagic fish that benefit more from these areas. Swordfish and other migratory fish do not benefit or provide significant benefits to these areas as they simply pass through, and there is no reason a harpoon boat should be restricted from taking a fish inside of these areas while a longline boat can operate in its entire grounds outside the EEZ, targeting the same fish I will find in the summer when the fish are coastal vs the winter/spring when they are in the longline grounds. These MPAs at the Channel Islands also expand federal and further overlap with our offshore fishery.

The proposed allowable methods for commercial swordfish are highly selective, for harpoon it is 100%, and both harpoon and buoy gear are the most sustainable methods we have for targeting swordfish. Granting selective access to these areas will also allow us to not worry about harpooned or hooked buoy fish swimming gear into the no-take areas which always seems to happen and cause an issue related to retrieving that legally taken fish. This is a problem made worse by these three areas expanding into federal water vs other MPAs that stay more nearshore, away from most swordfish grounds. We occasionally avoid looking in sections of legal water because we know if we hit a fish there the current that day will take it into the closure. That is not fair.

At a time when commercial swordfish is dying due to nets being removed and harpooners and buoy guys having to compete with international longliners and nets from other countries selling cheep fish here locally we need these areas back to be able to keep our clean, and domestic swordfish markets in operation.

Thank you,

Nathan Perez (FV Bear Flag 2)

From: Sarah Wallace <[redacted]>
Sent: Thursday, October 24, 2024 03:56 PM
To: FGC <FGC@fgc.ca.gov>
Subject: Written public comment for November 6th MPA meeting

Thank you for your time in reading my comments.

Sarah Wallace

Dear members of the California Fish and Game commission; Marine Resources Committee

I would like you to imagine, a man who works every single day for his family, including weekends, with hopes that the amount of money he brings home is enough to pay for food, clothing, a home and safety for his family. This man is trying to run a small business in an unstable economy with rules that are constantly changing, law enforcement who can investigate him at anytime for any reason without a warrant, in one of the most dangerous and unexplored environments known. He is paying for permits, paying for VMS tracking, paying for fishing gear, vessel repairs and still trying to pay fair wages for those working with him. Now, knowing all this, imagine he is now told that he can no longer fish where he has for the last 20 years, in waters he knows like his own backyard. In waters where he befriends, sheep head, grass bass, seals and other marine life, he knows these ecosystems more intimately than most can claim.

The proposed MPA closures in Petition ID 2023 33 MPA is not founded on science nor was it discussed with those who are in and under those waters on a weekly basis and know them best. May I ask, why is this even an option for closure then? If I am not mistaken, these closures are being driven by the hope to rebuild kelp. With that said, fishing is not known to be detrimental to kelp growth, in fact the harvesting of red and purple sea urchin has been know to help boost kelp growth. Instead of closing the area why not look to other organizations such a NOAA a with their kelp restoration projects and see what can be done to support and help them. Knowing how detrimental it could be to human life by causing families who work hard for a living to potentially need to rely on government financial assistance because the waters they were once allowed to fish in they no longer can.

As I am sure you know the “man” I speak of theoretically consists of a group of upstanding commercial fishermen who have made it their life’s work to fish sustainably, and try to keep the food they catch available to Americans and those who care to purchase sustainably caught seafood.

By pushing these fishermen out of these areas, you are then forcing the American people to rely more heavily on international fishing. These other fisheries have no where near as strict laws or support for sustainability and ecosystem management

Additionally, the waters that then are left as “available” our fishermen will become much more crowded, the biodiversity could potentially dwindle and cause further issues. At this point there is a fair percentage of our waters considered marine protected and we see no further need in creating more unless it is done based on sound scientific evidence and in collaboration with these fishermen who know the waters best.

As a further thought, it would be interesting to see the public’s reaction to a fishing documentary. One where it shows our United States fishermen, who are following all laws and practicing sustainable fishing. Compared to those of other countries- countries we import our fish from, with their disregard for biodiversity, sustainability and lack of deep care of the fish they are selling. Our fishermen take pride in their catch and we as consumers should support them in these efforts and not make it more difficult.

I acknowledge the weight of your responsibility as decision makers for our state waters. Please consider that your decisions impact directly our ability to provide for our children. The ripple effect would not only impact the immediate fisherman and their families but will continue to create tremendous hardships that will be disastrous for many generations to come. Once an area becomes an MPA is rarely ever changes back to “fishable waters”, I urge you to please consider other options besides closing these waters and to please work collaboratively with the fishermen who know the waters best.

Thank you for your time,

Sarah Wallace

From: Keith Rootsaert <keith@g2kr.com>
Sent: Thursday, October 24, 2024 3:26 PM
To: FGC <FGC@fgc.ca.gov>
Cc: Ashcraft, Susan
Subject: MRC meeting 11/6/24

Dear FGC,

Attached are our written comments for inclusion in the MRC meeting materials for Agenda Item 2(B) *Discuss sorting MPA petitions in Bin 2 (petitions that require additional policy guidance, information and/or resources before evaluation), and next steps.*

The G2KR Urchin Petitions Evaluations.xlsx file is best viewed in Excel. There are several tabs.

These comments are submitted prior to the written comment deadline on 10/24/24 at 5:00 PM.

Thank you,

Keith Rootsaert

Giant Giant Kelp Restoration

G2KR Petitions Summary

Outreach, Objections, Rebuttals, and Compromises. Where policy clarifications are needed.

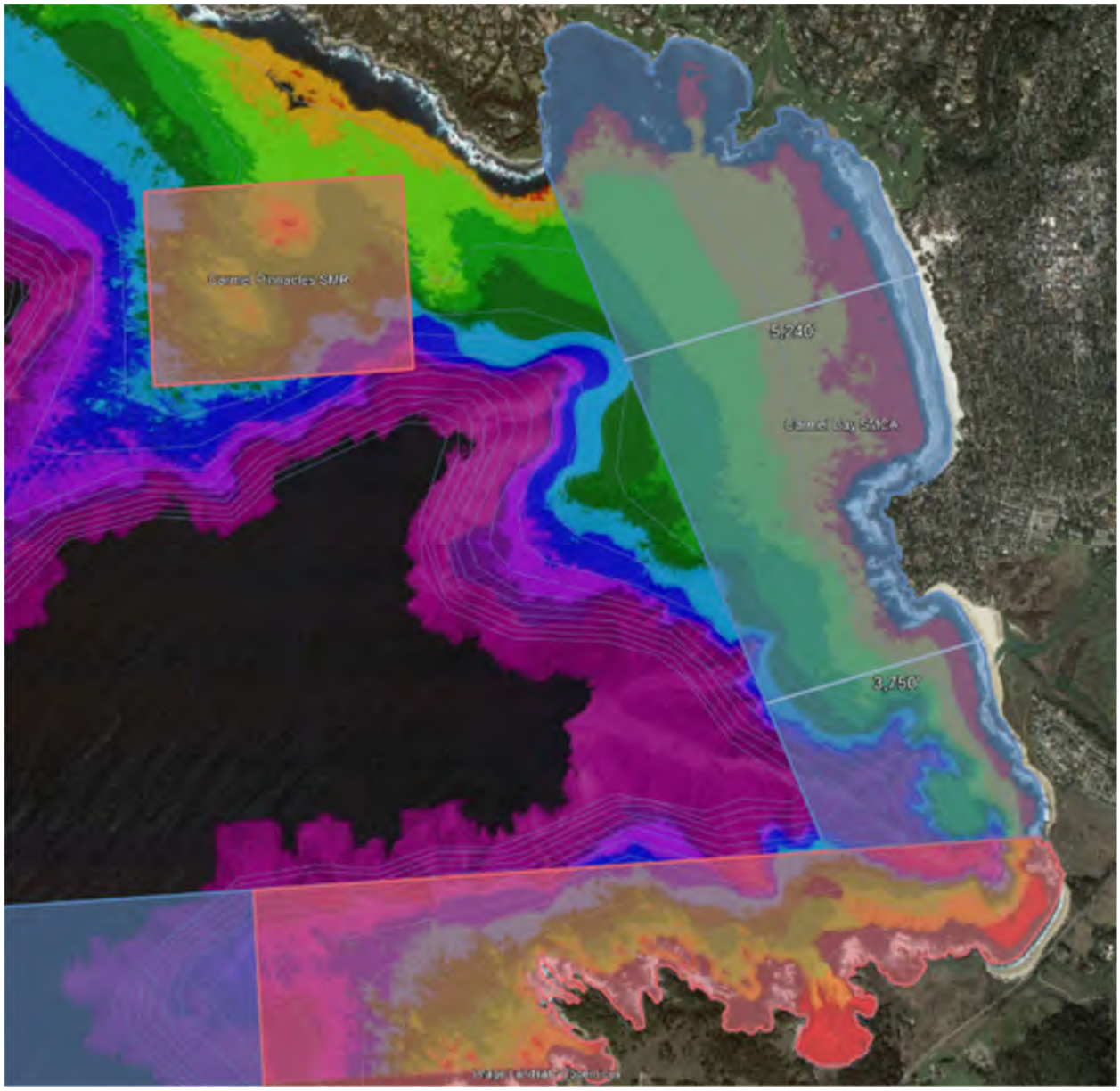
FGC Petition 2023-23MPA – Culling, baiting, trapping and airlifting urchins recreationally and commercially in MPAs. Planting, transplanting, and pruning kelp by Restoration Management Permit. Managing acid weed and invasive kelp species. Setting buoys and artificial reefs. Changing the SCP portal to accommodate Restoration Management Permits by community groups. FGC education and outreach. Changing three SMCAs to SMRs to protect kelp. Creating a new Tanker's Reef SMR.

Outreach: FGC, City of Carmel, City of Monterey, City of Pacific Grove, County of Monterey, Monterey Collaborative Network.

Objection 1: Allwaters fishng group objects to SMR redesignations.

Rebuttal 1: Monterey SMCAs and SMRs are not that deep in State water.

In Monterey Bay fishing is allowed seasonally a half mile or less offshore.



In Carmel Bay fishing is allowed seasonally about a mile or less offshore and from shore.

Greyhound Rock, Pt. Lobos, Point Sur, Big Creek, Piedras Blancas, Point Buchan all extend to 3 mile limit.

Objection 2: Monterey Abalone Company objects to SMRs not allowing kelp harvesting.

Rebuttal 2: Need harvester access to kelp bed 220 for restoration purposes in Restoration Management Permit.

Policy clarification needed: Restoration is an allowable activity in SMCAs and SMRs as written under current policy. Culling urchins and restoring kelp is a restoration activity, but OPC is blocking all restoration activities.

Compromise 1: Reduce size of Tanker's Reef SMR to exclude water beyond diving depths,

A revised Tanker's Reef SMR of 193 acres from 685 acres, (23%)

Compromise 2: If setting buoys is clarified as a fishing method which was used at Tanker's Reef for 3 years, then a change of sportfishing regulations is not required.

Compromise 3: Make three SMCA's "no-take SMCAs" except for urchins, seaweed and invasive species for restoration and allow shore fishing and kelp harvesting. SMCA and SMRs both allow restoration. We will need to cull urchins in Point Lobos SMRs in 2026 and Lovers Point SMR in 2028.

FGC Petition 2024-10 – Air lift for urchins. Allow use of an air lift and hookah and modify 2023-23MPA to allow the better method of collecting urchins.

Outreach: FGC, Mexico

Objections 3: Dave Rudie, President CSUC, objects to use of commercial gear for recreational purposes and selling of ranched urchins.

Rebuttal 3: Recreational fishing gear is never certified. Urchins have no value at port and collection is non-commercial by definition; what the processor does with refuse is their own business. If I throw a plastic bottle in the trash and a recycler makes a sweater out of the material, my throwing away trash is not commercial. As a practical application, commercial divers are better equipped to deploy and operate an airlift with hookah, the question is whether they fish under recreational or commercial fishery rules.

Recreational fishing only requires a simpler regulation change to Tit. 14, § 29.06. Commercial urchin fishing is governed by the CSUC and entrenched in Tit. 14, § 120.7. CSUC is not seeking in Petition 2024-04 to change the collapsed red sea urchin fishery into a non-sustainable kelp restoration effort. We asked for changes to their petition at the FGC meeting on 8-14-24. If the CSUC were truly an ally for kelp restoration, petition 2024-10 would not be necessary as this method could remain commercial.

Jon Holcomb, a commercial red urchin fisherman, developed and started using an air lift to collect urchins beginning in 2018 at Fort Bragg. The other red urchin fishermen collect the urchins by hand collects the large heavy urchins but leaves the small ones behind which then allows them to grow and be harvested later. The surviving urchin cohorts are smaller and denser than the initial invasion making removal that much harder. North coast commercial urchin fishermen are working in funded restoration projects but leaving red urchins to eat the kelp forests saved.

Policy clarification needed: Urchin collection & ranching is non-commercial. Urchin air lift is usable for recreational fishing.

Compromise 4: Create a new "Kelp Restoration" commercial fishing license to allow more commercial fishing entrants to work on kelp restoration management permits at the recreational license fee rate. Waive wonton waste rule for urchin pests.

FGC Petition 2024-12 – Allow urchin removal in 7 more coastal counties by all methods.

Outreach: FGC. Seeking to engage MPA Collaboratives and Counties.

Objections: None

Policy clarification needed: Culling red urchins is allowed.

Compromise 5: Delete urchin culling in County of San Francisco. Added for simplicity. No reports of urchins or kelp in SF County.

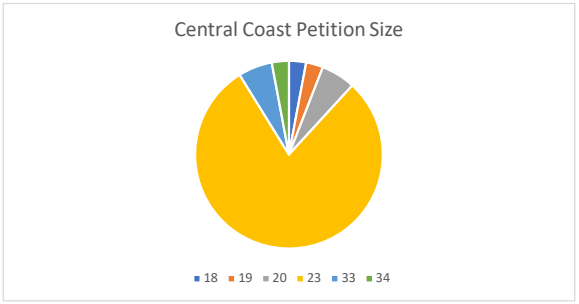
Summary of MPA Petitions

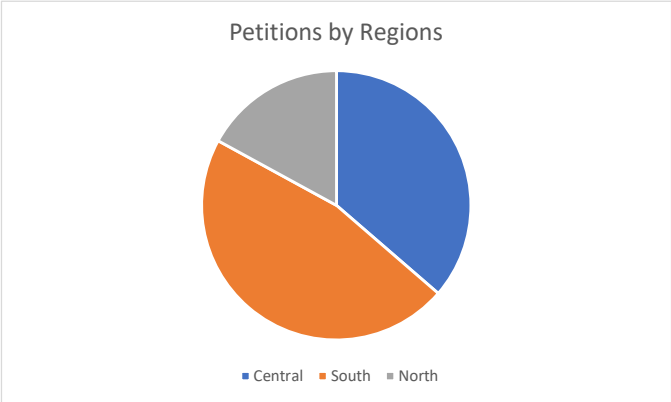
Based on limited descriptions provided by FGC agenda 2/7/24

		Affecting				Boundary			Take Allowance								Region					
Order	Petition	SMCA	SMR	MPAs	Special Closures	Changed	New	Redesignation	Tribal	Rec .	Com.	Species	Allowed Uses	Clarify Rules	Governance, etc.	sub track	South	Channel	Central	North	Protection +/	Similar related petitions	Notes
1	2023-14	9									1	Urchins				9	1				-1	See 23	
2	2023-15		3					1			1	palagic				3		1			-1		
3	2023-16		2					1			1	Salmon				2				1	-1		
4	2023-18			4	2								1			8		1			-1		
5	2023-19	1					1		1							1			1		1		
6	2023-20	1	1			1			1							2			1		-1	See 34	
7	2023-21	1														2	1				1		
8	2023-22			several										1		7	1				0		
9	2023-23	3	5				1	1		1	1	Urchin/Kelp	1		1	27			1		1	See 14	
10	2023-24	2				1										1		1			unknown		
11	2023-25			several		1							1			5		1			unknown		
12	2023-26	4				1								1		4	1						
13	2023-27	1						1								1		1			1		
14	2023-28		1				1		1							1	1				1		
15	2023-29	1							1							1	1				1		
16	2023-30	1								1		Crab				3				1	-1		
17	2023-31	1						1								2				1	1		
18	2023-32	1					1	1								2				1	1		
19	2023-33	1	6			1	1									7			1		1		
20	2023-34	3						1		1						3			1		1	See 20	
Totals		**30**	**18**	**4**	**2**	**5**	**5**	**7**	**4**	**3**	**4**	**5**	**3**	**2**	**1**	**91**	**6**	**5**	**5**	**4**	**4**		

20% Net petitions for added protections

Central Coast	
18	1
19	1
20	2
23	27
33	2
34	1





Petition	Part	Region	Central	South	North
14	1	North	FALSE	FALSE	1
14	2	North	FALSE	FALSE	1
14	3	North	FALSE	FALSE	1
14	4	North	FALSE	FALSE	1
14	5	South	FALSE	1	FALSE
14	6	South	FALSE	1	FALSE
14	7	South	FALSE	1	FALSE
14	8	South	FALSE	1	FALSE
14	9	South	FALSE	1	FALSE
15	1	South	FALSE	1	FALSE
15	2	South	FALSE	1	FALSE
15	3	South	FALSE	1	FALSE
16	1	North	FALSE	FALSE	1
16	2	North	FALSE	FALSE	1
18	1	Central	1	FALSE	FALSE
18	2	South	FALSE	1	FALSE
18	3	South	FALSE	1	FALSE
18	5	South	FALSE	1	FALSE
18	6	South	FALSE	1	FALSE
18	7	South	FALSE	1	FALSE
18	8	South	FALSE	1	FALSE
19	1	Central	1	FALSE	FALSE
20	1	Central	1	FALSE	FALSE
20	2	Central	1	FALSE	FALSE
21	1	North	FALSE	FALSE	1
21	2	North	FALSE	FALSE	1
22	1	South	FALSE	1	FALSE
22	2	South	FALSE	1	FALSE
22	3	South	FALSE	1	FALSE
22	4	South	FALSE	1	FALSE
22	5	South	FALSE	1	FALSE
22	6	South	FALSE	1	FALSE
22	7	South	FALSE	1	FALSE
23	1	Central	1	FALSE	FALSE
23	2	Central	1	FALSE	FALSE
23	3	Central	1	FALSE	FALSE
23	4	Central	1	FALSE	FALSE
23	5	Central	1	FALSE	FALSE
23	6	Central	1	FALSE	FALSE
23	7	Central	1	FALSE	FALSE
23	8	Central	1	FALSE	FALSE
23	9	Central	1	FALSE	FALSE
23	10	Central	1	FALSE	FALSE
23	11	Central	1	FALSE	FALSE
23	12	Central	1	FALSE	FALSE
23	13	Central	1	FALSE	FALSE
23	14	Central	1	FALSE	FALSE
23	15	Central	1	FALSE	FALSE
23	16	Central	1	FALSE	FALSE
23	17	Central	1	FALSE	FALSE
23	18	Central	1	FALSE	FALSE
23	19	Central	1	FALSE	FALSE
23	20	Central	1	FALSE	FALSE
23	21	Central	1	FALSE	FALSE
23	22	Central	1	FALSE	FALSE
23	23	Central	1	FALSE	FALSE
23	24	Central	1	FALSE	FALSE
23	25	Central	1	FALSE	FALSE
24	1	South	FALSE	1	FALSE
25	1	South	FALSE	1	FALSE
25	2	South	FALSE	1	FALSE
25	3	South	FALSE	1	FALSE
25	4	South	FALSE	1	FALSE
25	5	South	FALSE	1	FALSE
26	1	South	FALSE	1	FALSE
26	2	South	FALSE	1	FALSE

26	3	South	FALSE	1	FALSE
26	4	South	FALSE	1	FALSE
27	1	South	FALSE	1	FALSE
28	1	South	FALSE	1	FALSE
29	1	South	FALSE	1	FALSE
30	1	North	FALSE	FALSE	1
30	2	North	FALSE	FALSE	1
30	3	North	FALSE	FALSE	1
31	1	North	FALSE	FALSE	1
31	2	North	FALSE	FALSE	1
32	1	North	FALSE	FALSE	1
32	2	North	FALSE	FALSE	1
33	1	South	FALSE	1	FALSE
33	2	South	FALSE	1	FALSE
33	3	South	FALSE	1	FALSE
33	4	South	FALSE	1	FALSE
33	5	South	FALSE	1	FALSE
33	6	Central	1	FALSE	FALSE
33	7	Central	1	FALSE	FALSE
34	1	Central	1	FALSE	FALSE
34	2	South	FALSE	1	FALSE
34	3	South	FALSE	1	FALSE

Regional Petition Count	32	41	15
	Central	South	North

Central	32
South	41
North	15

Urchin Petitions

Petition Number	Affected MPA	MLPA Action	Action Type	Proposed Action	Justification by Petitioner	Notes	Priority	Individual Actions	Additional Policy	Add'l info needed	Resources need	Opposition	Collab Net	DMR category
Decadal Management Review Petition 2023-23MPA														
2023-23MPA_1	Edward F. Ricketts SMCA	Modify	Classification/Take	Reclassify SMCA to an SMR to prohibit take	Protect restored kelp forests; improve diver safety from fishing boat propellors and fishing gear.	1	B	Change MPA classification	none	no	none	Allwaters, Rec Fishing	77	4
2023-23MPA_2	Edward F. Ricketts SMCA	Modify	Take	Allow unlimited urchin removal	Restore Kelp Forests	2	A	Change Title 14, § 29.06	Policy established, see also 2024-10,12	no	None Requested	none	78	4
2023-23MPA_3	Edward F. Ricketts SMCA	Modify	unclear if within Commission authority	Allow out-planting kelp on the reef without an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3	C	Allow by Restoration Management Permit	KRMP guidance	yes	Decision tree framework	none		4,18
2023-23MPA_4	Edward F. Ricketts SMCA	Modify	unclear if within Commission authority	Allow spore dispersal by sporophyte bags without an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3	B	Allow by regulation change	KRMP guidance	no	Decision tree framework	none		4,18
2023-23MPA_5	Edward F. Ricketts SMCA	Modify	unclear if within Commission authority	Allow pruning kelp canopy to promote growth and resilience to storms with an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3,4	B	Allow kelp harvesting in SMRs by Restoration Management Permit	Presently allowable to harvest kelp	Kelp landing data	MAC	none		4
2023-23MPA_6	Pacific Grove Gardens SMCA	Modify	Classification/Take	Reclassify SMCA to an SMR to prohibit take	Protect restored kelp forests; improve diver safety from fishing boat propellors and fishing gear.	1	B	Change MPA classification	none	no	none	Allwaters, Rec Fishing	83	4,10
2023-23MPA_7	Pacific Grove Gardens SMCA	Modify	Take	Allow unlimited urchin removal	Restore Kelp Forests	2	A	Change Title 14, § 29.06	Policy established, see also 2024-10,12	no	Private funding	none		4
2023-23MPA_8	Pacific Grove Gardens SMCA	Modify	unclear if within Commission authority	Allow out-planting kelp on the reef without an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3	C	Allow by Restoration Management Permit	KRMP guidance	yes	Decision tree framework	none		4,18
2023-23MPA_9	Pacific Grove Gardens SMCA	Modify	unclear if within Commission authority	Allow spore dispersal by sporophyte bags without an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3	B	Allow by regulation change	KRMP guidance	no	Decision tree framework	none		4,18
2023-23MPA_10	Pacific Grove Gardens SMCA	Modify	unclear if within Commission authority	Allow pruning kelp canopy to promote growth and resilience to storms with an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3,4	B	Allow kelp harvesting in SMRs by Restoration Management Permit	Presently allowable to harvest kelp	Kelp landing data	MAC	none		4
2023-23MPA_11	Carmel Bay SMCA	Modify	Classification/Take	Reclassify SMCA to an SMR to prohibit take	Protect restored kelp forests; improve diver safety from fishing boat propellors and fishing gear.	1	B	Change MPA classification	none	no	none	Allwaters, Rec Fishing		4
2023-23MPA_12	Carmel Bay SMCA	Modify	Take	Allow unlimited urchin removal	Restore Kelp Forests	2	A	Change Title 14, § 29.06	Policy established, see also 2024-10,12	no	Private funding	none		4
2023-23MPA_13	Carmel Bay SMCA	Modify	unclear if within Commission authority	Allow out-planting kelp on the reef without an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3	C	Allow by Restoration Management Permit	KRMP guidance	yes	Decision tree framework	none		4,18
2023-23MPA_14	Carmel Bay SMCA	Modify	unclear if within Commission authority	Allow spore dispersal by sporophyte bags without an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3	B	Allow by regulation change	KRMP guidance	no	Decision tree framework	none		4,18
2023-23MPA_15	Carmel Bay SMCA	Modify	unclear if within Commission authority	Allow pruning kelp canopy to promote growth and resilience to storms with an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3,4	B	Allow kelp harvesting in SMRs by Restoration Management Permit	Presently allowable to harvest kelp	Kelp landing data	MAC	none		4,18
2023-23MPA_16	Point Lobos SMR	Modify	Take	Allow unlimited urchin removal	Restore Kelp Forests	2	B	Change Title 14, § 29.06	Need Policy to work in a SMR	no	Private funding	none	88	4,18
2023-23MPA_17	Point Lobos SMR	Modify	unclear if within Commission authority	Allow pruning kelp canopy to promote growth and resilience to storms with an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3,4	B	Allow kelp harvesting in SMRs by Restoration Management Permit	Presently not allowable to harvest kelp in a SMR	no	MAC	none		18
2023-23MPA_18	Point Lobos SMR	Modify	unclear if within Commission authority	Allow out-planting kelp on the reef without an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3	C	Allow by Restoration Management Permit	KRMP guidance	yes	Decision tree framework	none		18
2023-23MPA_19	Point Lobos SMR	Modify	unclear if within Commission authority	Allow spore dispersal by sporophyte bags without an SCP	The SCP process is difficult to navigate which makes it harder to protect and restore kelp forests; restore kelp forest	3	B	Allow by regulation change	KRMP guidance	no	Decision tree framework	none		18
2023-23MPA_20	n/a	Establish	Establish new MPA	Establisha new SMR at Tanker's Reef	Protect restored kelp forests; improve diver safety from fishing boat propellors and fishing gear.	1,5	B	Add an SMR to inventory	none	Ask tribes for a name	New maps	Allwaters, Rec Fishing		04
2023-23MPA_21	not specified	n/a	unclear if within Commission authority	Create regulatory pathway to allow placing of artificial reef structures and sunken ship for recreational diving	Create new habitat for kelp and other marine life; expand diving opportunities.	6	C	Develop Artificial reef prorgram	OPC, CCC, etc.	Meet and Discuss	Artificial reefs	none		4,18
2023-23MPA_22	not specified	n/a	unclear if within Commission authority	Allow placement of buoys in restoration areas	Protect substrate from anchors in restored kelp forests.	7	A	If buoys are "fishing" this petition can be deleted	Clarify	no	Buoys	none		04
2023-23MPA_23	not specified	n/a	Non-regulatory	Develop a framework to evaluate and approve appropriate restoration and mitigation actions within MPAs and marine managed areas	Allow restoration activites in MPAs	3,8	B	Allow work by Restoration Management Permit	KRMP guidance	Meet and Discuss	Decision tree framework	none		4,16,18
2023-23MPA_24	not specified	n/a	unclear if within Commission authority	Establish a new process in CDFW's scientific collecting permit program for Restoration Management Permits	The SCP process is difficult to navigate; wants to conduct restoration without scientific design to test effectiveness of methods	3	B	Make Restoration Management Permit Process	KRMP guidance	Meet and Discuss	Software development	none		17,18
2023-23MPA_25	not specified		Non-regulatory	Consider proposed kelp restoration sites as G2KR adopted reefs for continued kelp restoration	Protect and restore kelp forests; continued community engagement.	9	B	Make Restoration Management Permit define adoption	KRMP guidance	Meet and Discuss	Private funding	none		4,18
2023-23MPA_26	Various MPAs*	n/a	Commercial	Allow commercial urchin harvest in MPAs for Restoration	Harvest urchins for urchin ranching and other uses.	2, 10	B	Make Restoration Management Permit	KRMP guidance	none	Commercial Divers	none		4,18
2023-23MPA_27	Various MPAs*	n/a	Commercial	Exemption for Wonton Waste Rule	Allow commercial to destroy small urchins.	11	B	Make Restoration Management Permit	KRMP guidance	none	Commercial Divers	none		4,18

Other Urchin Petitions

2024-10	Initially outside MPAs	n/a	take	Airlift use by recreational fishers	Airlift is more efficient	2, 10	A	Change Title 14, § 29.06	Clarification on commercial use	Evaluation	Compressor	California Sea Urchin Commission	n/a
2024-12	Outside MPAs	n/a	take	Expand culling to 7 more counties	More divers can participate	2, 10	A	Change Title 14, § 29.06	Established policy	Kelp Watch	Private funding	none	n/a

* Could be subdivided into 5 MPAs to consider each instance individually.

Justification Notes

1

In SMCAs fish stocks are lower than SMRs
Protecting areas increases fish biomass.
Better outcomes for fish and kelp if fishing is prohibited. See DMR report:
Kelp Forest Technical Report Narratives. See pages 74-80, 83
Safer environment with kelp restoration divers below boats.
These MPAs are not very deep and do not extend to 3 mile state water limit like others.
Traversable in kayaks.
More fishing is done outside of these MPAs anyways.
Low value due to overfishing for Fishers.
High value and importance to Rec. Tourism, Diving, Business, Conservation etc.
Better fishery when rockfish are allowed to become adult in 8-10 years.
Culling urchins benefits snails which eat kelp.
Fish eat snails.
Don't take the fish that eat the snails.
Consumptive nearshore fishing is concentrated in 3 small SMCAs and non-MPAs.
CCFRP determined that SMCAs and non-MPAs have similar lower fish biomass.
PMFC prohibited groundfishing in < 120' for Rec. fishing for 6 months anyways.
CentralGroundfish Management Area (North of 36 N lat.), (Title 14 Sec. 27.40)
> 50 fathoms: April, October, December
< 20 fathoms: May, June July, August, September, November

2

Culling urchins by recreational divers was allowed at Tanker's Reef from 4-1-21 to 4-1-24
Resist Strategy as dfined in RAD
Reducing urchin grazing pressure restores kelp forests.
Legal recreational effort for 3 years demonstrated:
Well controlled and safe.
Collects data to inform FGC & KRMP.
Verified results by GOs and NGOs
Illegal recreational effort is common:
Unlawful conservation role for divers.
Data is not collected to inform FGC & KRMP.
Benthic disturbance/by-catch inconsequential by MBNMS.
Unforssen consequences were discovered:
Desmarestia ligulata (acid weed) early colonization.
Spread of invasive bryozoan species.
Marine Heat Waves.
Red tides and darkness affect on giant kelp.
Urchin size frequency decrease by culling makes culling harder.
Current Sea Grant research does not seek to learn other unforeen consequences.
Improved method discovered:
Air lift.

3

In the SCP portal, allow for RMP application and tracking.
"Difficult to navigate" would be better described as "inappropriate for kelp restoration".
The software is horrible for users and should be fixed.

- Needs to accommodate "unlimited" and widespread restoration.
- Scientific Collecting Permits don't work for kelp restoration.
  - Small area of design.
  - Project size allowed is a constant second guessing of what CDFW will accept.
    - Can't forecast the acceptable size.
    - Size is unnecessarily small for permission, but too small to grow a forest.
  - Must have a control area.
  - Limit disturbances to a species, which is contradictory to restoration purposes.
  - Take limits in Decision Tree are informed by old models, not adaptive.
  - Only scientists get applications approved.
    - We were denied SCP applications 3 times.
    - Written by scientists but submitted under our name.
    - SCP have a 98% application sucesss rate.
  - Research design changes during the study period require permits to adapt quickly.
  - Timing rarely works to have permition, funding, and people.
- Restoration Management Permit application and collaboration.
  - Restoration on land is a model
  - Allow kelp restoration by removing urchins (conspecifics).
  - Restore large kelp forests
  - Allow affecting species richness.
  - Control areas are simply untreated areas.
  - Non-scientiists can apply.
  - Scientiists collaborate with CPUE evaluations and SCPs.

4
- Kelp harvesting is needed by the Monterey Abalone Company to feed abalone
  - 6,000 lbs of kelp canopy per week
  - Presently only allowed in SMCAs
  - Kelp could feed urchins in existing ranching pens.
- Allow kelp harvesting in association with kelp restoration efforts in SMRs
  - Benefit kelp survival
  - Proxy for extinct Sea Cow.

5
- Majority of public comment supportive of MPAs
  - Only 20% of petitions request additional protections.
  - 30x30 calls for 14.4% of additional protections on the coast.
- Proposed areas of low economic value to the fishing community.
- Tanker's Reef may be partially covered in sand in the future.
- Site of possible artificial reef deployment.

6
- OPC recently funded a study to develop an artifical reef siting plan
  - Under consideration on Central Coast for 20 years.
  - Need Permitting pathway

7
- Buoys to guide culling efforts are essential tools
- If considered fishing practice no authorization needed from
  - CDFW
  - MBNMS

8	OPC's Kelp Restoration Management Permit working group Resulting recommendation to OPC in 2027 Incorporate guidance into RMP decision tree

9	Similar to adopt a highway for cleaning up litter Commissioners idea Control and coordinate several NGOs activities in a single space. Management point of contact and MOU with practitioners

10	Commercial divers can coordinate with recreational diving efforts More experienced at urchin diving Better equipment & safety Collect at higher workrates Use air lift more effectively and efficiently Sell harvested urchins for urchin ranching and sales Make Commercial Kelp Restoration Diver License Allow more entrants to Commercial Urchin Fishery Reduce license fee for Conservation activities. Allow commercial fishing for urchins without restrictions. Could allow as recreational activity if 2024-10 is approved by FGC. Commercial divers could work as recreational divers.

11	Commercial divers should be able to destroy small and unharvestable urchins Removal of small urchins is required. Exempt wanton waste rule for restoration activities.

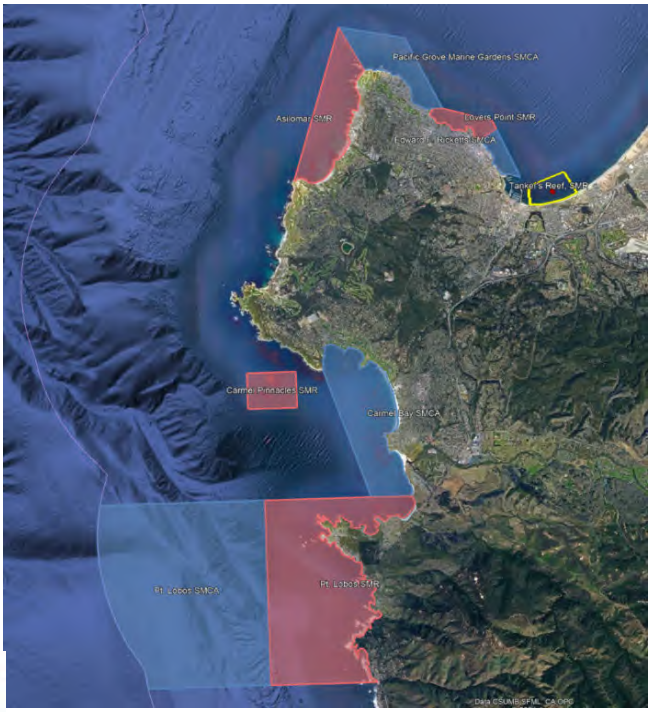
Priority to State calendar

Priority	Date	Milestone for
A	1-Apr-25	Rulemaking calendar
B	1-Apr-26	Guidance from KRMP Decision tree Outplanting Methods Adopt a Reef Commercial Divers Restoration Management Permit Portal
C	1-Apr-27	Guidance from KRMP Artificial Reefs and outplanting guidance

Kelp Restoration Petition 2023-23MPA

Read petition text

Number	MPA/Description	Change	Action	Description
23_1	Ed Ricketts	Modify	classification/take	SMR
23_2	Ed Ricketts	Modify	take	unlimited urchins
23_3	Ed Ricketts	Modify	unclear	outplanting
23_4	Ed Ricketts	Modify	unclear	Spore bag
23_5	Ed Ricketts	Modify	unclear	Pruning
23_6	PG Gardens	Modify	classification/take	SMR
23_7	PG Gardens	Modify	take	unlimited urchins
23_8	PG Gardens	Modify	unclear	Pruning
23_9	PG Gardens	Modify	unclear	outplanting
23_10	PG Gardens	Modify	unclear	Spore bag
23_11	Carmel Bay	Modify	classification/take	SMR
23_12	Carmel Bay	Modify	take	unlimited urchins
23_13	Carmel Bay	Modify	unclear	Pruning
23_14	Carmel Bay	Modify	unclear	outplanting
23_15	Carmel Bay	Modify	unclear	Spore bag
23_16	Pt. Lobos	Modify	take	unlimited urchins
23_17	Pt. Lobos	Modify	unclear	Pruning
23_18	Pt. Lobos	Modify	unclear	outplanting
23_19	Pt. Lobos	Modify	unclear	Spore bag
23_20	Tanker's Reef	Establish	Establish an MPA	SMR
23_21	Artificial Reefs	n/a	Unclear	Artificial Reef
23_22	Buoys	n/a	Unclear	Allow
23_23	Restoration in MPAs	n/a	non-regulatory	Framework
23_24	Restoration Permits	n/a	Unclear	SCP process
23_25	Adopted Reef commu	n/a	non-regulatory	Adopted
23_26	Commercial Harvest of Sea Urchins in MPAs			
23_27	Commercial restoration exception to Wanton Waste Rule			



Reference for MPA locations