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## **Guidance on marine protected area protection level assignments when faced with unknown regulatory information**

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## Highlights

- Direct MPA regulations or management plans rarely address the complete set of fishing and activity restrictions in place
- Regulation-based MPA evaluation systems can reliably identify fully and highly protected areas, even in the face of unknown information
- Navigator's Level of Fishing Protection (LFP) scores can help guide assumptions about unknown information
- The ability to assign protection levels (following the RBCS or The MPA guide in the near future) via existing MPA databases, allows for faster global assessments of protection

## **Abstract**

Strong human use regulations are an important precondition for marine protected area (MPA) effectiveness. Distinguishing MPAs based on their protection levels has shown advantages, but the availability of regulatory information about allowed activities is a major roadblock towards completing assessments at scale. Here, using a California case study, we explore assigning MPA protection levels following the regulation-based classification system (RBCS) under different scenarios of incomplete regulatory information. In the first group of scenarios (A), only readily available information was used, i.e., information contained in direct MPA implementing regulations and management plans. In the second group (B), information was limited to the activities in ProtectedSeas' Navigator that matched those in the RBCS. From group A, 99 and 100% correct classification of fully and highly protected areas, respectively, were obtained when treating unknown aquaculture, bottom exploitation, and bottom extraction as 'prohibited' and boating, anchoring, and fishing activities as 'allowed'. High classification accuracy was also obtained for moderately, poorly, and unprotected areas. From group B, 92 and 94% correct classification of fully and highly protected areas were obtained when using the same assumptions for non-fishing activities but using Navigator's Level of Fishing Protection (LFP) score to guide assumptions about unknown fishing activities. Correct classification rates were poorer with different assumptions. Regulation-based MPA evaluation systems can reliably identify fully and highly protected areas in the face of unknown information, when assumptions about unknown information are guided by contextual indicators such as generally regulated human activities and/or overall level of fishing restriction.

## Introduction

The effectiveness of fully or highly protected marine protected areas (MPAs) as a tool to restore fish populations and ocean health has been well studied and documented [1, 2, 3, 4]. Based on this evidence, numerous international goals have been set to promote the adoption of MPA networks in national waters. Although the CBD Aichi Target to implement 10% of effective MPAs by 2020 was not achieved in many regions, post-2020 targets are anticipated to increase ambition and set a target of 30% of effective protection by 2030 [5]. This new goal was proposed at the 2016 International Union for the Conservation of Nature (IUCN) World Conservation Congress [6] and includes the designation of 30% of global oceans in effective MPAs or Other Effective area-based Conservation Measures (OECMs) by 2030. In January 2021, the Biden administration committed the United States to this goal by executive order. Under the European Biodiversity Strategy and European Green Deal, Europe has already committed to protect 30% of its ocean, with 10% under strict protection [7].

In order for MPAs to realize their potential, MPAs need to implement strong regulatory protections [8, 9, 10, 11, 12]. To assess MPA protection levels, the complexity of regulations in each MPA should filter through an evaluation system that uses and verifies the measures in place. One such system is the Regulation-Based Classification System (RBCS) [13], which scores MPAs based on the potential impact of the activities that are allowed within an MPA. The RBCS is part of the Blue Parks awards criteria and is now integrated into the protection levels assessment of the recently developed MPA Guide [10]. Recent endeavors used the RBCS to assess the protection levels different countries and regions were using to meet their international coverage commitments [14, 15, 16, 17].

Standardized levels of protection, based on regulations, make estimating potential MPA effectiveness possible. Previous studies suggest the extent of human activities allowed within MPAs (i.e., protection levels) matters in achieving conservation benefits [18, 19, 20, 21]. Fully, highly, and moderately protected areas (particularly if adjacent to fully protected areas), have been found to provide significant conservation benefits, from which socioeconomic benefits are derived [21, 22]. Yet, using protection levels as proxies for potential positive outcomes assumes MPAs are implemented and enforced in the water with enabling conditions being met [10]. Enabling conditions, such as enforcement, monitoring of results, long-term political commitment, sustainable financing, community participation, and benefits sharing, must be in place for a MPA to be effective [10, 23, 24, 25, 26, 27]. Some of these features are not easily and objectively quantified (e.g., enforcement or compliance) or information is not readily available (e.g., funding), but indicators are needed to ensure MPA enabling conditions and MPA success (e.g., [28]).

In theory, MPA quality related to the level of protection can be obtained by documenting 'allowed' and 'prohibited' marine activities. Globally, this would lead to an overall picture of marine protections worldwide [3, 4, 13, 14, 15, 16, 21]. In practice, however, detailed regulatory information is not readily available for many MPAs, which can be a major roadblock in reaching that goal; often MPAs are only broadly referenced in bylaws or regional/national legislation [12,

29]. Researching all the regulatory information needed for a worldwide assessment of marine protections could be extremely time-consuming. Therefore, easier access to regulatory marine protections, as well as more robust methodologies to assess marine protections despite gaps in regulatory information could be helpful.

Here, the adequacy of estimating RBCS protection levels with incomplete input data was explored, by testing different assumptive methods. Californian MPAs and other Marine Managed Areas (MMAs)<sup>1</sup> in the ProtectedSeas' Navigator database [30] were used as a case study; they are considered to be implemented and meeting the enabling conditions for success [31, 32, 33, 34, 35]. It was assessed whether the regulation-based metrics can be robust and reliable using only information readily available from MPA regulations and management plans (referred to in this study as 'direct regulations'). It was also assessed whether Navigator's Level of Fishing Protection (LFP) score [12] can guide assumptions about unknown information to provide a reasonable first estimate of the RBCS protection levels when regulation information is incomplete in the management plans or equivalent legal texts. The use of such guidance in protection level estimations would enable MPA assessments to increase, allowing broad comparisons between MPAs, MPA networks, and other managed areas when the required information in bylaws or regional/national legislation is difficult to obtain or non-existent.

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<sup>1</sup> Beyond MPAs, other MMAs in Navigator include areas managed for fisheries purposes, such as permanent gear closure areas, that regulate extraction of marine life; these are rarely addressed by global databases focusing on MPAs, but they can be similarly classified based on existing regulations.

## Methods

MPA and other MMA management plans rarely address the complete set of fishing and activity restrictions in place, as some activities are often managed through bylaws or regional or national regulations (referred to in this study as 'external regulations'). However, for an accurate assignment of a protection level based on the RBCS, detailed information on allowed activities (e.g., fishing, aquaculture, mining, etc.) is necessary. Therefore, gathering all information to fulfill a complete assessment via the RBCS can be onerous at a large scale or might have to ignore areas where information is not available.

Various world databases document MPAs (e.g., World Database on Protected Areas (WDPA), MPAtlas, MAPAMED, etc.), with regulatory information for some regions (see the MPAtlas with some MPAs classified following the RBCS such as the Blue Parks, and recently The MPA Guide). Further, to facilitate extensive and global assessments in a timely manner, Navigator [30], launched in 2015, contains information on activities 'allowed' and 'prohibited' by regulation, as well as regulatory references for all areas in its database (i.e., MPAs and MMAs). Navigator focuses on activity restrictions on marine life extraction, i.e., mainly fishing [12], but it distinguishes itself from other databases by summarizing direct regulations and documenting a standardized set of uses for every included area. Navigator's Level of Fishing Protection (LFP) score is assigned based on heuristic rules structured in a decision tree that do not require all individual uses to be known. A simplified system capturing regulations, such as LFP, may serve to guide decisions associated with a more complete system (such as the RBCS or The MPA Guide) when detailed information is not easy to obtain.

To explore the adequacy of estimating the RBCS protection levels with incomplete input data, California's network of MPAs and other MMAs (381 areas from Navigator, as of December 2021) was selected as a sample to test potential assumptions that could be made for unknown information globally. For these areas, all the regulations were reviewed through a resource intensive process (whether from direct or external regulations). This allowed gathering the full set of regulations required to follow the RBCS decision tree [13], and assigning those areas with a 'correct' protection level ('real' case or 'Full RBCS'). We worked at the lowest possible resolution, hence MPAs or zones within a MPA in the case of multi-zone MPAs. All of the areas or zones were treated as individual sites (such as in [15, 16]) in order to not mask full or high protection in weighted-averaging zone scores. Where no information could be found on fishing gears, anchoring, and/or boating occurring in the assessed region, we considered them not prohibited by regulation (i.e., 'allowed'), as suggested by Horta e Costa et al. [13]. For aquaculture, bottom structures including pipelines and artificial reefs (referred to in this study as 'bottom exploitation'), and mining/oil platforms/sand extraction/detonations (referred to in this study as 'bottom extraction'), data layers were retrieved from the California Department of Fish and Wildlife and the U.S. Bureau of Ocean Energy Management to determine their locations (for pipelines, artificial reefs, and drilling platforms) or active lease locations (for aquaculture<sup>2</sup> and oil/gas). Where an aquaculture, bottom exploitation, or bottom extraction location intersected an

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<sup>2</sup> Aquaculture data layers from the California Department of Fish and Wildlife only show relative positions and shapes of lease areas and do not provide definitive legal boundaries.

area's boundary, that activity was coded as 'allowed', otherwise it was coded as 'prohibited'. These Full RBCS protection levels constituted the baseline for this study.

Comparisons between the protection levels obtained with the full set of regulations (Full RBCS) and those obtained under different scenarios with less information - unknowns - and distinct assumptions allowed validating their performance. Two groups of scenarios were tested (Figure 1, Appendix Table 1): (A) one using only the direct regulations of MPAs/MMAs (i.e., management plans or equivalent) which often do not provide the full set of regulations required to assign the RBCS; and (B) one using only the information gathered in Navigator with more unknowns due to the reduced number of uses included in Navigator (RBCS input fields with corresponding Navigator fields were used with the remaining considered unknown, detailed in Appendix Table 4). The first group of scenarios (A) reflects what is often available to evaluators, so the aim was to understand if gathering only the information readily available in management plans and equivalents would significantly change the final RBCS protection levels when guided by assumptions. The second group of scenarios (B) is also relevant to test because there are already more than 20,000 areas in over 120 countries assessed in Navigator, including all American and European MPAs [36]. These areas could be classified following the RBCS or The MPA Guide if guidance on what to do with the unknowns is clarified scientifically and the performance is satisfactory. The type and number of unknowns were evaluated for both groups of scenarios, comparing the number of unknowns between each scenario and the Full RBCS, to understand common unknowns and their impact in final classifications.





Scenario Group	Scenario Name	Assumptions for Unknown:	
		 Non-Fishing Activities	 Fishing Gears
<b>BASELINE - DIRECT &amp; EXTERNAL REGULATIONS</b>	Full RBCS	None	Simple* <small>*only applies to gears used in the region</small>
	A1 B1	Simple	Simple
<b>GROUP A - DIRECT REGULATIONS ONLY</b>	A2 B2	Simple	Simple
	A3 B3	Simple LFP-Guided	Simple LFP-Guided
	A4 B4	Complex LFP-Guided	Complex LFP-Guided
<b>GROUP B - REGULATORY DATA IN NAVIGATOR ONLY</b>	A5 B5	Informed	Simple
	A6 B6	Informed	Simple
	A7 B7	Informed	Simple LFP-Guided
	A8 B8	Informed	Complex LFP-Guided

Figure 1: Assumptive methods used in each scenario. See Appendix Table 1 for a full description of input information and assumptive methods for unknown fishing gears and non-fishing activities used in each scenario.

Within each group of scenarios (A and B), eight scenarios, named A1-A8 and B1-B8, with increasing complexity in assumptions pertaining to unknown fishing gears and non-fishing activities were tested. Simplest assumptive methods included assuming all unknown fishing gears and non-fishing activities ‘allowed’ or all ‘prohibited’, and more complex methods were tested to understand if the classification results could be improved. These included applying different assumptions to unknown non-fishing activities (*informed assumptions*), unknowns for different types of areas (*LFP-guided assumptions*), or a mix of approaches, with some assumptions being applied to unknown fishing gears and others to unknown non-fishing activities.

Informed assumptions, used in scenarios A5-A8 and B5-B8, were applied to unknown non-fishing activities. For aquaculture, bottom exploitation, and bottom extraction, given their environmental impact and weight in the RBCS and because they are commonly absent or

incomplete in management plans and regulated by external regulations (e.g., specific bylaws with leases), assumptions related to these activities are important. In addition, because such activities in the United States are generally subject to extensive regulatory requirements such as environmental assessments, public comment periods, and permitting, unknowns in these fields were coded as 'prohibited'. Non-fishing activities that are ordinarily unrestricted unless explicitly stated otherwise, such as boating and anchoring, were coded 'allowed' if unknown.

For the LFP-guided assumptions, Navigator's LFP score was used as a basic/heuristic and first step assessment of an area's protection level based on general information of one of the RBCS dimensions (i.e., fishing). Two versions of the LFP-guided assumptions were tested. In the simple version, unknown fishing gears and non-fishing activities were considered 'prohibited' for those areas consistent with fully and highly protected areas and 'allowed' for the areas consistent with moderately, poorly, and unprotected areas. Simple LFP-guided assumptions for unknown non-fishing activities were used in scenarios A3 and B3 and for unknown fishing gears in scenarios A3, B3, A7, and B7. In the complex version, for unknown non-fishing activities: i) unknown bottom extraction was considered 'prohibited' for the areas consistent with fully, highly, and moderately protected areas and 'allowed' for the areas consistent with poorly and unprotected areas; ii) unknown bottom exploitation and aquaculture were considered 'prohibited' for the areas consistent with fully and highly protected areas and 'allowed' for the areas consistent with moderately, poorly, and unprotected areas, and iii) unknown boating and anchoring were considered 'allowed' for all areas. Unknown fishing gears were considered 'prohibited' for those areas consistent with fully and highly protected areas and 'allowed' for the areas consistent with moderately, poorly, and unprotected areas, except for fishing gears with an impact score of 9 (highest impact) (i.e., bottom towed fishing gears; see the table in [13] for RBCS fishing gear impact scores) in the moderately protected areas, in which case they were considered 'prohibited'. Complex LFP-guided assumptions for unknown non-fishing activities were used in scenarios A4 and B4 and for unknown fishing gears in scenarios A4, B4, A8, and B8.

To support using the LFP scores to guide decisions in the RBCS, a chi-square test of independence was performed between the LFP scores and RBCS protection levels, under the Full RBCS, for the 381 study areas. Results showed a significant and relatively strong association between the Full RBCS protection levels and LFP scores ( $\chi^2(16, n = 381) = 657.3$ ,  $p < 0.001$ ; Cramer's  $V = 0.66$ ), suggesting LFP scores can help guide assumptions about unknown information. The distribution of the RBCS protection levels and LFP scores are plotted in Appendix Figure 1.

RBCS protection level estimates from each scenario were evaluated by computing the percentage of correctly classified areas with respect to the Full RBCS as well as false positive and negative rates. A false positive indicates an area where the RBCS protection level assigned by a scenario did not match that area's 'correct' RBCS protection level calculated by the Full RBCS. A false negative occurs when an area that scored a given RBCS protection level in the Full RBCS was assigned a different RBCS protection level in a scenario. In basic terms, the false positive rate indicates what percentage of areas assigned a given RBCS protection level

are incorrect for that level, while the false negative rate indicates how many areas that should be a given RBCS protection level are 'missed' (i.e., assigned an incorrect protection level). The calculation of RBCS protection levels in each scenario was conducted in Python.

## Results

The Full RBCS protection levels for California MPAs and other MMAs, calculated using all available information including activity restrictions from sources other than MPA management documentation, are reported in Figure 2 and Appendix Table 2, constituting the baseline for this study.

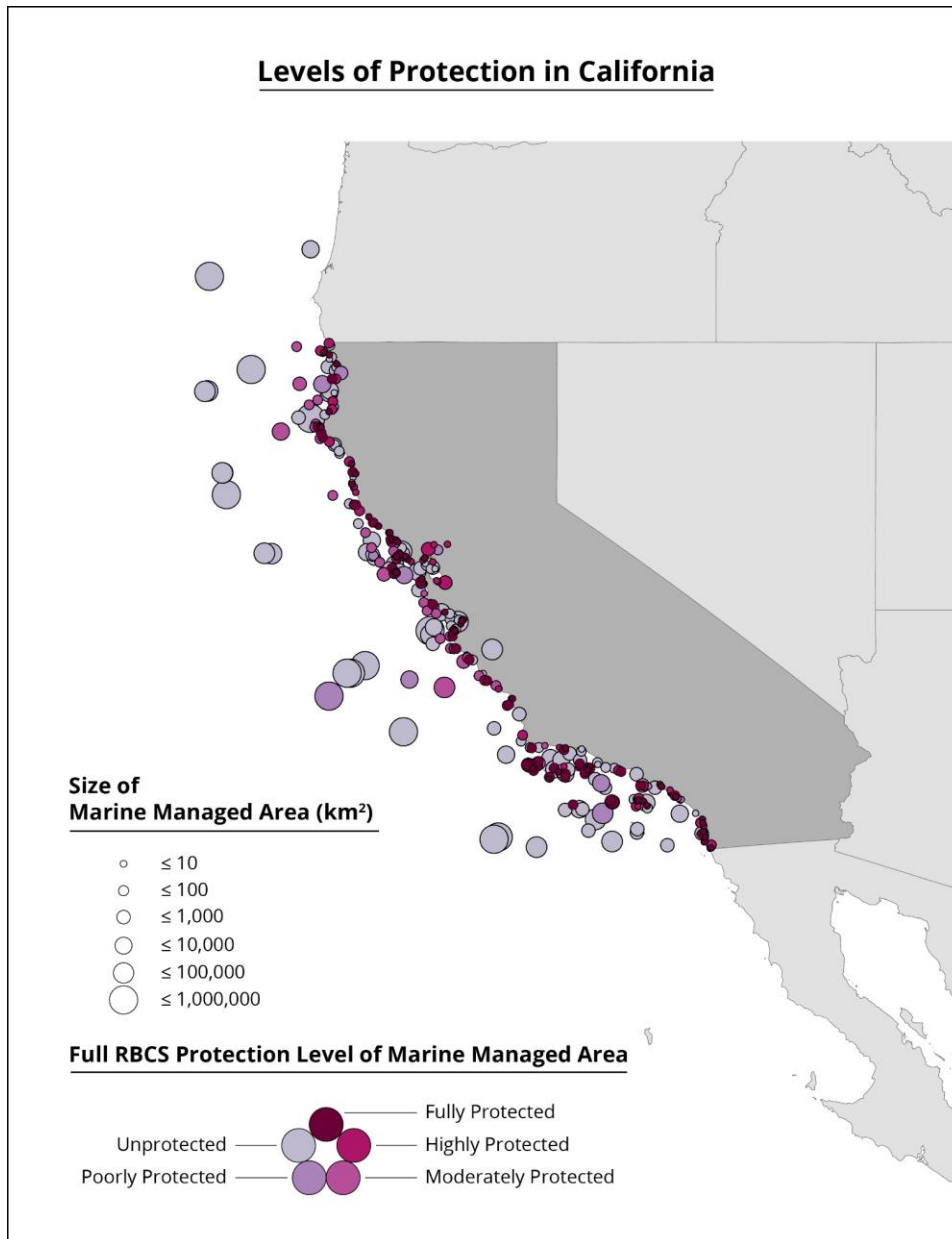


Figure 2. Map of California MPAs and other MMAs, illustrating their size and Full RBCS protection level. Included are all areas that at least partially overlap California marine waters; each dot represents the centroid of the MPA/MMA boundary.

The analysis of the unknowns (Appendix Table 3) revealed that some fishing gears were only known after searching external regulations (in the Full RBCS scenario). Most often these were drift nets, fish traps, fixed fish traps madragues, lines, longlines (bottom), longlines (pelagic), purse seining (bottom), purse seining (pelagic), spearfishing/diving, traps, and trawl pelagic. These gears were not regulated by direct regulations in 25 to 42% of the California areas. All fishing gears had unknowns in some MPAs when only searching for direct regulations - even those that are more destructive such as bottom trawls. Some gears such as trammel nets, gillnets, or dredges also display some unknowns even after researching the entire set of existing regulations (both direct and external) for an area or region. References to non-fishing activities were even less available in direct regulations with 45, 60, 97, and 98% of areas having no information about anchoring, aquaculture, bottom exploitation, and bottom extraction, respectively. When evaluating average unknowns across fishing gear and non-fishing activity fields by RBCS protection level, the percentage of unknowns increased as protection level decreased, except for unprotected areas which had somewhat less unknowns than poorly protected areas (Table 1).

Table 1 - Average percentage of unknown information, by RBCS protection level (n = 381)

Protection level (according to Full RBCS)	Fishing Gears		Non-fishing Activities	
	Full RBCS (avg. % unknown)	All other scenarios (avg. % unknown)	Full RBCS (avg. % unknown)	All other scenarios (avg. % unknown)
Fully Protected	0	0	1.10	11.60
Highly Protected	0.09	0.21	0.58	9.13
Moderately Protected	1.67	4.74	0.79	10.87
Poorly Protected	4.84	16.09	6.72	22.05
Unprotected	3.39	11.71	2.10	8.66

The scenarios within group A included all fields in the RBCS but only used information readily available in direct regulations. Both simple assumptive methods returned poor classification results (Table 2). When all unknowns were assumed 'allowed' (A1), fully to moderately protected areas from the Full RBCS shifted towards being classified as less protected, (Table 2, Appendix Table 5). When all unknowns were assumed 'prohibited' (A2), moderately to unprotected areas from the Full RBCS shifted to being classified as more protected (Table 2, Appendix Table 6). Both simple assumptions were not representative of 'reality'. Table 2 summarizes the assumptions and results for all scenarios in group A.

Table 2. RBCS classification results summary for all scenarios in group A.

<b>Scenario Name &amp; Description</b>	<b>Classification Shift</b>	<b>Match with Full RBCS</b>	<b>Correctly Classified (%)</b>
<b>A1:</b> using direct regulations w/ simple assumptions	Shift to less protected	Weak	45
<b>A2:</b> using direct regulations w/ simple assumptions	Shift to more protected	Weak	53
<b>A3:</b> using direct regulations w/ simple LFP-guided assumptions	Minor shift to less protected	Strong	84
<b>A4:</b> using direct regulations w/ complex LFP-guided assumptions	Minor shift to less protected	Strong	91
<b>A5:</b> using direct regulations w/ informed non-fishing assumptions, simple fishing assumptions	Minor shift to more protected	Strong	95
<b>A6:</b> using direct regulations w/ informed non-fishing assumptions, simple fishing assumptions	Shift to more protected	Weak	53
<b>A7:</b> using direct regulations w/ informed non-fishing assumptions, simple LFP-guided fishing assumptions	Minor shift to less protected	Strong	95
<b>A8:</b> using direct regulations w/ informed non-fishing assumptions, complex LFP-guided fishing assumptions	Minor shift to less protected	Strong	95

To test the reasonableness of the informed non-fishing activity assumptions in scenarios A5-A8 and B5-B8, which treat unknown aquaculture/bottom exploitation/bottom extraction as 'prohibited' and boat/anchoring as 'allowed', the codings ('allowed' or 'prohibited') of each non-fishing activity for each individual area were compared to their respective codings in the Full RBCS. Over 90% of the informed non-fishing activity assumption codings for each activity matched their respective Full RBCS codings (Table 3), proving the assumptions appropriate for use.

Table 3. Informed non-fishing activity assumption coding match with Full RBCS coding.

<b>Activity</b>	<b>Match with Full RBCS (%)</b>
Aquaculture	92
Bottom exploitation	93
Bottom extraction	92
Boating / anchoring	100

In the scenarios of group A that used the informed non-fishing assumptions (A5-A8), the first two options tested for the unknown fishing gears were all 'allowed' (A5) or all 'prohibited' (A6). Strong matches were obtained for all categories in A5, with each protection level having 90% or higher correct classification compared to the Full RBCS - 99% and 100% of correct classifications were obtained for fully and highly protected areas, respectively, with very low percentages of false negatives (Table 2, Appendix Table 9). This means that, in California, commercial non-fishing activities (e.g., aquaculture/bottom exploitation/bottom extraction) which are mostly regulated by external regulations, are not commonly allowed within MPAs/MMAs, and this is adequate to assume them as 'prohibited', while recreational non-fishing activities (e.g., boating/anchoring) are generally allowed so it is adequate to assume that as well. Regarding fishing gears, this indicated that when not stated in direct regulations, fishing gears are typically allowed. Indeed, poor results were obtained when unknown fishing gears were considered 'prohibited' (A6), with moderately to unprotected areas from the Full RBCS being classified as more protected with high error rates (Table 2, Appendix Table 10).

For scenarios where assumptions were differentiated according to a previously calculated protection level (using LFP scores) (A3 and A4), good results were obtained when unknown activities were assumed 'prohibited' in areas consistent with fully and highly protected areas and 'allowed' in the others (A3; Table 2, Appendix Table 7). However, a slight increase in performance was obtained when considering unknown bottom extraction as 'prohibited' in areas consistent with moderately protected areas, boating/anchoring as 'allowed' in all areas, and unknown fishing gears as 'allowed' in areas consistent with moderately protected areas except for large-impacting fishing gears (i.e., bottom towed fishing gears) (A4; Table 2, Appendix Table 8). These two scenarios showed a high rate of correct classification for almost all protection levels, except for poorly protected areas, with fully, highly, and moderately protected areas showing 99, 96 or 97 and 100% correct classification, respectively. However, the overall

performance was lower than scenario A5, with these scenarios (A3 and A4) showing a substantially larger percentage of false negatives for moderately and highly protected areas (in A3 only). Most false negatives corresponded to downgrades (i.e., assumed less protected) compared to the Full RBCS classification.

When mixing the informed non-fishing activity assumptions and the simple LFP-guided assumptions for fishing gears (A7) or the more complex LFP-guided assumptions for fishing gears (A8), the overall performance was better than in previous scenarios, particularly for moderately and poorly protected areas (Table 2, Appendix Tables 11 and 12). This improvement seems related to the impacting non-fishing activities which, in the California region, are typically not allowed (according to these results). Hence, better performances are reached when these are considered 'prohibited' in all area types. However, mixed scenarios A7 and A8 resulted in very similar results, suggesting that the better performance in A4 compared to in A3 was likely related to fishing assumptions (prohibiting highly impacting fishing gears in the areas consistent with moderately protected areas in A4 but allowing them in those areas in A3).

When applying the same tests and scenarios of group A to group B, which have more unknowns due to fewer individual activity and gear categories in Navigator, similar poor (though poorer) results were obtained for the simple assumptions (B1 and B2; Table 4, Appendix Tables 12 and 13). Table 4 summarizes the assumptions and results for all scenarios in group B.



Table 4. RBCS classification results summary for all scenarios in group B.

Scenario Name & Description	Classification Shift	Match with Full RBCS	Correctly Classified (%)
<b>B1:</b> using Navigator data w/ simple assumptions	Shift to less protected	Weak	26
<b>B2:</b> using Navigator data w/ simple assumptions	Shift to more protected	Weak	44
<b>B3:</b> using Navigator data w/ simple LFP-guided assumptions	General shift to less protected	Strong for Fully and Highly Protected, Weak for Moderately, Poorly and Unprotected	62
<b>B4:</b> using Navigator data w/ complex LFP-guided assumptions	General shift to less protected	Strong for Fully and Highly Protected, Weak for Moderately, Poorly and Unprotected	65
<b>B5:</b> using Navigator data w/ informed non-fishing assumptions, simple fishing assumptions	Shift to less protected	Weak	26
<b>B6:</b> using Navigator data w/ informed non-fishing assumptions, simple fishing assumptions	Shift to more protected	Weak	44
<b>B7:</b> using Navigator data w/ informed non-fishing assumptions, simple LFP-guided fishing assumptions	General shift to less protected	Strong for Fully and Highly Protected, Weak for Moderately, Poorly and Unprotected	62
<b>B8:</b> using Navigator data w/ informed non-fishing assumptions, complex LFP-guided fishing assumptions	General shift to less protected	Strong for Fully and Highly Protected, Weak for Moderately, Poorly and Unprotected	65

When LFP scores were used to guide assumptions for both the unknown fishing gears and non-fishing activities (B3), a good classification was found for fully and highly protected areas with 92% and 94% of correct classification, respectively, and low percentages of false negatives, compared to the Full RBCS (Table 4, Appendix Table 15). Considering fully and highly protected areas together as a group, correct classification rose to 97%. The percentage of false negatives was high in moderately and poorly protected areas though. The slight improvement in the performance of the less protected levels with the complex LFP-guided assumptions (B4) was due to the fact that if an area is consistent with a moderately protected area and bottom extraction is considered 'allowed' (like in B3), that area would be classified as poorly protected; whereas in B4, since bottom extraction is considered 'prohibited' in areas consistent with moderately protected areas, that area might keep the same class. This means that bottom extraction is likely not allowed in areas consistent with moderately protected areas.

The scenario mixing the informed assumptions for the non-fishing activities and the simple LFP-guided assumptions for fishing gears (B7) performed the same as B3, indicating that LFP-guided assumptions for non-fishing activities ('allowed' in areas consistent with moderately, poorly, and unprotected areas) or considering all these activities as 'prohibited' (informed), resulted in the same performance and classification (Table 4, Appendix Table 19). The same occurred in scenario B8 (Table 4, Appendix Table 20). This suggests that the non-fishing activities do not significantly impact final protection levels when fishing is weakly regulated (i.e., less fishing gear information is available). However, the large number of unknowns, particularly in the less protected areas, preclude a correct classification. Fully and highly protected areas more often explicitly prohibit the most damaging activities in their direct regulations, and thus are much less subject to assumptions.

## Discussion

While it is known that protection levels, together with enforcement and other enabling conditions, matter for MPA effectiveness [10, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28], this study shows the impact that the general lack of key regulatory information available in direct regulations can have on protection level assessments. In many of the California MPAs/MMAs, direct regulations did not specify whether the complete set of fishing gears required by the RBCS were 'allowed' or 'prohibited', sometimes not even addressing the more destructive gears such as bottom trawling. Non-fishing activities, such as aquaculture, bottom exploitation, and bottom extraction were rarely addressed in direct regulations. Such results suggest that these areas were not planned to manage non-fishing commercial activities or to work as a tool for wider marine spatial planning [37, 38]. Further, besides the reduced quality of direct regulations, these results also expose the lack of external regulations, whether regional or state, about fishing gears with substantial impact in the seabed or in marine resources, such as trammel nets, gillnets, or dredges. According to these results, managers and users do not know if they can use these gears inside or in the region of particular MPAs/MMAs. This is occurring in a particularly well-regulated and managed region of the world that is committed to strong conservation efforts, including good examples of MPA implementation and management [31, 32, 33, 34, 35]. These findings highlight that direct regulations should be given further attention and importance while being planned and revised, to ensure that they mention all regulations that apply within the area, as good management plans are key for the success of MPAs [27].

By comparing scenario outcomes, guidance can be provided on how to classify MPAs according to their protection levels when complete information is not available in direct regulations. Since these are the mechanisms that should regulate MPAs and should contain the information about what can be done inside them [27], they represent the main and central resource evaluators have while assessing protection levels. Before this study, in the absence of sufficient direct regulations, each evaluator would either search for additional information, use local knowledge, use their expertise, or a combination of these when assessing whether fishing gears and non-fishing activities are 'prohibited' or 'allowed' in particular MPAs. However, at a global scale, such individual decisions could compromise comparisons between areas or countries. By testing assumptions and displaying their performance, guidance is offered for coherent and comparable assessments when direct information is incomplete and precludes correct classifications. According to the results of this study, simple and homogeneous assumptions were not representative of reality.

The best assumptions to follow when using direct regulations (group A scenarios) are those using informed assumptions for non-fishing activities (A5) or those with LFP-guided assumptions for both non-fishing activities and fishing gears (A4) or a mix of both informed (for non-fishing activities) and LFP guided assumptions (for fishing gears) (A7 and A8). All these assumptive methods returned high percentages of correct classification and low percentages of false positives and false negatives. The fact that the informed assumptions for non-fishing activities (i.e., assuming impactful activities as 'prohibited') resulted in a good performance compared to the Full RBCS protection levels (in scenarios A5, A7 and A8), is likely due to these

activities being mostly forbidden in the California MPAs/MMAs by external regulations. Since this might not be the case in numerous MPAs [39], the evaluator should select this option with caution and based on knowledge about the region being assessed. Even though these non-fishing activities are mostly prohibited, some cases existed where they were allowed in California MPAs/MMAs. Hence, the overall good performance following these informed assumptions also highlights the stronger role of fishing gears in the RBCS, compared with non-fishing activities. This suggests that fishing gears are very important to know for an accurate assessment and that is why the best assumptions have considered fishing gears carefully.

The best LFP-guided assumptions for fishing would be to assume that all the unknown fishing gears that are typically used in the assessed region are 'allowed' in areas consistent with poorly and unprotected protected areas, whereas unknown fishing gears that are low or medium impact (i.e., excluding bottom towed fishing gears) can also occur in areas consistent with moderately protected areas (such as in scenarios A4 and A8). Although this is not what is assumed when all unknown fishing gears are 'allowed', as in scenario A5 where the performance of assumptions was very good, it results in similar protection levels in the California MPAs/MMAs where areas consistent with fully and highly protected areas had clear direct fisheries regulations without unknowns and fishing gears were not considered 'allowed'. In conclusion, as general guidance, scenario A4 would be best suited for areas where no previous knowledge exists or where MPAs are known to have impacting activities occurring inside them. Scenario A8 would be best for areas where such activities are not typically occurring within MPAs. Both options have very good performance for fully and highly protected areas (both with 99% and 97% of correct assignment and 0% and 2% false negatives for fully and highly protected areas, respectively). Further, both options require a quick, previous assessment of general fishing restrictions to assess their levels of fishing protection (LFP) [12], to proceed with the respective guidance.

The best assumptions to follow when using the data already gathered by Navigator (group B scenarios) are also those from scenarios B4 and B8, performing the same. The main difference between these two options is in considering the unknown non-fishing activities as all 'prohibited' (as in B8) or only 'allowed' in areas consistent with less protected areas (as in B4). The fact that they performed the same suggests that when there are several unknown fishing gears, the impact of this on the final classification outweighs the impact of using informed assumptions for non-fishing activities. To demonstrate, areas that had differing Aquaculture or Bottom Exploitation Index scores (step 3 of the RBCS, detailed in [13]) between scenarios B4 and B8 were all consistent with moderately, poorly, and unprotected areas. As such, fishing gear counts (step 1 of the RBCS, detailed in [13]) in these areas ended up being high since all unknown fishing gears were assumed 'allowed', and areas with a fishing gear count of >10 are automatically classified by the RBCS as poorly protected or unprotected without considering the impact of non-fishing activities. Both scenarios B4 and B8 offer good classification performance for fully protected areas (92% of correct assignment and 0% of false negatives) and relatively good performance for highly protected areas (94% of correct assignment but 29% of false negatives), suggesting this approach works, at least, to distinguish these two protection levels from the others. While this result is weaker than the scenarios using full direct regulations

(group A), it shows that fully and highly protected areas could still be classified with a reasonably high level of accuracy using the existing data in Navigator.

Assessing existing ocean protection using standardized measures is critical given global goals to protect increasing percentages of ocean and increasing attention on the quality of operational implementations [40, 41, 42, 43, 44]. Studies show that fully and highly protected areas are more effective overall than moderately protected areas [4, 19, 45, 46], so being able to accurately classify fully and highly protected areas is of greatest importance, which scenarios A4, A8, B4, and B8 were found to accomplish. The ability to assign protection levels (following the RBCS or The MPA Guide in the near future) via existing MPA databases, allows for faster global assessments of protection. Using the Navigator database to assign RBCS protection levels is supported by this study if it can be done in tandem with data improvements by gathering further direct regulations.

This study provides validated guidance for decisions to make in the face of incomplete regulations. Due to the common lack of information on impacting activities, getting the best possible information for a given region and MPA is an important effort, but missing information should not preclude assigning protection levels to understand the potential quality of protection in place.

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## Appendix

Table 1. Summary of input information and assumptive methods for unknown fishing gears and non-fishing activities used in each scenario.

Scenario Group	Scenario Names	Assumptions for unknown non-fishing activities	Assumptions for unknown fishing gears
<b>Baseline</b> – Direct and external regulations <sup>1</sup>	<b>Full RBCS</b>	<b>None:</b> Full information	<b>Simple:</b> Assume Allowed for all (that are used in the region) <sup>2</sup>
<b>Group A</b> – Direct regulations only (e.g., management plans)	<b>A1, B1</b>	<b>Simple:</b> Assume Allowed for all	<b>Simple:</b> Assume Allowed for all
	<b>A2, B2</b>	<b>Simple:</b> Assume Prohibited for all	<b>Simple:</b> Assume Prohibited for all
<b>Group B</b> – Regulatory data in Navigator only <sup>5</sup>	<b>A3, B3</b>	<b>Simple LFP-Guided<sup>3</sup>:</b> If LFP consistent with Fully or Highly Protected: Assume Prohibited If LFP consistent with Moderately, Poorly, or Unprotected: Assume Allowed	<b>Simple LFP-Guided:</b> If LFP consistent with Fully or Highly Protected: Assume Prohibited If LFP consistent with Moderately, Poorly, or Unprotected: Assume Allowed
	<b>A4, B4</b>	<b>Complex LFP-Guided<sup>3</sup>:</b> <i>Bottom Extraction</i> If LFP consistent with Fully, Highly, or Moderately Protected: Assume Prohibited  If LFP consistent with Poorly or Unprotected: Assume Allowed  <i>Aquaculture, Bottom Exploitation</i> If LFP consistent with Fully or Highly Protected: Assume Prohibited  If LFP consistent with Moderately, Poorly, or Unprotected: Assume Allowed  <i>Anchoring, Boating</i> Assume Allowed for all	<b>Complex LFP-Guided:</b> If LFP consistent with Fully or Highly Protected, or LFP consistent with Moderately Protected for gears with high impact score <sup>4</sup> : Assume Prohibited  If LFP consistent with Poorly or Unprotected, or LFP consistent with Moderately Protected for gears with low to medium impact score <sup>4</sup> : Assume Allowed

<b>A5, B5</b>	<p><b>Informed<sup>4</sup>:</b>  <i>Aquaculture, Bottom Exploitation, Bottom Extraction</i>          Assume Prohibited for all</p> <p><i>Anchoring, Boating</i>          Assume Allowed for all</p>	<b>Simple:</b> Assume Allowed for all
<b>A6, B6</b>	<p><b>Informed:</b>  <i>Aquaculture, Bottom Exploitation, Bottom Extraction</i>          Assume Prohibited for all</p> <p><i>Anchoring, Boating</i>          Assume Allowed for all</p>	<b>Simple:</b> Assume Prohibited for all
<b>A7, B7</b>	<p><b>Informed:</b>  <i>Aquaculture, Bottom Exploitation, Bottom Extraction</i>          Assume Prohibited for all</p> <p><i>Anchoring, Boating</i>          Assume Allowed for all</p>	<p><b>Simple LFP-Guided:</b>          If LFP consistent with Fully or Highly Protected: Assume Prohibited</p> <p>If LFP consistent with Moderately, Poorly, or Unprotected: Assume Allowed</p>
<b>A8, B8</b>	<p><b>Informed:</b>  <i>Aquaculture, Bottom Exploitation, Bottom Extraction</i>          Assume Prohibited for all</p> <p><i>Anchoring, Boating</i>          Assume Allowed for all</p>	<p><b>Complex LFP-Guided:</b>          If LFP consistent with Fully or Highly Protected, or LFP consistent with Moderately Protected for gears with high impact score<sup>4</sup>: Assume Prohibited</p> <p>If LFP consistent with Poorly or Unprotected, or LFP consistent with Moderately Protected for gears with low to medium impact score<sup>4</sup>: Assume Allowed</p>

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## Footnotes

<sup>1</sup> See Appendix Table 3 for details on the unknowns for each activity and the external regulatory information that contributed to reducing the unknowns in the Full RBCS.

<sup>2</sup> Some unknown fishing gears were considered not allowed ('prohibited') for not being viable in particular areas (e.g., offshore areas do not have beach seines, as this fishing gear is not viable in the open ocean, so those areas do not regulate them). Hence, non-applicable fishing gears were not considered unknown.

<sup>3</sup> Using the LFP-guided assumptions means that first the heuristic decision tree of Navigator's LFP was followed to obtain the LFP scores (LFP1 to LFP5), since the unknowns preclude reaching a correct classification of the RBCS protection levels. The LFP scores were temporarily used to distinguish the different protection levels, and then the guided assumptions were applied, i.e., application of different assumptions according to the protection level (or in this case the LFP scores consistent with the RBCS protection levels). A significant statistical chi-test and correlation (see Methods and Figure 1) support this approach.

<sup>4</sup> Informed assumptions are based on the reasoning that most damaging activities (e.g., mining, aquaculture) are typically less allowed than non-fishing recreational activities (e.g., boating). In such scenarios, commercial non-fishing activities are considered 'prohibited' and recreational non-fishing activities are considered 'allowed'.

<sup>4</sup> Gears with a high impact score are bottom purse seines and bottom trawls. Low to medium impact gears include all others listed in the fishing gear impact table in [13].

<sup>5</sup> For the scenarios in group B, RBCS input fields with corresponding Navigator fields - marked (m = match) in Table 4, representing 10 of the 26 total RBCS inputs - were used with the remaining considered unknown.

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Table 2. List of California areas with their classification results (Full RBCS).

Area Name	Area (km <sup>2</sup> )	Number of fishing gears	Highest fishing gear score	Aquaculture or Bottom Exploitation Index	Recreational Access Index	MPA Index	RBCS Protection Level
Pacific Grove Marine Gardens Fish Refuge	3.98	4	5	0	2	4	2
James V Fitzgerald Marine Reserve	1.85	2	5	0	2	4	2
Blue Cavern Offshore State Marine Conservation Area	19.93	3	5	0	2	4	2
Point Conception to Gaviota Trawl Closure	86.40	19	9	0	2	7	5
San Francisco Bay Sturgeon Management Area	162.96	21	9	0	2	8	5
Special North Coast District Sturgeon Closure	1783.44	21	9	1	2	8	5
Pillar Point Motorized Personal Watercraft Zone	2.30	19	9	0	2	7	5
Santa Cruz Motorized Personal Watercraft Zone	16.78	19	9	0	2	7	5
Moss Landing Motorized Personal Watercraft Zone	21.01	19	9	0	2	7	5
Salmon Closure - Smith River Mouth	62.73	21	9	0	2	8	5
Monterey Motorized Personal Watercraft Zone	16.64	19	9	0	2	7	5
Pillar Point High Surf Warning Motorized Personal Watercraft Zone	0.72	19	9	0	2	7	5
Los Angeles County White Croaker Closure	129.75	21	9	0	2	8	5
Central California Gillnet Fishery Closure	8852.08	21	9	2	2	8	5
South Caspar Point Sea Urchin closure	3.06	21	9	0	2	8	5
Newport Bay Harbor entrance lobster trap closure	0.28	21	9	0	2	8	5
Dana Point Harbor entrance lobster trap closure	0.56	21	9	0	2	8	5
Oceanside Harbor entrance lobster trap closure	0.47	21	9	0	2	8	5
Point Arguello Halibut Trawl Closure	37.98	19	9	0	2	7	5
Point Conception Halibut Trawl Closure	32.65	19	9	0	2	7	5
California State Waters	14855.32	20	9	2	2	7	5
Salmon Closure - Klamath River Mouth	56.90	21	9	0	2	8	5
Hueneme Canyon Halibut Trawl Closure	8.40	19	9	0	2	7	5
Mugu Canyon Halibut Trawl Closure	18.21	19	9	0	2	7	5
Point Conception to Gaviota Halibut Trawl Closure	86.40	19	9	0	2	7	5
Santa Barbara to Pitas Point Halibut Trawl Closure	61.94	19	9	1	2	7	5
Point Arguello to Point Conception and Hueneme Canyon to Point Mugu Halibut Trawl Closure	106.40	19	9	0	2	7	5
Monterey Bay Halibut Trawl Closure	79.37	19	9	0	2	7	5
Port San Luis Halibut Trawl Closure	163.19	19	9	0	2	7	5
Commercial Rock Crab Closure	1630.27	21	9	0	2	8	5
Crescent City Harbor	80.17	21	9	0	2	8	5
San Francisco Bay	894.45	21	9	0	2	8	5
Salmon Closure - Eel River Mouth	26.06	21	9	0	2	8	5

Tomales Bay	24.17	21	9	1	2	8	5
Humboldt Bay	62.47	21	9	1	2	8	5
Belvedere Cove Netting Closure	0.65	21	9	0	2	8	5
San Francisco Bay Seasonal Gill Net Closure	20.10	21	9	0	2	8	5
Deep-sea Ecosystem Conservation Area	319187.65	11	8	0	2	6	4
Brush Patch Essential Fish Habitat Conservation Area	78.78	10	8	0	2	5	3
Trinidad Canyon Essential Fish Habitat Conservation Area	227.62	10	8	0	2	5	3
Mad River Rough Patch Essential Fish Habitat Conservation Area	13.18	10	8	0	2	5	3
Samoa Deepwater Essential Fish Habitat Conservation Area	49.26	10	8	0	2	5	3
Navarro Canyon Essential Fish Habitat Conservation Area	47.51	10	8	0	2	5	3
The Football Essential Fish Habitat Conservation Area	31.47	10	8	0	2	5	3
Gobbler's Knob Essential Fish Habitat Conservation Area	29.97	10	8	0	2	5	3
Point Reyes Reef Essential Fish Habitat Conservation Area	19.64	10	8	0	2	5	3
Rittenburg Bank Essential Fish Habitat Conservation Area	33.01	10	8	0	2	5	3
Farallon Escarpment Essential Fish Habitat Conservation Area	327.15	10	8	0	2	5	3
Pescadero Reef Essential Fish Habitat Conservation Area	7.99	10	8	0	2	5	3
Pigeon Point Reef Essential Fish Habitat Conservation Area	25.25	10	8	0	2	5	3
Ascension Canyonhead Essential Fish Habitat Conservation Area	15.71	10	8	0	2	5	3
South of Davenport Essential Fish Habitat Conservation Area	16.20	10	8	0	2	5	3
West of Sobranes Point Essential Fish Habitat Conservation Area	62.84	10	8	0	2	5	3
La Cruz Canyon Essential Fish Habitat Conservation Area	23.04	10	8	0	2	5	3
West of Piedras Blancas State Marine Conservation Area Essential Fish Habitat Conservation Area	7.02	10	8	0	2	5	3
Southern California Bight Essential Fish Habitat Conservation Area	44962.28	10	8	2	2	6	4
Western Cowcod Conservation Area (CCA)	13279.54	21	9	0	2	8	5
Eastern Cowcod Conservation Area (CCA)	382.49	21	9	0	2	8	5
Cordell Banks Closed Area	164.66	21	9	0	2	8	5
Coastal Pelagic Species (CPS) - CPS Limited Entry Zone	430588.30	21	9	2	2	8	5
Coastal Pelagic Species (CPS) - Subarea A	364079.50	21	9	0	2	8	5
Coastal Pelagic Species (CPS) - Farallon Islands Closure	3359.72	21	9	0	2	8	5
Coastal Pelagic Species (CPS) - Subarea B	430588.30	21	9	2	2	8	5
Coastal Pelagic Species (CPS) - Oxnard Closure	64.10	21	9	1	2	8	5
Coastal Pelagic Species (CPS) - Santa Monica Bay Closure	321.49	21	9	1	2	8	5
Coastal Pelagic Species (CPS) - Los Angeles Harbor Closure	310.79	21	9	2	2	8	5

Coastal Pelagic Species (CPS) - Oceanside to San Diego Closure	860.94	21	9	1	2	8	5
Farallon Islands Closed Areas	1.81	21	9	0	2	8	5
Pacific Leatherback Conservation Area	451996.39	20	9	1	2	7	5
Santa Rosa Island Closure	2314.14	20	9	2	2	7	5
San Nicolas Island Closure	1019.71	20	9	0	2	7	5
San Clemente Island Closure	659.56	20	9	0	2	7	5
Pacific Loggerhead Conservation Area	65795.14	21	9	2	2	8	5
Highly Migratory Species Protection Area - Driftnet Closure 2	197931.91	20	9	2	2	7	5
Highly Migratory Species Protection Area - Driftnet Closure 3	67569.00	20	9	2	2	7	5
Highly Migratory Species Protection Area - Driftnet Closure 4	2909.80	20	9	1	2	7	5
Highly Migratory Species Protection Area - Driftnet Closure 5	24239.28	20	9	2	2	7	5
San Miguel Island Closures	20299.66	20	9	2	2	7	5
Recreational Rockfish Conservation Areas (RCA) - Northern Management Area	77263.19	21	9	0	2	8	5
Groundfish Conservation Areas (GCA) - Northern Management Area	79138.99	21	9	1	2	8	5
Recreational Rockfish Conservation Areas (RCA) - Mendocino Management Area	54763.39	21	9	0	2	8	5
Groundfish Conservation Areas (GCA) - Mendocino Management Area	55062.39	21	9	0	2	8	5
Recreational Rockfish Conservation Areas (RCA) - San Francisco Management Area	81908.78	21	9	0	2	8	5
Groundfish Conservation Areas (GCA) - San Francisco Management Area	86114.49	21	9	0	2	8	5
Recreational Rockfish Conservation Areas (RCA) - Central Management Area	134990.26	21	9	2	2	8	5
Groundfish Conservation Areas (GCA) - Central Management Area	138248.03	21	9	2	2	8	5
Recreational Rockfish Conservation Areas (RCA) - Southern Management Area	208673.41	21	9	2	2	8	5
Groundfish Conservation Areas (GCA) - Southern Management Area	215979.89	21	9	2	2	8	5
Point St. George Yelloweye Rockfish Conservation Area	23.07	21	9	0	2	8	5
South Reef Yelloweye Rockfish Conservation Area	9.61	21	9	0	2	8	5
Reading Rock Yelloweye Rockfish Conservation Area	7.75	21	9	0	2	8	5
Northern Point Delgada Yelloweye Rockfish Conservation Area	10.54	21	9	0	2	8	5



Southern Point Delgada Yelloweye Rockfish Conservation Area	23.73	21	9	0	2	8	5
Seal Rock Marine Mammal Reserve	<0.01	21	9	0	2	8	5
Año Nuevo Island Reserve	0.05	21	9	0	2	8	5
Bodega Marine Reserve	<0.01	21	9	0	2	8	5
Carpinteria Salt Marsh Reserve	<0.01	21	9	0	2	8	5
Coal Oil Point Natural Reserve	0.02	21	9	0	2	8	5
Kendall-Frost Mission Bay Marsh Reserve	0.07	21	9	0	2	8	5
Landels-Hill Big Creek Reserve	<0.01	21	9	0	2	8	5
Kenneth S. Norris Rancho Marino Reserve	<0.01	21	9	0	2	8	5
Santa Cruz Island Reserve	0.20	21	9	0	2	8	5
200 NM US EEZ Boundary (CA)	568694.41	21	9	2	2	8	5
Non-Trawl Rockfish Conservation Area - 40°10'-34°27'	8479.66	3	9	2	2	6	4
Non-Trawl Rockfish Conservation Area - South of 34°27'	1479.68	3	9	2	2	6	4
Pacific Essential Fish Habitats	495062.42	19	9	2	2	7	5
Santa Barbara Vessel Speed Reduction	1004.40	21	9	0	2	8	5
San Francisco Vessel Speed Reduction	481.09	21	9	0	2	8	5
Limited Entry Trawl Rockfish Conservation Area - 45°46'-40°10'	3872.33	21	9	0	2	8	5
Non-Trawl Rockfish Conservation Area - 42°0'-40°10'	2596.61	3	9	0	2	6	4
Santa Barbara Channel Ecological Preserve & Buffer	223.28	21	9	0	2	8	5
Redwoods National Park ASBS State Water Quality Protection Area	252.13	21	9	0	2	8	5
Point Reyes Headlands ASBS State Water Quality Protection Area	3.85	21	9	0	2	8	5
Double Point ASBS State Water Quality Protection Area	0.35	21	9	0	2	8	5
Scripps Coastal Reserve	0.32	1	5	0	2	4	2
Duxbury Reef ASBS State Water Quality Protection Area	3.42	21	9	0	2	8	5
Farallon Islands ASBS State Water Quality Protection Area	45.88	21	9	0	2	8	5
Richardson Rock State Marine Reserve	105.54	0	0	0	2	3	1
Judith Rock State Marine Reserve	11.61	0	0	0	2	3	1
Harris Point State Marine Reserve	64.74	0	0	0	2	3	1
Harris Point State Marine Reserve Exemption Area	1.64	21	9	0	2	8	5
Skunk Point State Marine Reserve	3.75	0	0	0	2	3	1
James V. Fitzgerald ASBS State Water Quality Protection Area	1.90	21	9	0	2	8	5
Carrington Point State Marine Reserve	32.33	0	0	0	2	3	1
South Point State Marine Reserve	33.45	0	0	0	2	3	1
Gull Island State Marine Reserve	51.24	0	0	0	2	3	1
Scorpion State Marine Reserve	24.57	0	0	0	2	3	1
Santa Barbara Island State Marine Reserve	32.95	0	0	0	2	3	1

Anacapa Island State Marine Reserve	29.59	0	0	0	2	3	1
Anacapa Island State Marine Conservation Area	18.75	6	5	0	2	5	3
Painted Cave State Marine Conservation Area	4.29	4	5	0	2	4	2
Año Nuevo ASBS State Water Quality Protection Area	54.59	21	9	0	2	8	5
San Miguel Island Special Closure	1.48	0	0	0	2	3	1
Anacapa Island Special Closure (B)	0.40	0	0	0	0	1	1
Pacific Grove ASBS State Water Quality Protection Area	1.77	21	9	0	2	8	5
Carmel Bay ASBS State Water Quality Protection Area	5.96	21	9	0	2	8	5
Point Lobos ASBS State Water Quality Protection Area	2.33	21	9	0	2	8	5
Julia Pfeiffer Burns ASBS State Water Quality Protection Area	6.59	21	9	0	2	8	5
Trinidad Head ASBS State Water Quality Protection Area	1.15	21	9	0	2	8	5
Salmon Creek Coast ASBS State Water Quality Protection Area	5.56	21	9	0	2	8	5
Año Nuevo State Marine Reserve	28.14	0	0	0	2	3	1
Greyhound Rock State Marine Conservation Area	30.77	6	6	0	2	5	3
Natural Bridges State Marine Reserve	0.16	0	0	0	2	3	1
Elkhorn Slough State Marine Reserve	1.47	0	0	0	2	3	1
Elkhorn Slough State Marine Conservation Area	0.20	4	5	0	2	4	2
Moro Cojo Slough State Marine Reserve	N/A	0	0	0	2	3	1
Soquel Canyon State Marine Conservation Area	59.48	17	9	0	2	7	5
Portuguese Ledge State Marine Conservation Area	27.55	17	9	0	2	7	5
Edward F. Ricketts State Marine Conservation Area	0.58	2	5	0	2	4	2
San Miguel, Santa Rosa, and Santa Cruz Islands ASBS State Water Quality Protection Area	1099.42	21	9	0	2	8	5
Lovers Point-Julia Platt State Marine Reserve	0.68	0	0	0	2	3	1
Pacific Grove Marine Gardens State Marine Conservation Area	2.44	5	6	0	2	5	3
Asilomar State Marine Reserve	3.86	0	0	0	2	3	1
Carmel Pinnacles State Marine Reserve	1.37	0	0	0	2	3	1
Carmel Bay State Marine Conservation Area	5.16	5	6	0	2	5	3
Point Lobos State Marine Reserve	12.95	0	0	0	2	3	1
Point Lobos State Marine Conservation Area	21.93	6	5	0	2	5	3
Point Sur State Marine Reserve	24.68	0	0	0	2	3	1
Point Sur State Marine Conservation Area	27.49	5	5	0	2	4	2
Big Creek State Marine Reserve	36.72	0	0	0	2	3	1
Santa Barbara and Anacapa Islands ASBS State Water Quality Protection Area	139.23	21	9	0	2	8	5
Big Creek State Marine Conservation Area	20.33	6	5	0	2	5	3
Piedras Blancas State Marine Reserve	26.27	0	0	0	2	3	1
Piedras Blancas State Marine Conservation Area	22.88	5	5	0	2	4	2

Cambria State Marine Conservation Area	15.76	10	8	0	2	5	3
White Rock State Marine Conservation Area	7.20	1	4	0	2	4	2
Morro Bay State Marine Recreational Management Area	7.27	10	6	1	2	5	3
Morro Bay State Marine Reserve	0.85	0	0	0	2	3	1
Point Buchon State Marine Reserve	16.75	0	0	0	2	3	1
Point Buchon State Marine Conservation Area	31.56	5	5	0	2	4	2
Vandenberg State Marine Reserve	83.69	0	0	1	2	4	2
San Nicolas Island and Begg Rock ASBS State Water Quality Protection Area	256.43	21	9	0	2	8	5
Anacapa Island Special Closure (A)	1.26	21	9	0	2	8	5
Footprint State Marine Reserve	18.27	0	0	0	2	3	1
Point Arena State Marine Reserve	11.10	0	0	0	2	3	1
Point Arena State Marine Conservation Area	17.45	1	5	0	2	4	2
Sea Lion Cove State Marine Conservation Area	0.45	15	9	0	2	6	4
Saunders Reef State Marine Conservation Area	23.79	1	5	0	2	4	2
Del Mar Landing State Marine Reserve	0.47	0	0	0	2	3	1
Stewarts Point State Marine Reserve	61.59	0	0	0	2	3	1
Salt Point State Marine Conservation Area	4.14	6	6	0	2	5	3
Laguna Point to Latigo Point ASBS State Water Quality Protection Area	47.16	21	9	0	2	8	5
Gerstle Cove State Marine Reserve	N/A	0	0	0	2	3	1
Russian River State Marine Recreational Management Area	0.68	0	0	0	2	3	1
Russian River State Marine Conservation Area	2.07	3	4	0	2	4	2
Bodega Head State Marine Reserve	23.72	0	0	0	2	3	1
Bodega Head State Marine Conservation Area	31.82	4	5	0	2	4	2
Estero Americano State Marine Recreational Management Area	0.25	0	0	0	2	3	1
Estero de San Antonio State Marine Recreational Management Area	N/A	0	0	0	2	3	1
Drakes Estero State Marine Conservation Area	5.07	3	5	0	2	4	2
Estero de Limantour State Marine Reserve	2.78	0	0	0	2	3	1
Point Reyes State Marine Reserve	24.00	0	0	0	2	3	1
Northwest Santa Catalina Island ASBS State Water Quality Protection Area	52.53	21	9	0	2	8	5
Point Reyes State Marine Conservation Area	31.77	1	4	0	2	4	2
Duxbury Reef State Marine Conservation Area	1.58	2	5	0	2	4	2
Southeast Farallon Island State Marine Reserve	13.60	0	0	0	2	3	1
Southeast Farallon Island State Marine Conservation Area	33.54	1	5	0	2	4	2
Montara State Marine Reserve	30.37	0	0	0	2	3	1
Pillar Point State Marine Conservation Area	17.33	4	5	0	2	4	2
Point Reyes Headlands Special Closure	1.28	0	0	0	0	1	1

Point Resistance Rock Special Closure	0.03	0	0	0	0	1	1
Double Point/Stormy Stack Rock Special Closure	0.06	0	0	0	0	1	1
Egg (Devil's Slide) Rock to Devil's Slide Special Closure	0.10	0	0	0	0	1	1
Western Santa Catalina Island ASBS State Water Quality Protection Area	8.83	21	9	0	2	8	5
North Farallon Islands Special Closure	0.55	11	8	0	0	6	4
Southeast Farallon Special Closure A	0.20	1	5	0	2	4	2
North Farallon Islands State Marine Reserve	46.81	0	0	0	2	3	1
Southeast Farallon Special Closure B	0.07	0	0	0	0	1	1
Stewarts Point State Marine Conservation Area	2.13	6	8	0	2	5	3
Point Conception State Marine Reserve	57.97	0	0	0	2	3	1
Kashtayit State Marine Conservation Area	5.17	8	8	0	2	5	3
Naples State Marine Conservation Area	6.64	2	4	0	2	4	2
Campus Point State Marine Conservation Area	27.23	0	0	0	2	3	1
Goleta Slough State Marine Conservation Area	0.01	0	0	0	2	3	1
Farnsworth Bank ASBS State Water Quality Protection Area	0.15	21	9	0	2	8	5
Begg Rock State Marine Reserve	98.32	0	0	0	2	3	1
Point Dume State Marine Conservation Area	40.89	2	5	0	2	4	2
Point Dume State Marine Reserve	19.34	0	0	0	2	3	1
Point Vicente State Marine Conservation Area	38.75	0	0	0	2	3	1
Abalone Cove State Marine Conservation Area	12.19	3	5	0	2	4	2
Bolsa Bay State Marine Conservation Area	0.12	1	5	0	2	4	2
Bolsa Chica Basin State Marine Conservation Area	0.56	0	0	0	2	3	1
Arrow Point to Lion Head Point State Marine Conservation Area	1.47	11	8	0	2	6	4
Blue Cavern Onshore State Marine Conservation Area	6.57	0	0	0	2	3	1
Blue Cavern Onshore State Marine Conservation Area - Catalina Marine Science Center Marine Life Refuge	0.11	0	0	0	2	3	1
Southeast Santa Catalina Island ASBS State Water Quality Protection Area	11.00	21	9	0	2	8	5
Long Point State Marine Reserve	4.16	0	0	0	2	3	1
Casino Point State Marine Conservation Area	0.02	0	0	0	2	3	1
Lover's Cove State Marine Conservation Area	0.15	1	5	0	2	4	2
Farnsworth Onshore State Marine Conservation Area	6.42	3	5	0	2	4	2
Farnsworth Offshore State Marine Conservation Area	17.28	4	5	0	2	4	2
Cat Harbor State Marine Conservation Area	0.58	4	5	0	2	4	2
Upper Newport Bay State Marine Conservation Area	1.29	1	5	0	2	4	2
Crystal Cove State Marine Conservation Area	8.59	6	5	0	2	5	3
Laguna Beach State Marine Reserve	17.08	0	0	0	2	3	1
Laguna Beach State Marine Conservation Area	7.92	0	0	0	2	3	1

San Clemente Island ASBS State Water Quality Protection Area	195.12	21	9	0	2	8	5
Dana Point State Marine Conservation Area	8.76	6	5	0	2	5	3
Batiquitos Lagoon State Marine Conservation Area	0.76	0	0	0	2	3	1
Swami's State Marine Conservation Area	32.75	3	5	0	2	4	2
San Elijo Lagoon State Marine Conservation Area	N/A	0	0	0	2	3	1
San Diego-Scripps Coastal State Marine Conservation Area	3.72	1	5	0	2	4	2
Matlahuayl State Marine Reserve	2.61	0	0	0	2	3	1
South La Jolla State Marine Reserve	12.85	0	0	0	2	3	1
South La Jolla State Marine Conservation Area	6.37	1	5	0	2	4	2
Famosa Slough State Marine Conservation Area	<0.01	0	0	0	2	3	1
Cabrillo State Marine Reserve	0.97	0	0	0	2	3	1
King Range ASBS State Water Quality Protection Area	100.62	21	9	0	2	8	5
Robert E. Badham ASBS State Water Quality Protection Area	0.80	21	9	0	2	8	5
Tijuana River Mouth State Marine Conservation Area	7.39	2	5	0	2	4	2
San Dieguito Lagoon State Marine Conservation Area	N/A	1	5	0	2	4	2
Pyramid Point State Marine Conservation Area	36.19	2	4	0	2	4	2
Point St. George Reef Offshore State Marine Conservation Area	24.67	2	5	0	2	4	2
Southwest Seal Rock Special Closure	0.06	0	0	0	0	1	1
Castle Rock Special Closure	0.09	0	0	0	0	1	1
False Klamath Rock Special Closure	0.07	0	0	0	0	1	1
Reading Rock State Marine Conservation Area	30.88	4	5	0	2	4	2
Reading Rock State Marine Reserve	24.87	0	0	0	2	3	1
Samoa State Marine Conservation Area	33.81	4	5	0	2	4	2
Irvine Coast ASBS State Water Quality Protection Area	3.56	21	9	0	2	8	5
South Humboldt Bay State Marine Recreational Management Area	1.95	0	0	0	2	3	1
Sugarloaf Island Special Closure	0.06	0	0	0	0	1	1
South Cape Mendocino State Marine Reserve	23.43	0	0	0	2	3	1
Steamboat Rock Special Closure	0.05	0	0	0	0	1	1
Mattole Canyon State Marine Reserve	25.37	0	0	0	2	3	1
Sea Lion Gulch State Marine Reserve	26.81	0	0	0	2	3	1
Big Flat State Marine Conservation Area	29.79	3	5	0	2	4	2
Double Cone Rock State Marine Conservation Area	47.55	3	4	0	2	4	2
Vizcaino Rock Special Closure	0.04	0	0	0	0	1	1
Heisler Park ASBS State Water Quality Protection Area	0.13	21	9	0	2	8	5
Ten Mile State Marine Reserve	30.61	0	0	0	2	3	1
Ten Mile Beach State Marine Conservation Area	9.16	2	4	0	2	4	2
Ten Mile Estuary State Marine Conservation Area	0.06	0	0	0	2	3	1

MacKerricher State Marine Conservation Area	6.28	21	9	0	2	8	5
Point Cabrillo State Marine Reserve	1.08	0	0	0	2	3	1
Russian Gulch State Marine Conservation Area	0.47	21	9	0	2	8	5
Big River Estuary State Marine Conservation Area (SMCA)	0.10	2	5	0	2	4	2
Van Damme State Marine Conservation Area	0.11	21	9	0	2	8	5
Navarro River Estuary State Marine Conservation Area (SMCA)	0.01	1	5	0	2	4	2
San Diego-Scripps ASBS State Water Quality Protection Area	0.32	21	9	0	2	8	5
Hopkins Marine Life Refuge	0.30	0	0	0	2	3	1
San Diego Marine Life Refuge	0.32	21	9	0	2	8	5
La Jolla ASBS State Water Quality Protection Area	1.79	21	9	0	2	8	5
Bodega Marine Life Refuge	0.46	0	0	0	0	1	1
Doheny Beach Marine Life Refuge	0.32	13	8	0	2	6	4
South Laguna Beach Marine Life Refuge	0.16	13	8	0	2	6	4
Niguel Marine Life Refuge	1.21	13	8	0	2	6	4
Dana Point Marine Life Refuge	0.50	13	8	0	2	6	4
Laguna Beach Marine Life Refuge	0.45	13	8	0	2	6	4
Irvine Coast Marine Life Refuge	0.71	13	8	0	2	6	4
Newport Beach Marine Life Refuge	0.01	13	8	0	2	6	4
Point Fermin Marine Life Refuge	0.15	13	8	0	2	6	4
City of Encinitas Marine Life Refuge	0.28	19	9	0	2	7	5
Albany Mudflats State Marine Park	0.65	1	5	0	2	4	2
Jughandle Cove ASBS State Water Quality Protection Area	0.79	21	9	0	2	8	5
Bair Island State Marine Park	0.28	1	5	0	0	4	2
Corte Madera Marsh State Marine Park	1.45	1	5	0	0	4	2
Fagan Marsh State Marine Park	N/A	1	5	0	2	4	2
Saunders Reef ASBS State Water Quality Protection Area	2.83	21	9	0	2	8	5
Marin Islands State Marine Park	1.42	1	5	0	2	4	2
Peytonia Slough State Marine Park	0.01	1	5	0	2	4	2
Redwood Shores State Marine Park	0.02	1	5	0	0	4	2
Del Mar Landing ASBS State Water Quality Protection Area	0.14	21	9	0	2	8	5
Gerstle Cove ASBS State Water Quality Protection Area	<0.01	21	9	0	2	8	5
Bodega ASBS State Water Quality Protection Area	0.36	21	9	0	2	8	5
Bird Rock ASBS State Water Quality Protection Area	0.40	21	9	0	2	8	5
Robert W. Crown State Marine Conservation Area	0.02	19	9	0	2	7	5
Cabrillo National Monument	0.02	1	5	0	2	4	2
California Coastal National Monument - Point Arena-Stornetta Unit	0.05	21	9	0	2	8	5
Tijuana River National Estuarine Research Reserve	<0.01	2	8	0	2	5	3
San Francisco Bay National Estuarine Research Reserve	0.67	14	9	0	2	6	4

Elkhorn Slough National Estuarine Research Reserve	0.05	5	7	0	2	5	3
Klamath River Salmon Conservation Zone	393.68	21	9	0	2	8	5
Big Sur/Port San Luis Main Essential Fish Habitat Conservation Area	11720.58	10	8	0	2	5	3
Big Sur/Port San Luis North Essential Fish Habitat Conservation Area	27.68	10	8	0	2	5	3
Big Sur/Port San Luis Northeast Essential Fish Habitat Conservation Area	122.11	10	8	0	2	5	3
Blunts Reef North Essential Fish Habitat Conservation Area	64.24	10	8	0	2	5	3
Blunts Reef South Essential Fish Habitat Conservation Area	17.37	10	8	0	2	5	3
Catalina Island Essential Fish Habitat Conservation Area	1185.61	17	8	0	2	7	5
Cherry Bank Essential Fish Habitat Conservation Area	562.18	17	8	0	2	7	5
Cordell Bank/Biogenic Area Essential Fish Habitat Conservation Area	422.97	17	8	0	2	7	5
Cowcod Conservation Area East Essential Fish Habitat Conservation Area	382.49	17	8	0	2	7	5
Delgada Canyon Essential Fish Habitat Conservation Area	19.97	17	8	0	2	7	5
East San Lucia Bank Essential Fish Habitat Conservation Area	272.57	17	8	0	2	7	5
Eel River Canyon Essential Fish Habitat Conservation Area	889.45	17	8	0	2	7	5
Farallon Islands/Fanny Shoal Essential Fish Habitat Conservation Area	158.51	17	8	0	2	7	5
Half Moon Bay Essential Fish Habitat Conservation Area	128.38	17	8	0	2	7	5
Hidden Reef/Kidney Bank Essential Fish Habitat Conservation Area	771.45	17	8	0	2	7	5
Mendocino Ridge North Essential Fish Habitat Conservation Area	1884.55	10	8	0	2	5	3
Mendocino Ridge South Essential Fish Habitat Conservation Area	24.82	10	8	0	2	5	3
Monterey Bay/Canyon Essential Fish Habitat Conservation Area	2161.80	17	8	0	2	7	5
Point Arena North Essential Fish Habitat Conservation Area	88.08	17	8	0	2	7	5
Point Arena South Biogenic Area Essential Fish Habitat Conservation Area	93.51	17	8	0	2	7	5
Point Conception Essential Fish Habitat Conservation Area	3280.90	17	8	2	2	7	5
Point Sur Deep Essential Fish Habitat Conservation Area	154.74	17	8	0	2	7	5
Potato Bank Essential Fish Habitat Conservation Area	287.04	17	8	0	2	7	5
Tolo Bank Essential Fish Habitat Conservation Area	55.27	17	8	0	2	7	5
Anacapa Island Essential Fish Habitat Conservation Area	64.23	12	8	0	2	6	4
Carrington Point Essential Fish Habitat Conservation Area	32.32	12	8	0	2	6	4
Cordell Bank (50 fm (91m) isobath) Essential Fish Habitat Conservation Area	68.32	12	8	0	2	6	4

Davidson Seamount Essential Fish Habitat Conservation Area	2008.34	12	8	0	2	6	4
Footprint Essential Fish Habitat Conservation Area	69.65	12	8	0	2	6	4
Gull Island Essential Fish Habitat Conservation Area	90.23	12	8	0	2	6	4
Harris Point Essential Fish Habitat Conservation Area	128.87	12	8	0	2	6	4
Judith Rock Essential Fish Habitat Conservation Area	11.69	12	8	0	2	6	4
Painted Cave Essential Fish Habitat Conservation Area	4.29	12	8	0	2	6	4
Richardson Rock Essential Fish Habitat Conservation Area	188.39	12	8	0	2	6	4
Santa Barbara Island Essential Fish Habitat Conservation Area	146.85	12	8	0	2	6	4
Scorpion Essential Fish Habitat Conservation Area	47.97	12	8	0	2	6	4
Skunk Point Essential Fish Habitat Conservation Area	3.54	12	8	0	2	6	4
South Point Essential Fish Habitat Conservation Area	38.32	12	8	0	2	6	4
Seaward of the 700-fm (1280-m) contour Essential Fish Habitat Conservation Area	337512.95	17	9	0	2	7	5
Anacapa Island Federal Marine Conservation Area	6.09	5	5	0	2	4	2
Richardson Rock (San Miguel Island) Federal Marine Reserve	82.79	0	0	0	2	3	1
Harris Point (San Miguel Island) Federal Marine Reserve	61.17	0	0	0	2	3	1
South Point (Santa Rosa Island) Federal Marine Reserve	4.88	0	0	0	2	3	1
Gull Island (Santa Cruz Island) Federal Marine Reserve	37.55	0	0	0	2	3	1
Scorpion (Santa Cruz Island) Federal Marine Reserve	22.79	0	0	0	2	3	1
Santa Barbara Island Federal Marine Reserve	113.90	0	0	0	2	3	1
Anacapa Island Federal Marine Reserve	9.80	0	0	0	2	3	1
Footprint (Anacapa Channel) Federal Marine Reserve	55.28	0	0	0	2	3	1
Channel Islands National Marine Sanctuary	3789.29	21	9	0	2	8	5
Monterey Bay National Marine Sanctuary	15773.34	19	9	0	2	7	5
Cordell Bank National Marine Sanctuary	3331.19	21	9	0	2	8	5
Greater Farallones National Marine Sanctuary	8569.49	20	9	1	2	7	5
Greater Farallones National Marine Sanctuary - Boating Restricted Areas	3379.38	20	9	1	2	7	5
Channel Islands National Park	474.09	21	9	0	2	8	5
Golden Gate National Recreation Area	38.69	20	9	1	2	7	5
Point Reyes National Seashore	49.70	21	9	0	2	8	5
Point Reyes National Seashore - Boating Closure	0.34	12	8	0	2	6	4
Redwood National Park	24.01	12	8	0	2	6	4
San Pablo Bay National Wildlife Refuge	32.43	1	5	0	2	4	2
Seal Beach National Wildlife Refuge	0.38	0	0	0	2	3	1
Tijuana Slough National Wildlife Refuge	0.01	0	0	0	2	3	1
Farallon National Wildlife Refuge	0.10	0	0	0	2	3	1
Marin Islands National Wildlife Refuge	1.90	0	0	0	0	1	1



San Diego Bay National Wildlife Refuge	12.54	1	5	0	2	4	2
Castle Rock National Wildlife Refuge	<0.01	0	0	0	0	1	1
Humboldt Bay National Wildlife Refuge	4.36	3	5	1	2	4	2
Salinas River National Wildlife Refuge	0.53	0	0	0	2	3	1
Don Edwards San Francisco Bay National Wildlife Refuge	2.85	3	5	0	2	4	2

Table 3. Percentage of areas with unknown information in Full RBCS vs. other scenarios, by activity (n = 381).

\*coded 'prohibited' if area not coastal

	Full RBCS (% unknown)	All other scenarios (% unknown)	Extra information from external regulations that reduced unknowns in Full RBCS
<b>Fishing Gears</b>			
Beach seines*	26	26	
Cast nets*	28	28	
Dredges (bivalves)	29	29	
Drift nets	0	42	Allowed in both state and federal waters
Fish traps	0	37	Allowed in both state and federal waters
Fixed fish traps (madrague)	0	38	Allowed in both state and federal waters
Gillnets	23	43	Prohibited in state waters
Hand dredges (bivalves)*	22	22	
Intertidal hand captures*	27	27	
Lines (jigs/hook and line/rod/troll)	0	33	Allowed in both state and federal waters
Longlines (bottom)	0	34	Prohibited in state and federal waters
Longlines (pelagic)	0	34	Prohibited in state and federal waters
Purse seining (bottom)	0	31	Allowed in both state and federal waters (although some species restrictions may apply)
Purse seining (pelagic)	0	40	Allowed in both state and federal waters
Spearfishing/diving	0	38	Allowed in both state and federal waters
Surrounding nets near shore*	29	29	
Trammel nets	17	38	Prohibited in state waters

Traps (lobster/octopus/crab)	0	35	Allowed in both state and federal waters
Trawl (bottom)	0	26	Prohibited in state and federal waters unless specified otherwise
Trawl (pelagic)	0	25	Allowed in both state and federal waters
<b>Non-fishing Activities</b>			
Anchoring	45	45	
Boating	11	11	
Aquaculture	0	60	Considered allowed if area intersects an active lease boundary, otherwise prohibited
Bottom exploitation (Other bottom structures)	0	98	Considered allowed if area intersects an active lease boundary, otherwise prohibited
Bottom extraction (Mining/oil platforms/sand extraction/detonations)	0	97	Considered allowed if area intersects an active lease boundary, otherwise prohibited

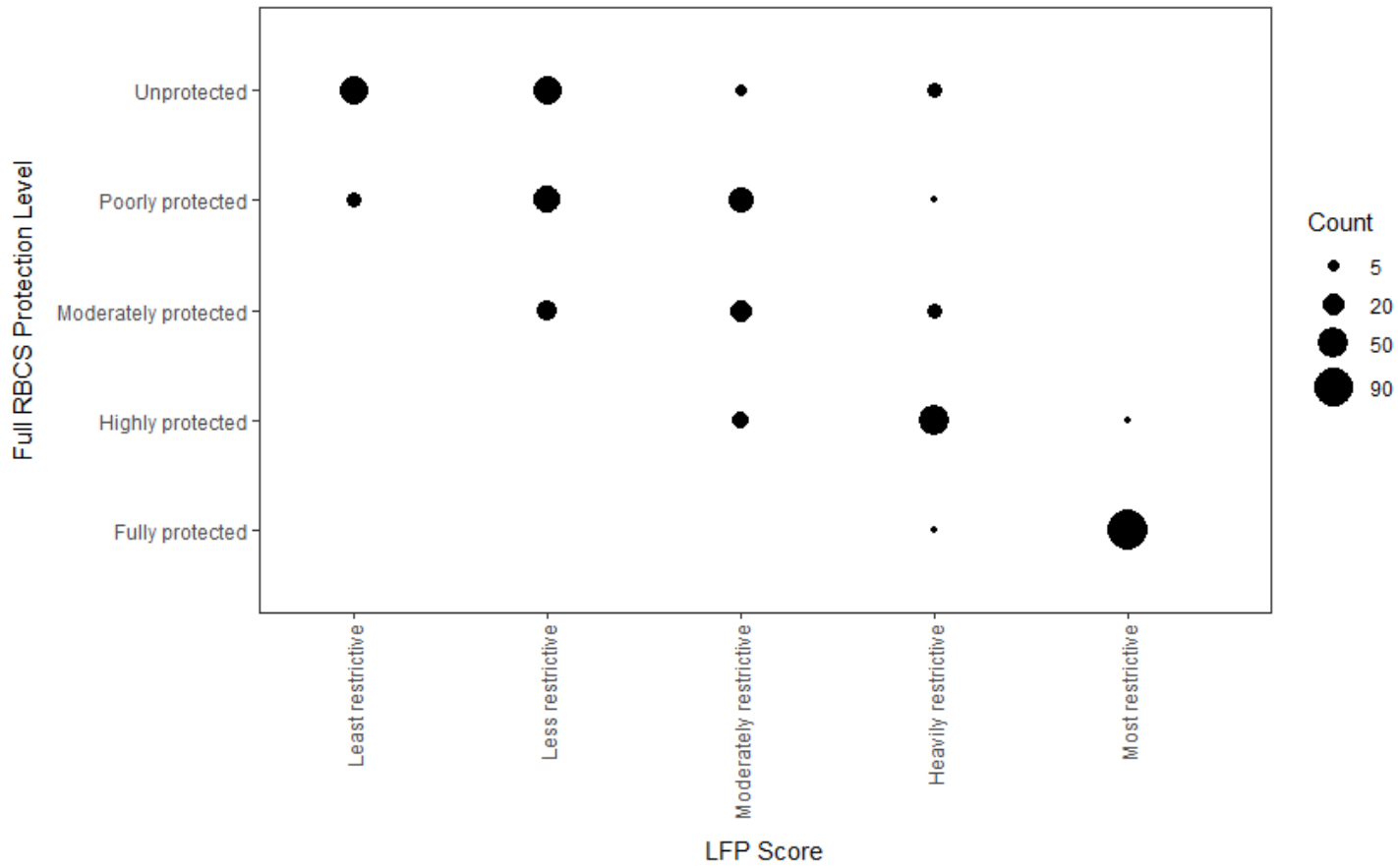


Figure 1. California Areas - Distribution of Full RBCS protection levels and Navigator LFP scores, (n = 381).

Table 4. RBCS and Navigator data model comparison. (m) denotes a RBCS input field match with a Navigator field, while (+) denotes a RBCS input field without a match and is considered unknown in the group B scenarios.

<b>RBCS</b>	<b>Navigator</b>
<b>Fishing Gears</b>	
Beach seines (+) Cast nets (+) Drift nets (+) Purse seining (bottom) (+) Purse seining (pelagic) (+) Surrounding nets near shore (+) Trammel nets (+) Trawl (pelagic) (+)	Nets
Dredges (bivalves) (m) Hand dredges (bivalves) (+)	Dredging
Fish traps (m) Fixed fish traps "madrague" (+) Traps (lobster/octopus/crab) (+)	Traps and Pots
Gillnets (m)	Gillnetting
Hand harvesting (+)	No similar field
Intertidal hand captures (+)	No similar field
Lines (jigs, hook and line, rod, troll) (m)	Hook and Line
Longlines (bottom) (m) Longlines (pelagic) (+)	Longlining
Spearfishing/diving (m)	Spear Fishing
Trawl (bottom) (m)	Bottom Trawling
<b>Non-fishing Activities</b>	
Anchoring (m)	Anchoring

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Aquaculture (+)	No similar field
Boating (m)	Entry
Bottom exploitation (+)	No similar field
Bottom extraction (m)	Industrial or Mineral Exploration

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Table 5. Scenario A1 Score Matrix - Scenario A1 protection levels vs. Full RBCS protection levels.

Scenario A1 → Full RBCS ↓	Fully Protected	Highly Protected	Moderately Protected	Poorly Protected	Unprotected	Sum	% False Negatives
Unprotected	0	0	0	0	97	97	0
Poorly Protected	0	0	0	72	7	79	9
Moderately Protected	0	0	0	48	0	48	100
Highly Protected	0	0	0	63	0	63	100
Fully Protected	1	2	0	91	0	94	99
Sum	1	2	0	274	104	381	
<b>% Correct</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>26</b>	<b>93</b>		
<b>% False Positives</b>	0	100	0	74	7		

Table 6. Scenario A2 Score Matrix - Scenario A2 protection levels vs. Full RBCS protection levels.

<b>Scenario A2 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	51	13	11	8	14	97	86
<b>Poorly Protected</b>	19	26	14	20	0	79	75
<b>Moderately Protected</b>	25	10	13	0	0	48	73
<b>Highly Protected</b>	1	62	0	0	0	63	2
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	190	111	38	28	14	381	
<b>% Correct</b>	<b>49</b>	<b>56</b>	<b>34</b>	<b>71</b>	<b>100</b>		
<b>% False Positives</b>	51	44	66	29	0		



Table 7. Scenario A3 Score Matrix - Scenario A3 protection levels vs. Full RBCS protection levels.

<b>Scenario A3 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	0	0	0	0	97	97	0
<b>Poorly Protected</b>	0	0	0	72	7	79	9
<b>Moderately Protected</b>	0	2	7	39	0	48	85
<b>Highly Protected</b>	1	51	0	11	0	63	19
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	95	53	7	122	104	381	
<b>% Correct</b>	<b>99</b>	<b>96</b>	<b>100</b>	<b>59</b>	<b>93</b>		
<b>% False Positives</b>	1	4	0	41	7		

Table 8. Scenario A4 Score Matrix - Scenario A4 protection levels vs. Full RBCS protection levels.

<b>Scenario A4 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	0	0	0	0	97	97	0
<b>Poorly Protected</b>	0	0	0	72	7	79	9
<b>Moderately Protected</b>	0	2	20	26	0	48	58
<b>Highly Protected</b>	1	62	0	0	0	63	2
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	95	64	20	98	104	381	
<b>% Correct</b>	<b>99</b>	<b>97</b>	<b>100</b>	<b>73</b>	<b>93</b>		
<b>% False Positives</b>	1	3	0	27	7		

Table 9. Scenario A5 Score Matrix - Scenario A5 protection levels vs. Full RBCS protection levels.

<b>Scenario A5 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	0	0	0	0	97	97	0
<b>Poorly Protected</b>	0	0	1	71	7	79	10
<b>Moderately Protected</b>	0	0	40	8	0	48	17
<b>Highly Protected</b>	1	61	1	0	0	63	3
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	95	61	42	79	104	381	
<b>% Correct</b>	<b>99</b>	<b>100</b>	<b>95</b>	<b>90</b>	<b>93</b>		
<b>% False Positives</b>	1	0	5	10	7		

Table 10. Scenario A6 Score Matrix - Scenario A6 protection levels vs. Full RBCS protection levels.

<b>Scenario A6 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	51	13	11	8	14	97	86
<b>Poorly Protected</b>	19	26	14	20	0	79	69
<b>Moderately Protected</b>	25	10	13	0	0	48	73
<b>Highly Protected</b>	1	62	0	0	0	63	2
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	190	111	38	28	14	381	
<b>% Correct</b>	<b>49</b>	<b>56</b>	<b>34</b>	<b>71</b>	<b>100</b>		
<b>% False Positives</b>	51	44	66	29	0		

Table 11. Scenario A7 Score Matrix - Scenario A7 protection levels vs. Full RBCS protection levels.

<b>Scenario A7 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	0	0	0	0	97	97	0
<b>Poorly Protected</b>	0	0	1	71	7	79	10
<b>Moderately Protected</b>	0	2	38	8	0	48	21
<b>Highly Protected</b>	1	62	0	0	0	63	2
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	95	64	39	79	104	381	
<b>% Correct</b>	<b>99</b>	<b>97</b>	<b>97</b>	<b>90</b>	<b>93</b>		
<b>% False Positives</b>	1	3	3	10	7		

Table 12. Scenario A8 Score Matrix - Scenario A8 protection levels vs. Full RBCS protection levels.

<b>Scenario A8 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	0	0	0	0	97	97	0
<b>Poorly Protected</b>	0	0	1	71	7	79	10
<b>Moderately Protected</b>	0	2	38	8	0	48	21
<b>Highly Protected</b>	1	62	0	0	0	63	2
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	95	64	39	79	104	381	
<b>% Correct</b>	<b>99</b>	<b>97</b>	<b>97</b>	<b>90</b>	<b>93</b>		
<b>% False Positives</b>	1	3	3	10	7		

Table 13. Scenario B1 Score Matrix - Scenario B1 protection levels vs. Full RBCS protection levels.

<b>Scenario B1 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	0	0	0	0	97	97	0
<b>Poorly Protected</b>	0	0	0	3	76	79	96
<b>Moderately Protected</b>	0	0	0	3	45	48	100
<b>Highly Protected</b>	0	0	0	62	1	63	100
<b>Fully Protected</b>	0	0	0	94	0	94	100
<b>Sum</b>	0	0	0	162	219	381	
<b>% Correct</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>44</b>		
<b>% False Positives</b>	0	0	0	98	56		

Table 14. Scenario B2 Score Matrix - Scenario B2 protection levels vs. Full RBCS protection levels.

<b>Scenario B2 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	58	6	14	19	0	97	100
<b>Poorly Protected</b>	25	20	25	9	0	79	89
<b>Moderately Protected</b>	26	11	11	0	0	48	77
<b>Highly Protected</b>	8	55	0	0	0	63	13
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	211	92	50	28	0	381	
<b>% Correct</b>	<b>45</b>	<b>60</b>	<b>22</b>	<b>32</b>	<b>0</b>		
<b>% False Positives</b>	55	40	78	68	0		



Table 15. Scenario B3 Score Matrix - Scenario B3 protection levels vs. Full RBCS protection levels.

<b>Scenario B3 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	0	0	0	8	89	97	8
<b>Poorly Protected</b>	0	0	2	3	74	79	96
<b>Moderately Protected</b>	1	3	5	0	39	48	90
<b>Highly Protected</b>	7	45	0	11	0	63	29
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	102	48	7	22	202	381	
<b>% Correct</b>	<b>92</b>	<b>94</b>	<b>71</b>	<b>14</b>	<b>44</b>		
<b>% False Positives</b>	8	6	29	86	56		

Table 16. Scenario B4 Score Matrix - Scenario B4 protection levels vs. Full RBCS protection levels.

<b>Scenario B4 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	0	0	0	8	89	97	8
<b>Poorly Protected</b>	0	0	2	14	63	79	83
<b>Moderately Protected</b>	1	3	5	12	27	48	90
<b>Highly Protected</b>	7	45	0	11	0	63	29
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	102	48	7	45	179	381	
<b>% Correct</b>	<b>92</b>	<b>94</b>	<b>71</b>	<b>31</b>	<b>50</b>		
<b>% False Positives</b>	8	6	29	69	50		

Table 17. Scenario B5 Score Matrix - Scenario B5 protection levels vs. Full RBCS protection levels.

Scenario B5 → Full RBCS ↓	Fully Protected	Highly Protected	Moderately Protected	Poorly Protected	Unprotected	Sum	% False Negatives
Unprotected	0	0	0	0	97	97	0
Poorly Protected	0	0	0	3	76	79	96
Moderately Protected	0	0	0	3	45	48	100
Highly Protected	0	0	0	62	1	63	100
Fully Protected	0	0	0	94	0	94	100
<b>Sum</b>	0	0	0	162	219	381	
<b>% Correct</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>44</b>		
<b>% False Positives</b>	0	0	0	98	56		

Table 18. Scenario B6 Score Matrix - Scenario B6 protection levels vs. Full RBCS protection levels.

<b>Scenario B6 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	58	6	14	19	0	97	100
<b>Poorly Protected</b>	25	20	25	9	0	79	89
<b>Moderately Protected</b>	26	11	11	0	0	48	77
<b>Highly Protected</b>	8	55	0	0	0	63	13
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	211	92	50	28	0	381	
<b>% Correct</b>	<b>45</b>	<b>60</b>	<b>22</b>	<b>32</b>	<b>0</b>		
<b>% False Positives</b>	55	40	78	68	0		

Table 19. Scenario B7 Score Matrix - Scenario B7 protection levels vs. Full RBCS protection levels.

<b>Scenario B7 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	0	0	0	8	89	97	8
<b>Poorly Protected</b>	0	0	2	3	74	79	96
<b>Moderately Protected</b>	1	3	5	0	39	48	90
<b>Highly Protected</b>	7	45	0	11	0	63	29
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	102	48	7	22	202	381	
<b>% Correct</b>	<b>92</b>	<b>94</b>	<b>71</b>	<b>14</b>	<b>44</b>		
<b>% False Positives</b>	8	6	29	86	56		

Table 20. Scenario B8 Score Matrix - Scenario B8 protection levels vs. Full RBCS protection levels.

<b>Scenario B8 → Full RBCS ↓</b>	<b>Fully Protected</b>	<b>Highly Protected</b>	<b>Moderately Protected</b>	<b>Poorly Protected</b>	<b>Unprotected</b>	<b>Sum</b>	<b>% False Negatives</b>
<b>Unprotected</b>	0	0	0	8	89	97	8
<b>Poorly Protected</b>	0	0	2	14	63	79	83
<b>Moderately Protected</b>	1	3	5	12	27	48	90
<b>Highly Protected</b>	7	45	0	11	0	63	29
<b>Fully Protected</b>	94	0	0	0	0	94	0
<b>Sum</b>	102	48	7	45	179	381	
<b>% Correct</b>	<b>92</b>	<b>94</b>	<b>71</b>	<b>31</b>	<b>50</b>		
<b>% False Positives</b>	8	6	29	69	50		