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Implementing California's Nearshore Fishery Management Plan — twelve years later

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The Nearshore Fishery Management Plan (NFMP) mandated by California's Marine Life Management Act of 1998 was adopted by the California Fish and Game Commission in October 2002. The NFMP provides a framework for managing the nearshore species complex under joint state-federal authority using more conservative measures, while in close coordination with federal management. Since 2002, the California Department of Fish and Wildlife (CDFW) has managed 19 nearshore species in accordance with NFMP management measures. Prior to adoption of the NFMP, all nearshore species were considered data-poor. Since implementation, half of the nearshore species have been assessed, moving from data-poor to more informed. The status of assessed stocks is healthy or precautionary, which has resulted in increased total allowable catches. Regional management, as envisioned by the NFMP, has yet to be fully implemented, although progress has been made in the form of regional recreational and commercial catch monitoring and estimation of catch and effort, and a restricted access program instituted on a regional basis in 2003 for the commercial fishery. Since 2003, the number of restricted access permits has been reduced by 29%. Allocation of harvest limits between the recreational and commercial sectors continues to be based on historic landings. Recent implementation of a statewide network of marine protected areas provides protection to approximately 20% of nearshore habitat important to NFMP species and provides the opportunity to investigate the utility of marine protected areas as reference reserves for stock monitoring and assessment. Research on nearshore species is progressing, albeit slowly, given limited CDFW resources and by virtue of collaborative partnerships. Although the state intended to

pursue federal transfer of authority to gain sole management authority, most of the NFMP species continue to be jointly managed.

Key words: allocation, fishery control rules, marine protected areas, MPA, nearshore rockfish, Nearshore Fishery Management Plan, regional management, restricted access program, stock assessments

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In the late 1980s the commercial nearshore fishery began to evolve and expanded rapidly as fishermen shifted from the less profitable market for fresh, dead fish to the more lucrative market for live fish (Pattison and Vejar 2000). Fishermen made extra efforts to keep fish alive for markets, including providing onboard oxygen and chilling tanks. The increased fishing pressure in shallow waters raised concerns about the potential for local depletion of these nearshore stocks given their life history characteristics — resident, long-lived, relatively slow growing, and sporadic recruitment success. An additional concern was the absence of a mechanism for quickly implementing management actions and more coordinated management.

To address growing concerns about the nearshore fishery, the Marine Life Management Act (MLMA) specifically mandated the development of a Nearshore Fishery Management Plan (NFMP) by 2001. The MLMA, enacted in 1998, also directed more responsibility toward the California Fish and Game Commission (FGC) and California Department of Fish and Wildlife (CDFW) for ocean fisheries management, prioritized sustainable resources over the long term above all other needs, recognized the economic and cultural importance of recreational and commercial fisheries, required increased constituent involvement, and advocated management grounded in science via fishery management plans.

To provide a mechanism for more responsive management of this nearshore fishery prior to the adoption of the NFMP, the Nearshore Fishery Management Act (NFMA) section of the MLMA granted the FGC more authority to regulate nearshore fish stocks and fisheries, and identified 10 nearshore species of special importance: cabezon (*Scorpaenichthys marmoratus*), California scorpionfish (*Scorpaena guttata*), California sheephead (*Semicossyphus pulcher*), kelp greenling (*Hexagrammos decagrammus*), rock greenling (*H. lagocephalus*), and black-and-yellow (*Sebastes chrysomelas*), China (*S. nebulosus*), gopher (*S. carnatus*), grass (*S. rastrelliger*), and kelp rockfishes (*S. atrovirens*). The NFMA required a Nearshore Fishery Permit (NFP) for their commercial take, set minimum size limits for those species, and directed funding from permit fees for developing the NFMP as well as for conservation and management (Weber and Heneman 2000).

In 2000, the FGC adopted interim regulations, including the NFP, total allowable catches (TACs), commercial trip limits, and minimum size limits to proactively protect cabezon, greenlings, and California sheephead. This set the stage for future state and federal management of these and other nearshore species prior to the completion of the NFMP. Due to insufficient life history information on nearshore stocks and, hence, no science-based harvest strategies, these management actions included development of state and federal harvest levels specific to NFMP species. These harvest levels were then allocated between the recreational and commercial sectors pending better information.

Coincident with NFMP development, the Pacific Fishery Management Council (PFMC), one of eight regional fisheries management councils established by the Magnusen-Stevens Fishery Conservations and Management Act (MSA) of 1976, began closely regulating the recreational and commercial sectors of the groundfish fishery in federal waters. This was due to the need to protect rebuilding rockfish species (cowcod [*Sebastes levis*], bocaccio [*S. paucispinis*], and canary rockfish [*S. pinniger*]) living in deeper waters and recently subject to a federal overfished declaration (PFMC 2003). The overfished status required federal action to rebuild the depleted stocks as quickly as possible, while minimizing impacts on fishing communities (MSA 1976, 1996). In 2000 and 2001, the PFMC initiated the establishment of various management area boundaries to allow for finer scale rockfish and lingcod (*Ophiodon elongatus*) closures (Figure 1), and implemented the first recreational closures. Also in 2001, two Cowcod Conservation Areas were designated to

<table>
<tr><th rowspan="2">Geographic Location[a]</th><th colspan="3">State</th><th>State and Federal</th><th>Federal</th></tr>
<tr><th>NFMP and NFP</th><th>DNSFP and CGS Trip Limits</th><th>MPA</th><th>Recreational Groundfish Management</th><th>Nearshore Rockfish Trip Limits[b]</th></tr>
<tr><td>California-Oregon Border</td><td rowspan="2">North Coast</td><td rowspan="6">Statewide</td><td rowspan="3">Northern</td><td rowspan="2">Northern</td><td rowspan="2">North</td></tr>
<tr><td>Cape Mendocino</td></tr>
<tr><td>Point Arena</td><td rowspan="2">North-Central Coast</td><td>Mendocino</td><td rowspan="5"></td></tr>
<tr><td>Pigeon Point
Año Nuevo</td><td>North-Central</td><td>San Francisco</td></tr>
<tr><td></td><td rowspan="2">South-Central Coast</td><td rowspan="2">Central</td><td rowspan="2">Central</td></tr>
<tr><td>Point Conception</td></tr>
<tr><td>U.S.-Mexico Border</td><td>South Coast</td><td>Southern</td><td>Southern</td><td>South</td></tr>
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[a]Spacing between locations represents relative distance, not to scale; AñoNuevo is only12.1 km from Pigeon Point.

[b]Limits for some species differ north and south of Point Conception (dashed line).

Figure 1.—California state and federal regional management boundaries relevant to Nearshore Fisheries Management Plan (NFMP) species. NFP = Nearshore Fishery Permit, DNSFP = Deeper Nearshore Species Fishery Permit, CGS = cabezon, greenlings, California sheephead, MPA = marine protected area network.

protect overfished cowcod off the coast of southern California; they totaled 10,878 km^2 and fishing for groundfish deeper than 37 m was closed. In 2003, depth-based Rockfish Conservation Areas were established that closed the shelf (61 m to as deep as 274 m) to all groundfish fishing gears so bycatch of rebuilding species was minimized. (Overfishing of

these stocks would later turn out to be recognized as partially the result of overly high productivity estimates during what turned out to be a warmer water regime with less favorable recruitment conditions). In that same year, recreational fishing for groundfish also began to be depth-restricted regionally and temporally in nearshore waters. As a PFMC member, CDFW developed recommendations for the groundfish fishery, including the nearshore. These actions were mirrored in state waters through FGC actions. Consequently, at the same time the nearshore stocks were being subjected to an increasingly active and unregulated live-fish fishery, they were in danger of increased fishing pressure shifting to the nearshore from the continental shelf due to these federal shelf closures.

The NFMP (CDFG 2002) was adopted by the FGC in October 2002. Nineteen species were included: all of the NFP shallow nearshore species, as well as eight deeper nearshore rockfish species (black [*Sebastes melanops*], blue [*S. mystinus*], brown [*S. auriculatus*], calico [*S. dallii*], copper [*S. caurinus*], olive [*S. serranoides*], quillback [*S. maliger*], and treefish [*S. serriceps*] and monkeyface prickleback [*Cebidichthys violaceus*]). The NFMP contained five main management measures to sustainably manage the nearshore fishery: fishery control rules (FCRs), regional management, allocation, restricted access, and marine protected areas (MPAs). The NFMP also included sections on research needs, species life histories, history of the fisheries, and implementation of the NFMP. Implementation of the NFMP began a decade of fine tuning groundfish management at both the state and federal levels to maximize fishing opportunity while controlling effort and protecting vulnerable species. Efforts were also initiated to collect essential fisheries information (EFI) on nearshore species and to evaluate stock status. In addition, implementation coincided with the process to develop a network of MPAs along the coast focused, in part, on rocky reef areas that are ideal habitat for nearshore species.

The framework approach used in the NFMP provided a tool chest of measures to implement the plan in accordance with its goals and objectives, consistent with the MLMA mandate for adaptive management (Fish and Game Code Sections 90.1 and 7056[g]), and included flexibility for making progress. In the sections below, we provide a review of the steps that have been taken and progress made in implementing each of the plan's primary management measures or approaches (i.e., FCRs, regional management, allocation, restricted access, and MPAs), as well as other aspects of management (e.g., research and monitoring, transfer of authority, enforcement, bycatch). At the same time, we document the important concurrent state and federal management actions in progress, and lay out the ongoing, complex coordination needed to help provide some context for progress or lack thereof. In addition, a summary of future opportunities and challenges is provided.

Fishery Control Rules and Stock Status

Fishery control rules.—Fishery control rules are the primary mechanism for achieving the main objectives of the MLMA for management, including sustainable use, preventing overfishing, and rebuilding depressed stocks (CDFG 2002). The FCRs are management tools used to predict appropriate fishing levels and long-term maximum sustainable yields. Maximum sustainable yield (MSY) is the highest average yield over time that does not result in a continuing reduction in stock abundance, taking into account fluctuations in abundance and environmental variability (Fish and Game Code Section 96.5).

The FCRs also provide a means to determine stock condition (e.g., healthy, overfished) by comparing stock status with pre-determined biological reference points.

The FCR for the NFMP incorporates different approaches to meet its objectives by integrating EFI into the level of precaution used in setting the TAC. Thus, in the absence of information beyond catch data, management should be more precautionary than when additional EFI (e.g., size or age data, abundance indices) is available. The TAC is equivalent to the definition of optimal yield (OY) in Fish and Game Code Section 97, with both describing an amount of fish that can be sustainably harvested in a fishery; this value can never exceed MSY. The framework for the FCR includes three stages, depending on the level of EFI available (Table 1). The PFMC uses similar categories in setting annual

Table 1.— Comparison between state (California Department of Fish and Wildlife) under the Nearshore Fishery Management Plan (NFMP) and federal management (Pacific Fishery Management Council [PFMC]) under the Groundfish Fishery Management Plan (GFMP) and definitions of essential fishery information (EFI) required to determine catch limits.

Stage	NFMP management (CDFW)	Category	GFMP management (PFMC)
I	Data-poor—*Precautionary approach for setting TACs* Data sets used: Catch history	3	Catch based Data sets used: Catch history
II	Data-moderate—*Supports improved single species management* Additional data sets used: Abundance indices Size and/or age data	2	Catch based and abundance indices Additional data sets used: Abundance indices
III	Data-rich—*Supports ecosystem-based management* Additional data sets used: Additional environmental data Reference reserves	1	Full catch at age (or length) structured model Additional data sets used: Size and/or age data Additional environmental data[a] Reference reserves[a]

[a]Not required

catch limits (ACLs) for jointly managed species, although the data and methods used to determine these limits are slightly different, as defined in the West Coast Groundfish Fishery Management Plan (GFMP). For example, the NFMP Stage III (data-rich) category supports ecosystem-based management, particularly incorporating the effect of marine reserves and other environmental factors into assessments. Kaufman et al. (2004) provided examples of what could be incorporated into Stage III management. By definition, a number of the nearshore stocks that have been assessed (e.g., black rockfish) are considered data-rich (Category 1) in the PFMC arena, although considered data-moderate (Stage II) by the NFMP definition (Table 1).

During development of the interim regulations, the FGC was presented with differing approaches for management of the nearshore fishery and ultimately chose an approach modeled after Restrepo et al. (1998) as a proxy for MSY and OY (i.e., TAC) in data-poor (Stage I) situations. In simple terms, the proxy for MSY was based on the combined average catch for the recreational and commercial fisheries from 1993 to 1998, a period that included catch estimates from both sectors, had better accounting of individual nearshore rockfish in the commercial fishery, and was a period when stocks were not considered in decline. The proxy for TAC was set at 50% of the proxy MSY. The TAC was then allocated between the recreational and commercial sectors. The framework of the NFMP allows adjustments to the TAC; as information improves, management can be less precautionary.

Following adoption of the NFMP, the FGC used the above approach to set harvest limits because no stock assessments were then available for the NFMP species. Since then, with the availability of more data (i.e., EFI), formal stock assessments have been used to determine the status of a number of the NFMP species and to set TACs under Stage II management. The current management stage for each NFMP species is provided in Table 2.

Species	Managed by	NFMP Species by Permit	Last Assessed	Stage	Status[a]	PSA Vulnerability Score[b]
Black rockfish	Fed/State	Deep	2007	II	healthy	1.94
Black-and-yellow rockfish	Fed/State	Shallow		I		1.70
Blue rockfish	Fed/State	Deep	2007	II	precautionary	2.01
Brown rockfish	Fed/State	Deep	2013	II	precautionary	1.99
Calico rockfish	Fed/State	Deep		I		1.46
China rockfish	Fed/State	Shallow	2013	II	**[c]	2.23
Copper rockfish	Fed/State	Deep	2013	II	**[c]	2.27
Gopher rockfish	Fed/State	Shallow	2005	II	healthy	1.76
Grass rockfish	Fed/State	Shallow		I		1.89
Kelp rockfish	Fed/State	Shallow		I		1.62
Olive rockfish	Fed/State	Deep		I		1.87
Quillback rockfish	Fed/State	Deep		I		2.22
Treefish	Fed/State	Deep		I		1.73
Cabezon	Fed/State	Shallow	2009	II	**[c]	1.68
California scorpionfish	Fed/State	Shallow	2005	II	healthy	1.41
Kelp greenling[d]	Fed/State	Shallow	2011	II		1.56
Rock greenling	State	Shallow		I		1.77
California sheephead[d]	State	Shallow	2004	II		1.7[e]
Monkeyface prickleback[d]	State	--[f]		I		1.6[e]

TABLE 2.—The 19 nearshore species with relevant federal and state management and stock assessment information. Shallow and Deep permit types refer to the Nearshore Fishery Permit and Deeper Nearshore Species Fishery Permit, respectively.

[a]Status of the stock is based on the Nearshore Fishery Management Plan (NFMP) 60-20 Harvest Control Rule

[b]Productivity-Susceptibility Analysis (PSA) values were taken from Cope et al (2011). A higher PSA score equates to being more vulnerable

[c] " ** " indicates the northern portion of the stock was precautionary; the southern portion was healthy

[d]Stock status was not determined or the assessments were deemed inadequate for management

[e]PSA values were taken from Patrick et al. (2009)

[f]No permit required. A commercial fishing license is required as it is for all 19 species

Methodologies for determining stock status have improved since implementation of the NFMP. While TACs were previously set using 50% of recent landings (Stage I), new catch-based methodologies have been developed for estimating sustainable yields and management reference points for data-poor fish stocks. Recently, methods such as Depletion-Corrected Average Catch (MacCall 2009) and Depletion-Based Stock Reduction Analysis (DB-SRA; Dick and MacCall 2011) have been used in setting harvest limits for data-poor stocks in the NFMP (e.g., calico rockfish) when compositional data (e.g., lengths) or indices of abundance are not available. Additionally, the Scientific and Statistical Committee to the PFMC has reviewed and recommended the use of two data-moderate assessment methods for setting harvest limits under Stage II management (PFMC in press): Extended Simple Stock Synthesis and Extended Depletion-based Stock Reduction Analysis (XDB-SRA).

Under Stage II management, the NFMP applies a 60-20 FCR (Figure 2). For a given stock, if the current spawning biomass is estimated to be at or above 60% of the unfished biomass ($B_{Unfished}$; under federal harvest control rules the equivalent would be B_0),

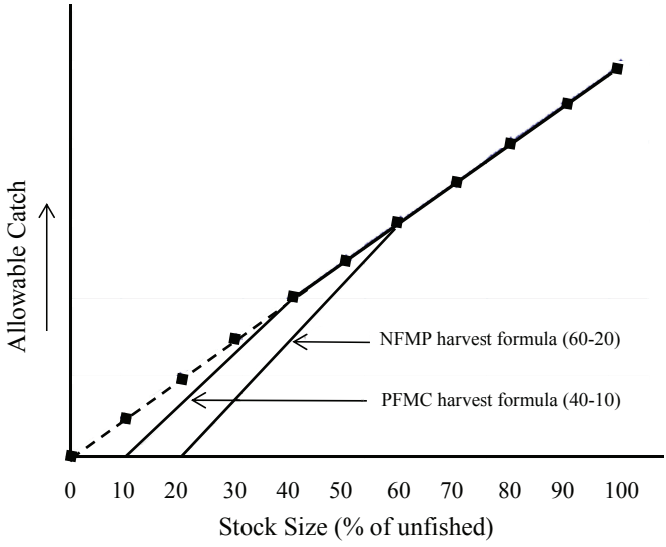

Figure 2.—Comparison of state and federal harvest control rules (60-20 and 40-10, respectively) for groundfish in California. NFMP (state) = Nearshore Fisheries Management Plan, PFMC (federal) = Pacific Fisheries Management Council.

it is considered to be "healthy". Once below 60% of $B_{Unfished}$ (i.e., depletion), the status of the stock is in a "precautionary" zone and the catch must be reduced below the default $F_{50\%}$ fishing rate, along a line where zero catch occurs at 20% of $B_{Unfished}$ (Figure 2). The default $F_{50\%}$ fishing rate may be considered precautionary for some species (e.g., cabezon). A stock is considered overfished if the biomass estimate falls below 30% of $B_{Unfished}$, at which point an interim adjustment is made to harvest levels until a rebuilding plan can be developed. The NFMP FCR is more precautionary than the federal GFMP 40-10 harvest control rule (Figure 2), where a stock must fall below 40% of $B_{Unfished}$ to be considered "precautionary" and must fall below 25% of $B_{Unfished}$ to be considered overfished and with zero catch at 10% of $B_{Unfished}$.

A key objective for MPAs proposed by the NFMP was to act as reference reserves that could be temporally compared to similar fished areas as a means to evaluate stock health, in addition to helping preserve nearshore habitat and ecosystems. The use of MPAs as a part of the FCR under Stage III management is now being considered. Trends in the densities of nearshore species outside and inside MPAs are being evaluated as stock status indicators, along with the reference reserve concept put forward in the NFMP (CDFG 2002, Wilson et al. 2010). Using a ratio of the density of fish outside the MPA to that of density inside the MPA, McGilliard et al. (2011) evaluated a control rule to determine the direction and magnitude of change in the fishing effort in the following year. This density ratio control rule could be used as a potential tool for managing fish stocks on a smaller spatial scale, such as in nearshore waters where localized depletion can occur.

Stock assessments and stock status.—Initially, to prioritize which stocks to assess, CDFW evaluated EFI for each of the 19 nearshore species, including catch data, available length and age compositional data, data sources to provide relative indices of abundance, and relevant life history information. This exercise was used to rank the species, depending on the amount of data available to assess the stock. More recently, another index has been used to help set these priorities, based on productivity of the species and their susceptibility to the fishery. The productivity-susceptibility analysis (PSA) is a way to rank the vulnerability of a species (Cope et al. 2011). While this analysis helps to rank the species warranting assessment, the amount of data available for an assessment is also used to rank the order of species to assess.

Since 2004, CDFW has participated in a number of nearshore stock assessments, acting in such capacities as the lead or member of a stock assessment team, developer of assessment methodology, assessment reviewer, or provider of data and preliminary analyses to the stock assessment team. As many of the NFMP species are jointly managed, this work is often conducted in collaboration with federal partners (e.g., National Marine Fisheries Service [NMFS]). When assessment results are accepted for these jointly managed species, the PFMC has adopted more conservative state harvest limit recommendations to abide by the rules laid out in the NFMP for these species.

Stage II management incorporates population modeling that replaces the precautionary approach to setting TACs laid out under Stage I. Seven of the nearshore species have been assessed under the Stage II scenario (Table 2) using the size and age structured modeling platform of Stock Synthesis (Methot and Wetzel 2013). Numerous types of data can be incorporated into this model, including age and length composition information, fishery-dependent and fishery-independent indices of abundance, and relevant life history information (e.g., growth, maturity). The Stock Synthesis model produces estimates of unfished biomass, depletion, and MSY. However, MSY is a difficult measure to estimate and the uncertainty in this estimate is likely larger than is accounted for when reporting this reference point.

Stock boundaries are typically developed based on stock structure, including regional differences in life history or other biological characteristics that form the basis of management units. If stock structure information is not available, boundaries could be set based on management lines or data availability. Of the seven stocks fully assessed using Stock Synthesis, the following five were used to advise management. The gopher rockfish stock north of Point Conception to the Oregon border was assessed in 2005 (Key et al. 2006) and deemed "healthy". The California scorpionfish population in the waters off southern California (Point Conception to the U.S.-Mexico border) was also assessed

in 2005 (Maunder et al. 2006) and deemed "healthy". Black rockfish was last assessed in 2007 (Sampson 2008) within waters between Cape Falcon, Oregon and Point Piedras Blancas, California (the southern extent of its range); this stock was also found to be of "healthy" status. Blue rockfish was assessed in 2007 (Key et al. 2008) and included the portion of the stock north of Point Conception to the California-Oregon border. The stock was found to be in a "precautionary" zone at 30% of $B_{Unfished}$; blue rockfish in California was identified as a "species of concern" (i.e., a species about which NMFS has some concerns regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the Endangered Species Act [ESA]; species of concern status does not carry any procedural or substantive protections under the ESA). The stock assessment team advised that this assessment be used with caution for management purposes. Lastly, Cope and Key (2010) conducted the most recent assessment of cabezon, separately modeling northern and southern California (i.e., north or south of Point Conception) sub-stocks. The northern stock was found to be "precautionary" and the southern stock was found to be "healthy".

California sheephead and kelp greenling were also assessed using Stock Synthesis, although the assessment results were not considered adequate for providing management advice. The peer review helped to identify data needs and future research for these species. California sheephead was the first CDFW-sponsored stock assessment, for the area south of Point Conception to the U.S.-Mexico border (Alonzo et al. 2004). This species is a protogynous (female to male) sequential hermaphrodite; therefore, the assessment examined the stock status using various biomass estimates (e.g., female, male, or female+male biomass). Due to the highly uncertain stock status results and numerous other uncertainties (e.g., the behaviors and cues that trigger this species to transition from female to male), the assessment was not considered as a basis for setting harvest limits or revising management measures.

Kelp greenling was assessed in 2005 (Cope and MacCall 2006) for both the Oregon and California sub-stocks. The assessment of the Oregon sub-stock was accepted for management, although a stable model could not be identified for the California sub-stock. The stock assessment review panel concluded that the results for the California sub-stock were inadequate for providing management advice. In 2011, the California population of kelp greenling was re-evaluated using the DB-SRA (Stage I) data-poor method resulting in a three-fold increase to the TAC (Dick and MacCall 2010). The status of stocks under Stage I management is considered unknown.

Brown rockfish, China rockfish, and copper rockfish were assessed in 2013 (Cope et al. 2013) using XDB-SRA, which is an extension of the DB-SRA method with the addition of abundance indices as model inputs and other parameters. Brown rockfish was assessed on a coastwide level (including Oregon and Washington) and deemed "precautionary" based on the NFMP definition. The China rockfish and copper rockfish assessments were split within California, north and south of 40º 10' N (near Cape Mendocino), and north and south of 34º 27' N (Point Conception), respectively. The northern portions of those stocks (based on where the assessment was split) were more depleted than the southern portions in both cases, similar to the results for cabezon.

In the absence of information on stock status, 2003 harvest limits were very precautionary. As information has improved and more stocks have been assessed using new methods, changes to state and federal harvest limits have reflected these improvements with a reduced need for precaution. Most of the nearshore rockfishes continue to be man-

aged as complexes under current management. When 2003 harvest limits are compared to 2014 values based on the most recent assessment information (Figure 3), limits have increased for all NFMP species except California sheephead.

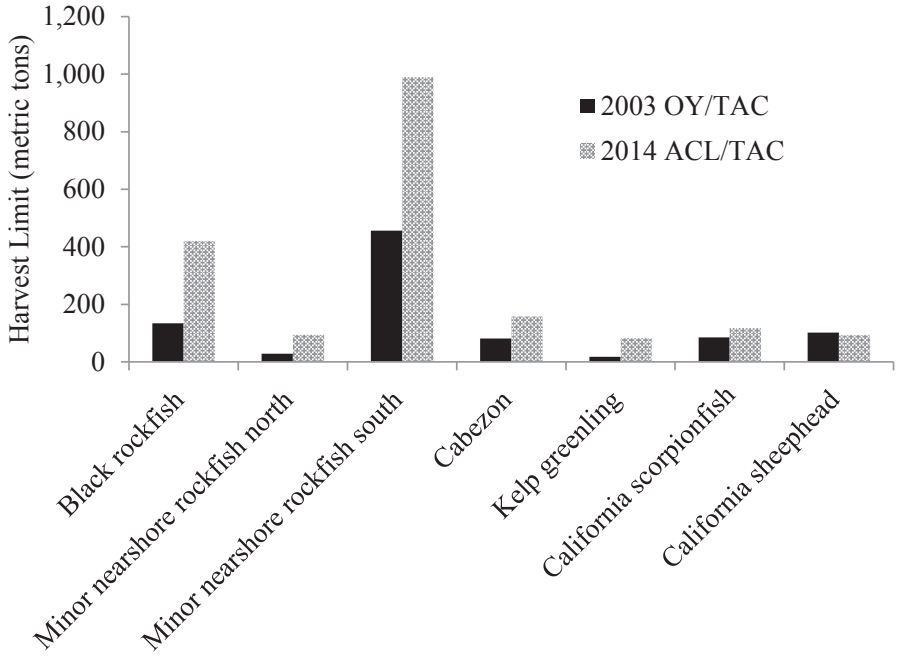

Figure 3.—Comparison of 2003 and 2014 harvest limits for some nearshore complexes and individual species. Minor rockfish complexes are managed separately north and south of 40° 10' N near Cape Mendocino, California. OY = optimal yield, TAC = total allowable catch, ACL = annual catch limit.

Accounting for uncertainty.—The reauthorization of the Magnuson-Stevens Fishery Conversation and Management Act (MSA 2006) changed the requirements for developing management actions for U.S. fisheries. The eight regional fishery management councils are now required to set ACLs for all managed stocks in the fishery. Two sources of uncertainty are now separately considered when establishing ACLs: scientific uncertainty (σ), based on assessment results; and management uncertainty (P*), determined by the risk (or likelihood) of exceeding harvest limits. Ralston et al. (2011) describe an approach to quantifying σ, while P* is a risk of the overfishing probability (0.25–0.45) chosen by the PFMC. These ACLs are equivalent to TACs in the NFMP; as a result, the attempt to quantify uncertainties when setting TACs is more scientifically based than when using the approach of Restrepo et al. (1998). Federal ACLs are now calculated for 16 of the 19 nearshore species in the NFMP that are also in the GFMP (Table 2).

When the NFMP was adopted in 2002, the Department believed there was sufficient information only on cabezon, California scorpionfish and, potentially, California sheephead for conducting formal stock assessments. Assessment of the other 16 nearshore stocks was considered extremely unlikely in the following decade (CDFG 2002). As

seen here, there have been a number of assessments completed due, in part, to the state's involvement in stock assessments of the nearshore species as well as the reauthorization of the MSA and the development of several new assessment tools for data-poor species. The methods developed (e.g., DCAC, XDB-SRA) to set harvest limits have substantially improved, and continued efforts will be made to determine the status of these stocks.

Regional Management

During the NFMP development process, statewide differences were identified in the biogeography of the species, characteristics of the fisheries, and current management. The FGC adopted a four region approach for the NFMP partly to address these differences. Regions were the North Coast, from the California-Oregon border (42° N) to near Cape Mendocino (40° 10' N); North-Central Coast, from Cape Mendocino to Point Año Nuevo (37° 06' N); South-Central Coast, from Point Año Nuevo to Point Conception (34° 27' N); and the South Coast, from Point Conception to the U.S.-Mexico border (32°32' N) (Figure 1). The FGC recognized that implementing regional management would require several building blocks that were not yet available: regional catch monitoring of and catch estimates from both fishery sectors; regional harvest limits and regulations; a regional commercial permit program for all fishery sectors; regional stock information; regional MPAs; regional CDFW infrastructure; and regional constituent advisors. However, the FGC did adopt regional management for the NFP due to concerns that fishing effort could be concentrated in a few areas resulting in the localized depletion of some species (e.g., cabezon, a species in which the male guards the egg nest) in the absence of finer scale management. Effective regional management also requires coordination with other processes such as federal management (e.g., harvest and trip limits, regional assessments), MPA development and management, and data collection. The regional scales used in these other components and processes vary widely (Figure 1), adding to the challenges of implementing a regional nearshore approach. Although many of the building blocks required for regional management have been implemented since 2002, management has yet to be fully regional as described in the NFMP and envisioned by the FGC.

Catch monitoring and estimation.—Sampling occurs on a port basis for both recreational and commercial sectors. Catch information is available by region using landings data from the commercial fishery on a port basis, and recreational catch estimates are available by district (Figure 1). These districts are delineated by county boundaries and are combined to align closely with NFMP region boundaries so that regional monitoring is possible.

Harvest limits, permitting, and regulations.—Recreational and commercial fishery management is a coordinated effort to regionally maximize opportunity (e.g., harvest limits, sector allocations, allowable depth, time on the water), while minimizing bycatch of overfished species. This effort has resulted in an evolving suite of management areas (e.g., Rockfish Conservation Areas, Groundfish Management Areas [recreational fishing areas with depth-based closures], Cowcod Conservation Areas) and regulations that have varied by region since 2003. The evolution results from attempting to provide sufficient access to more healthy nearshore stocks throughout the state, while recognizing regional variation in the fishery. Harvest limits and allocations can be statewide or regional, which often translates into region-based mechanisms (e.g., permitting, trip limits, seasonal access) to control effort and catch in the nearshore fishery.

Commercial nearshore fishery management is partially regional, based on a four-region permit system for the shallow nearshore species; however, deeper nearshore species are permitted statewide, and state and federal trip limits for NFMP species do not match the regions (Figure 1). Trip limits for the state-managed species (i.e., cabezon, greenlings, California sheephead) are statewide, while trip limits for the shallow and deeper nearshore rockfishes are different north of Cape Mendocino, and sometimes south of Point Conception (Figure 1). This mismatch in trip limit structure and permits can result in regulatory discarding of NFMP species, affect fishery profitability, or both.

Stock status information.—Some species have been assessed on a scale less than statewide, but not at the scale of NFMP regions with two exceptions; California sheephead and California scorpionfish were assessed for their most common ranges in California, which is only the South Coast Region. The spatial scale of assessments can be based on a variety of factors including available information, management considerations, or biogeographic distribution of species. Splitting assessments into different regions requires considerably more region-specific data; otherwise uncertainty surrounding the assessment results will increase and could result in decreased TACs to account for that uncertainty. As a result, the scale of most NFMP stock assessments has not matched NFMP regions.

Development of marine protected areas.—The four regional MPA management areas are defined by boundaries similar to those established for the NFMP (Figure 1). Consequently, as MPA monitoring progresses on a regional basis, it should be possible to build a better view of each nearshore NFMP region relative to overall ecosystem health, and to obtain some information for individual NFMP species that may apply to an entire region (see the *MPA monitoring* section below).

Regional advisory committees.—The NFMP was developed with a statewide advisory committee representing many different constituent interests, with the intent that regional advisory committees would be established as the NFMP was implemented. The protracted planning process for the Marine Life Protection Act (MLPA) also involved regional stakeholder groups, including many of the same individuals involved in the NFMP development, so limited interest has been expressed by key fishery stakeholders for a new advisory process. In addition, CDFW resources required for maintaining effective advisory groups are scarce; hence nearshore regional advisory groups have not yet been formed. Management actions at the state and federal level are, however, developed through established constituent input processes and these actions often include regional components.

Allocation

Allocation of allowable catch between recreational and commercial fisheries is one of the more difficult aspects of fisheries management, as participants in each sector differ in their concept of fairness in allocating resources. The MLMA provides limited guidance on allocation, calling for coordination of recreational and commercial fishery management; maintenance of sufficient resources to support a reasonable recreational fishery while encouraging the growth of commercial fisheries; observation of the long-term interests of people dependent on fishing for food, livelihood, or recreation, and minimizing impacts of fisheries management on small-scale fisheries, coastal communities, and local economies; and the fair allocation of increases or restrictions to overall harvest among recreational and commercial sectors participating in the fishery (Fish and Game Code Section 7050 et seq.).

The master plan for fishery management (Master Plan; CDFG 2001), adopted by the FGC in 2001, recognized the difficulties of allocating fish resources and called for developing a framework to determine allocation in advance of decision making. The Master Plan provides some factors to consider when making allocation decisions, including present versus historical participation, economics of the fishery, local community impacts, product quality and flow to the consumer, gear conflicts, non-consumptive values, fishing efficiency, and recreational versus commercial sectors (CDFG 2001). During NFMP adoption, these factors were incorporated into the California Code of Regulations Title 14, Section 52.05, which describes how to determine allocation for the nearshore fishery. They were also included in the allocation discussion in the NFMP (CDFG 2002).

Developing the allocation ratio.—The FGC adopted an allocation formula for cabezon, greenlings, and California sheephead in 2002 for use in 2003, which was built on the approach used during the development of interim regulations in 2000 and based on a ratio of statewide catch taken by the recreational and commercial fisheries during the periods 1983–1989 and 1993–1999. This time frame was chosen because the earlier period (1983–1989) had higher recreational catch, while the later period (1993–1999) had higher commercial catch, and regulations during these time periods were largely unchanged. The years 1990–1992 were not used because no recreational data were available during that time period. This resulted in an allocation ratio between the recreational and commercial sectors of 61:39 for cabezon, 91:9 for greenlings, and 63:37 for California sheephead.

In 2003, the PFMC set the overall allocation of the minor nearshore rockfish south complex at 80:20 between the recreational and commercial sectors, respectively. Within that group, the allocations (based on historic use during the same time periods) were: shallow nearshore rockfish 63:37, California scorpionfish 75:25, and deeper nearshore rockfish 86:14 (Barnes 2002).

Developing rockfish TACs.—Proposed groundfish regulations for 2003 were expected to increase pressure on the nearshore species, so the PFMC split the unassessed rockfish into nearshore, shelf, and slope complexes, which provided closer monitoring of the nearshore fishery. The nearshore rockfish were then split into two complexes north and south of Cape Mendocino based on PFMC management areas (Barnes 2002). However, at the time, state recreational catch estimates were determined north and south of Point Conception, not Cape Mendocino. California Department of Fish and Wildlife staff developed a method to split recreational catch estimates for Point Conception to the California-Oregon border at Cape Mendocino to generate contributions to the two nearshore complex OYs (northern complex: a separate contribution from the California-Oregon border to Cape Mendocino; southern complex: the contribution from Cape Mendocino to Point Conception plus southern California [Point Conception south to the U.S.-Mexico border]). The 2003 OYs (TACs) for nearshore rockfish complexes and other jointly managed NFMP species were established based on the rationale used by the FGC in 2000 when the interim regulations were established; however, total catches from 1994–1999 were used because better accounting of individual nearshore rockfish in the commercial fishery began in 1994.

Applying allocation ratios to TACs.—The allocation ratios were applied to the TACs to determine recreational and commercial harvest limits; regulatory changes for all fisheries followed to keep catches within the allowable limits. Once regional management is fully phased in, the allocation ratios could be revised based on criteria in California Code of Regulations Title 14, Section 52.05.

The allocation ratios remained unchanged from 2003 to 2012, when the FGC revised the ratio for greenlings. In 2011, a new (Stage I) assessment for kelp greenling resulted in a substantially higher TAC (55 metric tons compared to 17 metric tons previously). Using the established allocation ratio, this would have resulted in 50 metric tons allocated to the recreational fishery and 5 metric tons to the commercial fishery. A review of the recreational fishery revealed that it was highly unlikely to take the 50 metric ton allocation, even when increasing the bag limit from 2 to 10 fish. The commercial fishery would remain a bycatch fishery at the 5-metric ton allocation. Thus, the FGC decided to adopt a recreational allocation of 30 metric tons, which was equal to the 2003 landings, the year of highest landings between 1998 and 2010. Rather than leave fish unallocated, the FGC increased the commercial allocation to 25 metric tons. This action resulted in higher trip limits closer to those for cabezon, which would reduce discarding because they are often caught together. Thus, the current greenling allocation ratio is 55:45 to the recreational and commercial fisheries, respectively.

Restricted Access

During development of the NFMP, the commercial fishery was significantly over capitalized, and limiting participation in the fishery through restricted access was utilized to keep catches within TACs. The nearshore restricted access program was developed at the same time as the NFMP and was adopted just after the NFMP, thereby building on the previously established NFP program.

The NFP was first required in 1999, after enactment of the Nearshore Fisheries Management Act in 1998, for the take of 10 shallow nearshore species (Table 2). Initially, the NFP was a nonrestrictive permit (no annual renewal requirement) established in response to the expanding live-fish fishery. In 2000, the FGC adopted regulations for the NFP, making it a restrictive permit (annual renewal required), and adding a moratorium on new permits along with a control date for a future restricted access program (Table 3). In 2001, the FGC added a landing requirement to renew a NFP and set a control date for future gear endorsements. These actions reduced the number of permits issued from 1,127 in 1999 to 505 in 2002 (Table 3).

In 2003, the FGC adopted a regional restricted access program for the NFP species (Table 3) in accordance with the FGC policy on restricted access commercial fisheries (FGC 1999). The permits were regional, and reflected the regional approach taken by the FGC when the NFMP was adopted. The NFP restricted access program was considered a first step in developing regional management for the nearshore fishery, while the FGC and the CDFW worked toward managing all aspects of the nearshore fishery on a regional basis.

There are four different regions (Figure 1) with separate NFPs and capacity goals. To qualify for a permit transfer between regions, two permits must be purchased in the management region and one must be retired. The number of NFPs purchased in 2003 totaled 220 but has been reduced through transfers or non-renewal, to 157 permits in 2013, for an attrition rate of 29%. Despite the reduction in the number of NFPs, each region remains above its goal of 14, 9, 20, and 18 transferable NFPs for the North Coast, North-Central Coast, South-Central Coast and South Coast regions, respectively (2013 permits total 18, 26, 54, and 57, respectively). Twenty-year commercial fishermen who had been active in the nearshore fishery were grandfathered in and received a nontransferable NFP; the capacity goal for nontransferable NFPs is, nevertheless, zero.

Table 3.—Legislative and regulatory acton timeline of California nearshore fishery permit (e.g., Nearshore Fishery Permit [NFP], Deeper Nearshore Species Fishery Permit [DNSFP], Nearshore Fishery Bycatch Permit [bycatch permit]); NFMP=Nearshore Fishery Management Plan.

Year	Action	Permits
1998	Legislature established NFP – no annual renewal	
1999	NFP first required for 10 species	1,127
2000	Commission adopted:	1,007
	NFP	
	Minimum size limits	
	Annual NFP renewal required	
	Moratorium on new NFPs	
	One person on boat needs NFP	
2001	Commission adopted:	746
	A NFP control date (31 Dec 1999)	
	Renewal requirement of 45.4 kg NFP species landed between 1994 and 2000	
	Extended NFP moratorium to 2003	
	Adopted a control date for NFP gear endorsements (20 Oct 2000)	
2002	Additional 9 species added to NFMP	505
2003	Commission adopted:	
	NFP restricted access program with regional permits	220
	DNSFP	294
	Bycatch permit	26
2013	NFP restricted access program with regional permits	157
	DNSFP	191
	Bycatch permit	13

A Nearshore Fishery Bycatch Permit (bycatch permit) was adopted at the same time as the nearshore restricted access program (Table 3) for the incidental take of the nine shallow nearshore species with trawl or gill net gear only. The purpose of this permit was to allow fishermen who had been using these gears to continue to take nearshore species (to minimize wastage) while phasing out the use of these gears. There was concern that trawl and gill net methods, if allowed in the nearshore fishery, could utilize large portions of the TACs, adversely impact habitat (trawl), increase bycatch of other species, and market fresh rather than live fish. Two objectives in the NFMP are to limit the bycatch of nearshore species and all species taken by nearshore fisheries, and to maintain the health of marine nearshore fishery habitat. Additionally, since the TACs for these species were low in 2003,

one of the objectives of the nearshore restricted access program was to preserve the live fish component of the fishery, which offered a much higher ex-vessel price per kilogram. To ensure that bycatch permit holders did not target nearshore species, the FGC adopted daily trip limits in addition to the state and federal bimonthly trip limits already established.

In 2003, 97 individuals qualified for a bycatch permit but only 26 permits were issued. By 2013, the number of bycatch permits was reduced to 13 permits. In 2013, only 5 bycatch permit holders were active (i.e., making at least one landing of shallow nearshore species). Bycatch permit holders account for less than 1% of the total shallow nearshore species landings each year.

Nine deeper nearshore species (Table 2) were added to the NFMP during development because of the anticipated shift in effort to these unpermitted nearshore species as a result of the upcoming restricted access program. The FGC adopted a Deeper Nearshore Fishery Permit (DNSFP) for the take of eight rockfish species in 2002 (Table 3). The DNSFP is a restrictive permit with no gear restrictions, and is not considered part of a true restricted access program because there is no capacity goal and no transferability. In 2003, 294 DNSFPs were issued; through attrition the number has been reduced 35% to 191 permits in 2013.

The DNSFP is statewide, not regional like the NFP. There were modest qualifying criteria of 200 pounds landed between 1994 and 1999 to receive a permit. A control date of 31 December 1999 was set for participation and a control date of 20 October 2000 for possible gear endorsements in case a formal restricted access program was developed at a later date.

Fishery analysis.—The live-fish fishery targeting nearshore species began in the late 1980s (McKee 1993), and expanded throughout the 1990s, both spatially and volumetrically. In 1993, the live-fish fishery focused on shallow nearshore species in the southern and central parts of the state, as evidenced by the ex-vessel price differential for shallow and deeper nearshore species, \$0.92 and \$0.36/kg, respectively. Coastwide, nearshore landings (shallow and deeper combined) totaled 445 metric tons consisting of both live and fresh (dead) fish, mostly shallow nearshore species (303 metric tons; Figure 4), with an ex-vessel value of \$1.7 million.

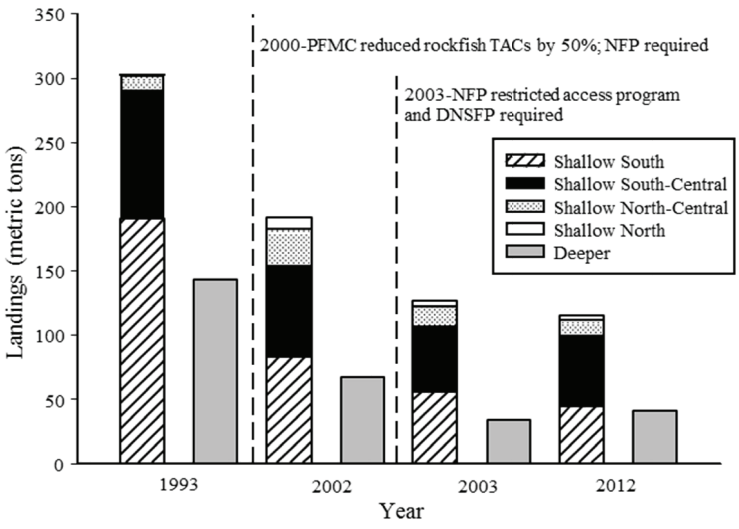

Figure 4.—Comparison of nearshore commercial landings before and after implementation of the Nearshore Fishery Management Plan. Total nearshore landings is the combination of the stacked bar and the grey bar for each year. Data are from California Department of Fish and Wildlife commercial landing receipts. PFMC = Pacific Fisheries Management Council, TAC = total allowable catch, NFP = Nearshore Fishery Permit, DNSFP = Deeper Nearshore Species Fishery Permit.

Ten years later, in 2002 and after the federal 50% reduction in TACs, the live-fish fishery, which now included deeper nearshore species, was fully established in the South and South-Central Coast regions and was expanding into the North-Central and North Coast regions. In 2002, landings were almost half what they were in 1993, with a coastwide total of 258 metric tons of shallow and deeper nearshore species landed (Figure 4) and an ex-vessel value of $2.4 million. Shallow nearshore landings continued to dominate the nearshore fishery, accounting for 74% of the landings and 80% of the value.

Implementation of the nearshore restricted access program and the DNSFP in 2003 reduced landings by another 38%, with the North Coast and North-Central Coast regions having the largest reduction in catch (50%). The northern regions were not as well developed at the time of the restricted access program and, despite different qualifying criteria tailored to the region, fewer fishermen qualified for a permit. Coastwide shallow and deeper landings totaled 160 metric tons (Figure 4), with an ex-vessel value of $1.6 million. Ten years later, in 2012, coastwide nearshore landings (shallow and deeper combined) were slightly reduced (9%) to 155 metric tons compared to 2003 (Figure 4); however, the ex-vessel value increased to $2.1 million. Average price per kilogram was similar between the regions, with the highest price paid in the South-Central and North-Central Coast regions. This is perhaps due to proximity to the San Francisco area, where the demand for live fish is at its peak.

Permit analysis.—In the nearshore fishery, there are three de facto permit holder classes excluding bycatch permit holders: NFP only, NFP and DNSFP, and DNSFP only. Of the three permit holder classes, the class with both a NFP and a DNSFP is the most active (i.e., landing ≥250 kg in a year) with 72% participating each year. Those with only a NFP are also quite active with 54% participating in a given year. Those with only a DNSFP are least active, with only 19% participating in a given year.

Regional analysis.—This regional analysis is based on landings from 2003 to 2013, encompassing all the years of the nearshore restricted access program and DNSFP. The North Coast Region accounts for 32% of all nearshore landings (Figure 5), focusing

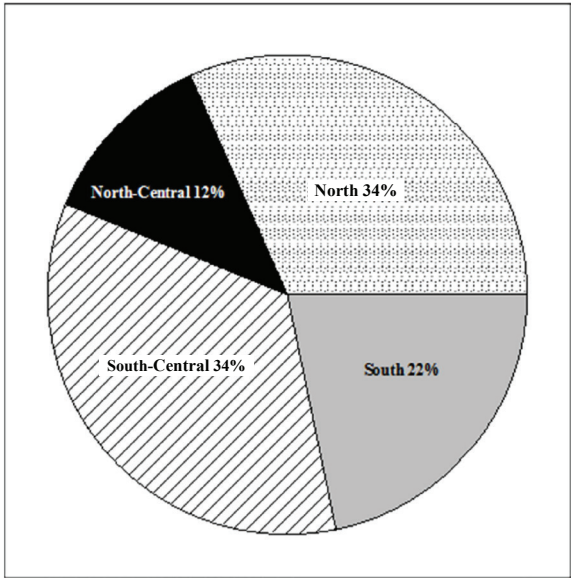

Figure 5.—Commercial nearshore fisheries landings (shallow and deeper combined) by region, 2003–2013. Data are from California Department of Fish and Wildlife commercial landing receipts.

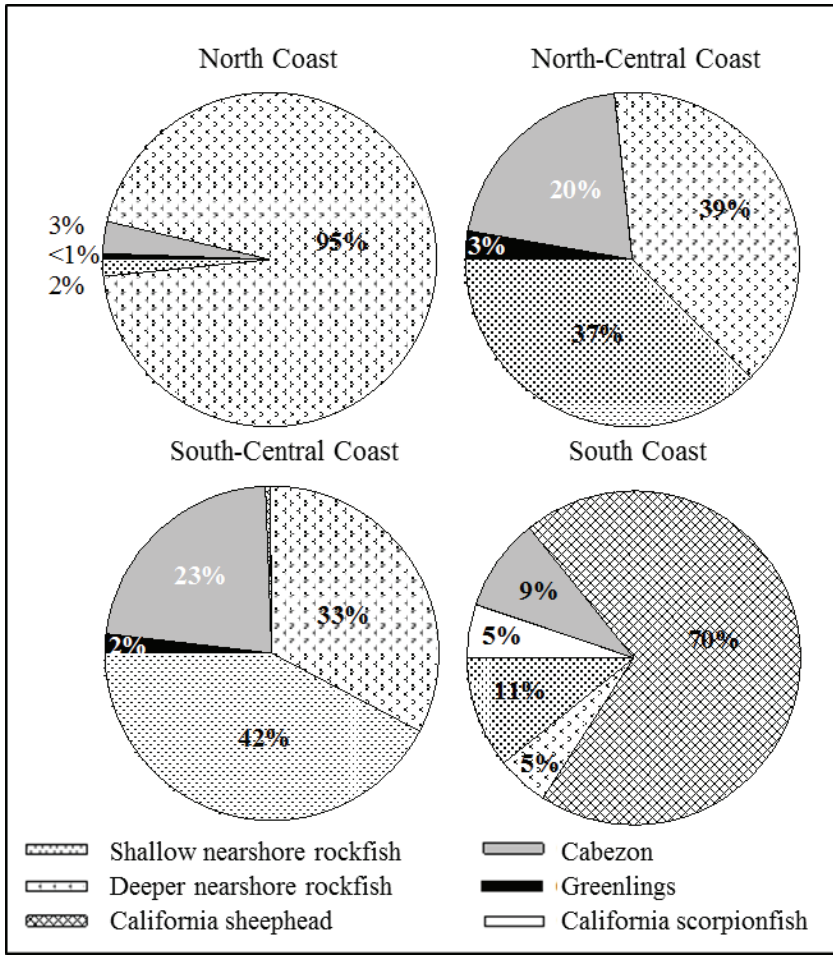

Figure 6.—Nearshore fish species regional commercial landings composition, 2003–2013. Data are from California Department of Fish and Wildlife commercial landing receipts.

on deeper nearshore rockfishes (95% of North Coast Region landings), with small landings of cabezon, shallow nearshore rockfish, and greenlings (Figure 6). This emphasis on deeper nearshore rockfish is due to their much higher trip limits available north of Cape Mendocino. The North-Central Coast Region accounts for 12% of nearshore landings (Figure 5), focusing on deeper and shallow nearshore rockfishes (39 and 37%, respectively), with cabezon and greenling making up the remainder (Figure 6). The South-Central Coast Region accounts for 34% of nearshore landings (Figure 5), focusing on shallow and deeper nearshore rockfishes (42 and 33%, respectively), with cabezon and greenlings making up the remainder (Figure 6). The South Coast Region accounts for 22% of nearshore landings (Figure 5). In this region, the focus shifts dramatically with California sheephead comprising the majority of landings (70%); a mix of shallow nearshore rockfish, cabezon, California scorpionfish, and deeper nearshore rockfish are also present in the landings (Figure 6). The shift to California sheephead is due to its availability in the region as well as its popularity in the live-fish market, where it is called the "fish of good health".

Marine Protected Areas

The NFMP considered MPAs as another management tool and proposed design guidelines for their use. These guidelines included protecting 10 to 20% of key habitats for NFMP species from fishing depending on the level and success of management outside the MPAs. Two key objectives for MPAs proposed by the NFMP were to preserve nearshore habitat and ecosystems, and to use MPAs as "reference reserves" that could be compared over time to similar fished areas as a means to evaluate stock health. The NFMP recommendations relative to the use and role of MPAs included the objectives of (1) insuring that MPAs met the goal of conservation of nearshore communities; (2) spacing MPAs as a network so that their connectivity would maximize successful larval transport or movement of the fish they were protecting; (3) sizing individual MPAs large enough to protect adequate spawning biomass for species that were largely resident and had home ranges on the order of a few km^2; and (4) ensuring MPAs encompassed a variety of habitats, which were replicated along the coast (CDFG 2002). At the time, localized benefits of MPAs were well documented (Dugan and Davis 1993, Roberts 1998, Ocean Studies Board 2001, Palumbi 2001), although the full regional effects and true benefits of a network functioning as envisioned in the NFMP were unknown (Palumbi 2001). The NFMP highlighted the need for adequate research and long-term monitoring to determine any real benefits to NFMP species and the fisheries they support. Although the NFMP proposed specific criteria to benefit NFMP nearshore species, the NFMP deferred establishment of MPAs to the concurrent efforts to implement the new MLPA. As a result, it was uncertain how MPA design and monitoring plans would be incorporated into nearshore fishery management.

The MLPA implementation process was initiated in 1999 following enactment of the new statute, so its initial progress was coincident with the development of the NFMP. Ultimately, it took 14 years and three attempts to revise existing or establish new MPAs in four coastal regions (Figure 1). By 2012, the planning process was completed along the coast when the FGC adopted 27 MPAs in the northern region of the state. California now has the largest scientifically designed network of MPAs in the continental U.S. and the second largest in the world, including 124 separate areas with varying levels of protection encompassing almost 2,207 km^2 of the state's coastal waters. The network includes 58 no-take MPAs (State Marine Reserves [SMRs]) encompassing 1,705 km^2 of coastal waters and habitats.

All SMRs and many State Marine Conservation Areas (SMCAs) protect the NFMP species from take and incorporate a variety of habitats vital to NFMP species including the rocky intertidal, kelp forests, and shallow (0–30 m) and deep rocky reefs (30–100 m). The statewide network includes almost 100 linear km of rocky intertidal or cliff habitats and 44 km^2 of subtidal kelp and rocky reef habitats shallower than 100 m closed to most fishing for nearshore species. Together these areas represent 20% of those habitats along the coastline and in state waters (Figure 7), based on existing knowledge of species habitat use and mapped habitat (M. Parker, CDFW, unpublished data). This is likely a conservative estimate of their overall protection, given that these species also make use of other protected habitats (e.g., some soft bottom habitats and submarine canyon habitats out to 100 m), not all state waters have been mapped, and areas within Rockfish Conservation Areas—but not in MPAs—also provide some nearshore species protection.

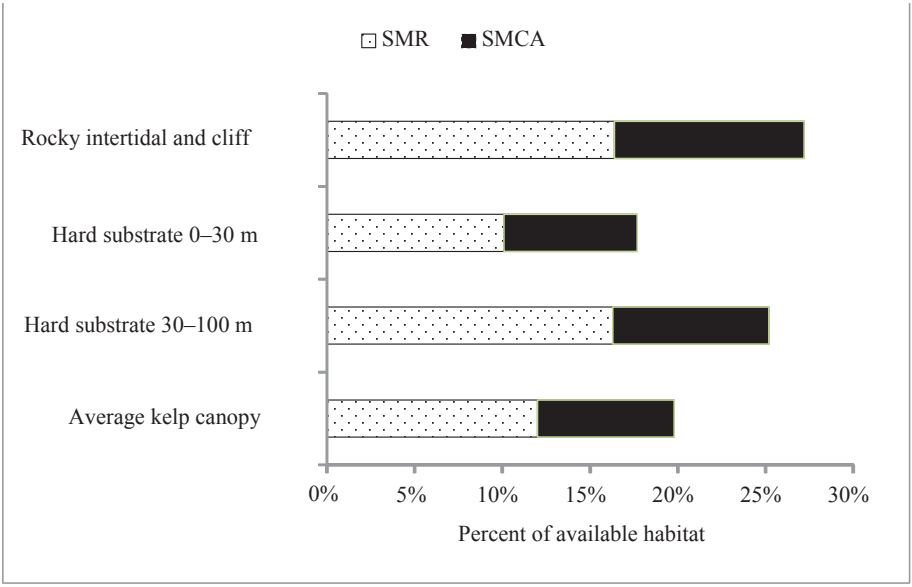

Figure 7.—Percentage of estimated appropriate habitat for Nearshore Fisheries Management Plan (NFMP) species in state waters that are in State Marine Reserves (SMRs) or State Marine Conservation Areas (SCMAs), and in which fishing for NFMP species is prohibited. Data sources: California State University Monterey Bay, Fugro Pelagos Inc., United States Geological Survey, National Oceanographic and Atmospheric Administration, Ocean Imaging, and California Department of Fish and Wildlife. Average kelp canopy was based on the years of available data: 1989, 1999, 2002–2006, and 2008.

MPA monitoring.—The NFMP envisioned MPA monitoring that would include ongoing, cost-effective research to assess the characteristics of NFMP species (e.g., fish size, density, abundance, proportion of adults and juveniles) inside and outside MPAs as a fishery management tool (CDFG 2002, Babcock and MacCall 2011). In fact, comparing NFMP species densities between fished and unfished areas over time was considered a possible alternative to data-intensive full stock assessments (CDFG 2002). However, this approach is dependent on establishing a robust, long term monitoring program focused on tracking trends through time. To be valuable for fisheries management of particular NFMP species, a robust program requires sufficient geographic coverage, sampling and replication to distinguish between trends (e.g., changes in abundance, size) and natural variation. To date, CDFW has not dedicated resources toward an MPA monitoring program with this emphasis. However, in 2011 CDFW hosted a workshop to begin investigating how MPAs could be used in fisheries management and which fisheries might benefit (Wertz et al. 2011). A follow up workshop was held in May 2014.

As MPAs were established in each region, the MPA Monitoring Enterprise (a program of the California Ocean Science Trust), in partnership with CDFW, has completed a collaborative effort including input from agencies, scientists, and the public, to develop an overall MPA baseline and ongoing monitoring framework. The framework includes indicators to track trends in ecosystem condition, evaluate the effectiveness of MPA design, and inform adaptive management (Gleason et al. 2013). To date, regional MPA monitoring plans that apply this framework have been developed for three MLPA regions (MPA Monitoring Enterprise 2010, MPA Monitoring Enterprise 2011). The CDFW also

collaborates with the MPA Monitoring Enterprise, California Ocean Protection Council, and California Sea Grant to develop regional MPA baseline monitoring programs that are designed to establish an ecological and socioeconomic benchmark against which future MPA performance can be measured. Baseline MPA monitoring programs have been initiated or completed for all four coastal MLPA regions, and the results from baseline programs are expected to inform the development of cost-effective continuing MPA monitoring programs (Frimodig 2014). Monitoring results may eventually be used for evaluating MPA connectivity, demonstrating network functionality, monitoring impacts from climate change, and assessing ecosystem protection. As such, the overall monitoring will take a broader view of the ecosystem as a whole, rather than a more focused look at particular fisheries as described above. Components of the monitoring plans specifically focused on fisheries management are found in MPA Monitoring Enterprise (2010) and MPA Monitoring Enterprise (2011). Some of the indicator species identified in the plans for monitoring have commercial or recreational importance and are NFMP species.

So far, baseline monitoring has been initiated in three of the four MLPA regions (Frimodig 2014). Results of monitoring California's MPAs have shown some limited benefits to NFMP species within MPAs (COST and CDFW 2013), although much of the current focus has been on establishing a baseline or starting point. Some of the baseline monitoring focused on inside-outside comparisons and trends in fished species (Wendt and Starr 2009) could be useful for assessments in future years when a longer time series becomes available.

Other Aspects of Nearshore Fishery Management

Research needs.—The NFMP management framework is based on science and research and, at the time of development, laid out a strategy for the CDFW to improve existing information for more effective and sustainable management. Some of the identified needs included the collection of more EFI, the improvement of information for stock assessments and of existing catch monitoring and estimation methodologies, and the development of a better understanding of the nearshore ecosystem and the importance of the NFMP species within that ecosystem. These were to be accomplished by building on the specific approaches in the NFMP (e.g., sustainable FCRs, effective regional management, MPAs that benefit nearshore ecosystems, and a successful restricted access program; CDFG 2002).

As stated in the NFMP, "The CDFW's research plan rests on two bases: improvement of existing fishery-dependent and fishery-independent monitoring and assessment, and a systematic program of research and monitoring in a discrete set of reference sites" (CDFG 2002). However, available staff and fiscal resources necessary to accomplish this strategy are constrained, so CDFW support of outside efforts through collaborative partnerships has been maximized. Efforts since 2002 have addressed some of the major data gaps and have improved our understanding of the status of the majority of the NFMP species in California waters (Table 2). In addition, the technology and methods available to collect, analyze, store, utilize, share, and convey new and existing information have greatly improved.

Improvement of fishery-dependent and fishery-independent monitoring.—A new recreational sampling program, California Recreational Fisheries Survey (CRFS), was im-

plemented by CDFW in 2004 in partnership with the Pacific States Marine Fisheries Commission, with the intent to improve upon the existing federal recreational fisheries survey program. The new CRFS program divides the state into six districts from the previous two (north and south of Point Conception), which increases the sampling effort for boat-based fishing, where most nearshore species are caught; increases the previous efforts for collecting location specific catch information; and greatly improves the estimation procedures. All of these changes have benefited management of the NFMP species, and have resulted in the collection of recreational data at the resolution required for regional management and monitoring. There have been few changes in the gathering and monitoring of commercial fisheries data in the past 12 years. Biological sampling of the commercial live-fish fishery continues to be challenging due to limited resources and the handling stress caused to the high value live-fish, which impacts sampling efforts. Although a voluntary commercial logbook program was tested, it has not been implemented (Thomson et al. 2007).

Improvements to fishery-independent monitoring for the NFMP species have been modest since 2002, with the exception of those related to MPA monitoring, or already ongoing efforts by outside entities (e.g., Cooperative Research and Assessment of Nearshore Ecosystems [CRANE], Partnership for Interdisciplinary Studies of Coastal Oceans [PISCO]). The focus of the MLPA initiative on nearshore species helped increase available EFI on NFMP species by focusing some research toward information critically important for MPA siting or monitoring. These efforts included tagging and comparing movement patterns of three species (blue rockfish, kelp rockfish, and kelp greenling; Freiwald 2009) and fisheries research conducted from 2007 to 2009 at the Santa Barbara Channel islands as collaborative MPA monitoring (Kay et al. 2007). Focal species in Kay et al. (2007) included cabezon, grass rockfish, and California sheephead, and one study objective was to collect life history data and EFI for use in traditional and alternative (i.e., MPA-based) stock assessment models, which should benefit management and assessment work (Wilson et al. 2010).

As MPAs are implemented, some of the consequent MPA monitoring already occurring focuses on the nearshore ecosystem that includes the NFMP species, and may improve EFI for those species. Monitoring efforts related to MPAs and reference reserves are detailed below.

Improvements to resource assessment.—Over the past 12 years, CDFW has led and contributed effort in many forms to improve stock status information for the NFMP species. CDFW staff collaborated on a NMFS project to complete a historic catch reconstruction for California's recreational and commercial fisheries (Ralston et al. 2010). Although this project is ongoing, the improved catch data have been used in recent stock assessments for brown rockfish, China rockfish, and copper rockfish. The most recent stock assessments for California sheephead, California scorpionfish, gopher rockfish, blue rockfish, and cabezon were supported by CDFW (Alonzo et al. 2004, Maunder et al. 2006, Key et al. 2006, Key et al. 2008, Cope and Key 2010). The CDFW also contributes to efforts to improve methods for data limited species (Field et al. 2010). In late 2008, CDFW sponsored a fisheries management workshop in conjunction with University of California Sea Grant Extension Program to encourage international fishery managers and scientists to seek better ways to manage California's nearshore stocks in data-limited conditions (Starr et al. 2010). One outcome of the workshop was an effort to determine the potential of more formal management procedures to be used as decision-making tools for California fisher-

ies, including the nearshore. This study included a meta-evaluation of the NFMP species to find reasonable management procedures, using available metrics that could be used in lieu of species-specific management (Bentley and Stokes 2011). More recently, a stock assessment review panel evaluated data-moderate assessments of brown rockfish, China rockfish, and copper rockfish (Cope et al. 2013) and those results will be used in management.

To improve EFI for stock assessments, age and growth information have been completed for cabezon (Grebel and Cailliet 2010) and olive rockfish (J. Grebel, CDFW, personal communication, 17 July 2014), and are in progress for copper rockfish (C. McKnight, CDFW, personal communication, 26 March 2014). Schmidt (2014) recently described changes in life history parameters (e.g., age at maturity, fecundity) of female blue rockfish after long term, high fishing pressure on the species. Some efforts to collect EFI have also been useful for MPA monitoring and siting.

Central to improving our understanding of stock status, nearshore ecosystems, and the role of reference reserves is better knowledge of nearshore habitats. The California Ocean Protection Council made surveying and mapping seafloor bottom habitats along the coast a priority in 2006 (COPC 2007), primarily to benefit the MPA siting process. The plan was to complete the mapping of all seafloor habitats within California state waters (shoreline out to 5.6 km). In 2007, they authorized spending up to $15 million for this effort. This effort is ongoing as methods for surveying very nearshore waters improve and should return dividends for many years.

Research and monitoring in reference reserves.—Although CDFW did not have any ongoing long-term monitoring in place prior to the development of the NFMP, there were several programs in place led by other institutions. The CRANE program began as the NFMP was being implemented and was an attempt by CDFW and nine partners (including universities and other government agencies) to build on existing monitoring programs to provide a more comprehensive monitoring effort for the nearshore (Tenera 2006). The goal was a collaborative monitoring program on a scale that could be used for assessment and management of rocky reef ecosystems. The collaborative effort determined which metrics would be most important for assessment and management and, more importantly, developed consistent sampling designs and methodologies to be used with the reference reserve concept. In 2004, CRANE completed a cooperative sampling effort to provide information for managing California's nearshore rocky reef fish and invertebrate populations using the established protocols. The CRANE objectives were to estimate fish densities; measure population size structure for key species; and measure habitat and ecosystem components that can be associated with changes in density and size distributions over space and time (Tenera 2006). Funding for the collaborative sampling effort was provided by the federal Coastal Impact Assistance Program. From 2005 to 2007, a similar, smaller scale study occurred. A subset of the original collaborators studied density measurements and size frequency of nearshore fish at select locations, primarily in conjunction with established MPAs at the Santa Barbara Channel Islands and in areas of the central coast where MPAs were being considered. To date, there have been no additional CRANE surveys that would become incorporated into a routine, long-term monitoring effort.

Many research surveys of varying temporal and spatial scales have been conducted since 2002 and focused on MPA monitoring; benefits to fisheries management vary considerably depending on their scope. One such program is PISCO, which is a long-term monitoring and research program designed to understand the California Current ecosys-

tem. A major focus of PISCO science is the design and monitoring of MPAs using their experience with long-term monitoring programs and baseline monitoring efforts. Another collaborative study, which has been ongoing for several years, involves recreational hook and line monitoring inside and outside MPAs. This study has provided useful information for MPA monitoring along the central California coast (Wendt and Starr 2009). The intent is that the study results could be used to develop abundance indices of nearshore species with enough years of data. Because NFMP species make wide use of habitats in the nearshore ecosystem and vary in their availability for visual or fishery survey methods, some investigators have evaluated and compared the success of various methodologies to survey individual species (Starr et al. 2006, Karpov et al. 2010). These results will contribute to study design for future monitoring and increase confidence for interpreting observed trends.

Recreational fishery.—Early in the development of the NFMP there were discussions regarding limiting recreational access to nearshore fishes via a stamp requirement, although this did not proceed as shorter seasons and lower bag limits designed to protect overfished shelf rockfish species were implemented. The recreational fishery had few limitations prior to 2000. The season was open year-round, the daily bag limit was 15 rockfish (all species combined), and there were no depth restrictions. State and federal actions in 2000 that reduced rockfish TACs by 50%, along with drastic reductions in the harvest guidelines for overfished shelf species resulted in numerous changes to the recreational rockfish fishery in the subsequent years. It was a challenging time for anglers, the fishing industry, coastal communities, and fishery managers. To reduce the take of overfished shelf species, spatial, temporal, and depth-based restrictions that closed the shelf forced fishermen into shallower waters. In 2000, the recreational daily bag limit was reduced to a combination of 10 rockfish, cabezon, and greenlings, and in some years there were sublimits for some species (e.g., shallow nearshore rockfish, cabezon, and greenlings). The number of hooks was reduced from 15 to 3 in 2000, then to 2 in 2001. The coast was split into various management areas, up to seven different areas in some years, with different seasons and depth restrictions (37–91 m) in an effort to maximize fishing opportunities while limiting the bycatch of overfished species. In the early 2000s, there were times when one or more recreational management areas were closed for six months or longer. Then in several years, emergency in-season actions were taken to close the fishery or otherwise reduce or curtail effort to prevent exceeding harvest limits. Over time, as CDFW and PFMC have become better able to estimate catch and predict fishing activity, and additional nearshore species are assessed and TACs increased, the early closures of the recreational rockfish fishery ended, and the seasons and depth restrictions currently change less frequently.

Transfer of authority.—As mentioned above, most of the nearshore species are co-managed by the state and federal governments, with 16 of the 19 NFMP species also listed in the federal GFMP (Table 2). Fourteen of the 16 species are actively managed by the PFMC; cabezon and kelp greenlings are managed by the PFMC but are more actively managed by the state, which sets trip limits by regulation and can modify trip limits or close sectors if necessary. Three nearshore species are managed exclusively by the state: California sheephead, monkeyface prickleback, and rock greenling. Some of the nearshore species (e.g., black rockfish, cabezon) are also included in fishery management plans of other states, further complicating management of these species at the federal level.

To decrease the complexity of managing these nearshore species and to fully implement the NFMP, that plan proposed that the state request a transfer of authority for some

or all 16 nearshore species listed in the GFMP. This action requires an amendment to the GFMP to remove the requested species from the GFMP, and requires that CDFW assumes responsibility for all aspects of management, including management measures, research, stock assessments, monitoring fishing activity, biological sampling, and enforcement.

Transferring authority for these species, which occur in and are fished primarily in state waters, is desired by the FGC and the CDFW; however, lack of stable funding required to fully manage the nearshore species has kept CDFW from requesting a transfer of authority. Instead, CDFW works closely with the PFMC and NMFS to develop management measures so that the nearshore species are managed to the more conservative standards of the NFMP. One example of this coordination is in setting OYs or TACs. In 2005, the PFMC used the state's more restrictive FCR (60-20) to set the cabezon TAC in California waters after a 2004 stock assessment revealed a cabezon biomass at 35% $B_{Unfished}$ off California. The FGC then set the same TAC and recreational and commercial allocations according to the established allocation ratio, and then management measures were appropriately revised.

Because it has been possible to incorporate the more conservative NFMP requirements into the federal management process, it is now questionable whether the benefits of transferring authority to the state (e.g., situations for when the state wants to be less restrictive) would outweigh the costs (i.e., need for additional resources). Even though California does not have sole management authority for the nearshore species, CDFW actively manages the nearshore fishery in many ways (Appendix I).

Enforcement.—Prior to 2002 and during the expansion of the live-fish fishery, enforcement and monitoring of fishing and landings were very challenging. The commercial nearshore fleet was expanding in an unregulated fashion, making it difficult to identify participants from recreational anglers and track activity; vessels were fishing all along the coast and landing fish at all hours of the day or night (sometimes at roadside pullouts), and on-the-water enforcement was limited. There were many small-scale buyers that were hard to identify and track. The amount and locations of stick gear, a type of connected hook-and-line gear of up to 1,000 hooks with multiple vertical lines and flotation at either end to keep gear just off the bottom, in the water was also problematic. Beginning in the early 1990s, gear was everywhere in the nearshore, including within harbor mouths and along their jetties (where high-value cabezon and grass rockfish lived) and interfering with navigation and safety to the point that harbor districts responded in a coordinated fashion with regulations to prevent that activity (S. Cabral, personal communication, 5 August 2014).

Many of these challenges have been addressed over the past 12 years. Rampant fleet expansion and unregulated participation has been replaced with a much reduced number of identifiable permittees. The number of dealers is also much reduced and more organized, making tracking more straightforward. Additionally, new regulations resulted in more accountability of where fish are coming from. The implementation of MPAs and a state commitment to their protection has increased a watchful presence of the nearshore, and enforcement response to potential violations has a high priority. For example, from 2007 to 2012, 9.5% of marine-related violations along the central coast were MPA-related (COST and CDFW 2013). On-the-water presence has also increased with the acquisition of newer, larger, modernized patrol vessels and new agreements or increased coordination with other state and federal enforcement partners. Nearshore commercial fishermen who

also fish for groundfish (open access) in federal waters have been required to carry vessel monitoring systems on their vessels since 2008. Limitations on stick gear to reduce the total number of hooks used to take nearshore fish to 150 (and only 15 hooks per line) also were implemented.

Accounting for bycatch.—Information on the amount and type of bycatch is required in state (Fish and Game Code Section 7085) and federal law (MSA 2006). Improvements have been made in collecting information to account for total mortality in both the commercial and recreational nearshore fisheries. Historically, the nearshore commercial fishery has been difficult to observe and does not have the level of coverage as those groundfish fisheries further from shore. The West Coast Groundfish Observer Program (NMFS) produces annual mortality reports (http://www.nwfsc.noaa.gov/research/divisions/fram/observation/data_products/species_management.cfm) that are used by management to evaluate harvest guidelines. The CRFS collects information on fish kept and released, and produces estimates of total marine recreational finfish catch and effort in California, including discards.

With a federal mandate for "total catch accounting", the PFMC developed discard mortality rates to be applied to nearshore groundfish released in the recreational and commercial fisheries. This information is used as part of the catch history in stock assessments and for catch tracking. Since 2012, the PFMC has discussed methods that can be employed to increase survival of rockfish released in the recreational fishery that enable fish to be successfully released at deeper depths; a decrease in discard mortality has been demonstrated when descending devices are used to release fish (Jarvis and Lowe 2008). The PFMC has adopted depth-dependent mortality rates, based on using descending devices (PFMC 2014), to be applied to some overfished species, among which are cowcod, canary rockfish, and yelloweye rockfish. Further research is needed, however, to fully understand the benefits of these descending devices.

In the Future

The CDFW has made substantial progress implementing the NFMP, given the limitations in data and resources. Prior to 2002, none of the nearshore species had been assessed, and in 2013, 10 species (>50%) have been assessed. Regional management has been established, in part, with the NFP restricted access program and regional recreational monitoring and catch estimation. While not all aspects of the nearshore fishery are regional or the same regions as the NFP, there is an effort to conduct stock assessments and set trip limits on a regional basis, when there are sufficient data to support it. As TACs change, the allocation of nearshore fish stocks is reassessed, following the original guidelines or changing the allocation ratios when necessary, to maximize opportunities while preserving historical sector preferences. The NFP restricted access program is getting closer to its regional capacity goals, although these goals may need to be revisited in light of increases to the TACs as shallow nearshore species are assessed. The establishment of a network of MPAs lays the groundwork for future use of these areas as a way to monitor the health of the nearshore ecosystem; however, monitoring is just beginning in some regions, so it will be a long process. The continued collection of EFI for nearshore species, especially for unassessed or vulnerable species with high PSA scores (Table 2), is essential to sustainably manage the nearshore fishery. For those species that have been assessed, better EFI is also

important for species to progress from Stage II to Stage III assessments (Table 2) to meet the mandate of ecosystem-based management. Additional EFI could also make it possible to begin allocating fish on a regional basis. Once CDFW increases its stock assessment capabilities and has sufficient funding to assume responsibility for the other aspects of managing the nearshore fishery, it may be time to re-consider transferring authority for the nearshore species in the GFMP to the state, although co-management is working smoothly at this time.

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Appendix I: Methods Used by the California Department of Fish and Wildlife to Actively Manage the Nearshore Fishery

Performing the analyses and providing recommendations on setting state and federal harvest limits (e.g., harvest guidelines, total allowable catches [TACs], optimal yield [OYs], and annual catch limits [ACLs]) and management measures

Allocating between recreational and commercial fisheries

Conducting in-season monitoring of nearshore rockfish, cabezon, California scorpionfish, California sheephead, and greenlings along with overfished shelf rockfish species

Modifying or closing recreational seasons, or adjusting depth restrictions or bag limits to keep within allowed catch

Closing commercial fisheries or adjusting trip limits as needed to keep within allowed catch

Conducting or participating in stock assessments for nearshore species

Conducting or collaborating on research on nearshore species to better understand aspects of their life history

Addressing minimization of bycatch and reducing discard mortality

Enforcing Nearshore Fishery Management Plan implementation through increased monitoring and protection