

# Spiny lobster (*Panulirus interruptus*)

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## Certification Units Considered Under this Species:

- California Trap fishery

## Summary

The California fishery for spiny lobster takes place south of Point Conception, California to the California-Mexico border. It is managed by the Fish and Game Commission and the California Department of Fish and Wildlife via a limited access program (limit on number of permits issued), seasonal closure, and gear and size restrictions. Based on the 2011 stock assessment, the spiny lobster population off southern California appears to be stable. Support for this determination includes consistently large harvest levels, harvest rates, and sizes of animals caught by both the commercial and recreational fisheries. Bycatch from lobster traps are low, but are generally reported and not quantified. A spiny lobster Fishery Management Plan (FMP), as required by the Marine Life Management Act, is currently being developed by the California Department of Fish and Wildlife and is expected to be adopted in 2015 and will contain harvest control rules. The spiny lobster trap fishery on the Pacific coast of Baja California is currently certified by the Marine Stewardship Council (MSC)<sup>1</sup>.

## Strengths:

- Stock assessment indicates population is currently stable
- Low impacts to incidental caught species, and endangered, threatened and protected species

## Weaknesses:

- Currently no target or limit reference points (though likely presented in the FMP in 2015)
  - Bycatch rates are unknown, although preliminary research is being conducted
  - Habitat impacts from trap gear in California not well document
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<sup>1</sup>The MSC Assessment for the Baja California spiny lobster trap fishery may be accessed here: [http://www.msc.org/track-a-fishery/fisheries-in-the-program/certified/pacific/mexico-baja-california-red-rock-lobster/assessment-downloads-1/Final\\_-BC-Lobster\\_032704.pdf/at\\_download/file](http://www.msc.org/track-a-fishery/fisheries-in-the-program/certified/pacific/mexico-baja-california-red-rock-lobster/assessment-downloads-1/Final_-BC-Lobster_032704.pdf/at_download/file)

## History of the Fishery in California

### Biology of the Species

The California spiny lobster, *Panulirus interruptus*, is endemic to the west coast of North America from Monterey, California southward at least as far as Magdalena Bay, Baja California (Wilson, 1948; Schmitt, 1921), with a small isolated population in the northwestern corner of the Gulf of California (Kerstitch, 1989).

Spiny lobsters are found in rocky areas often with plant communities dominated by giant kelp (*Macrocystis* sp.), feather boa kelp (*Egregia* sp.), coralline algae (*Corallina* sp.), and surf grass (*Phyllospadix* sp.) (Lindbergh, 1955). They are also associated with eel grass (*Zostera* sp.) which flourishes in sandy areas (CDFG 2001). Spiny lobsters are a major predator of benthic invertebrates and act as a keystone species preying on mussels along rocky shores (Robles et al., 1990) and on sea urchins in kelp forests (Tegner and Levin, 1983; Lafferty, 2004). Primary predators on lobster include sheephead (*Semicossyphus pulcher*) and black sea bass (*Stereolepis gigas*) (Loflen, 2007), horn shark, leopard shark, octopus, and sea otters (Loflen, 2007; CDFG and Sea Grant, 2008).

Spawning occurs once a year during late spring through summer (January – April) (Johnson, 1960) in which female eggs (approximately 50,000 to 800,000) are fertilized by a male spermatorphore and carried under the abdomen of the female until hatching (CDFG 2011b). Embryos hatch into planktonic larvae which spend approximately 10 months in the open ocean (Mai & Hovel, 2007), where they can be transported up to 350 mi (563 km) offshore, and are found from surface depths to greater than 400 ft (107 m). During planktonic development, larvae shed their outer skeleton (molt) 12 times until metamorphosing into puerulus larvae that swims inshore and settle as juveniles on mussel or surf grass beds which serve as a nursery for about 2 years (Booth et al., 1994). Lobsters typically reach sexual maturity in 5 to 6 years (or approximately 2.5 in / 6.35 cm carapace length), and reach legal size at 7 to 10 years. Males and females can live to 30 and 20 years, respectively.

### Commercial Fishery

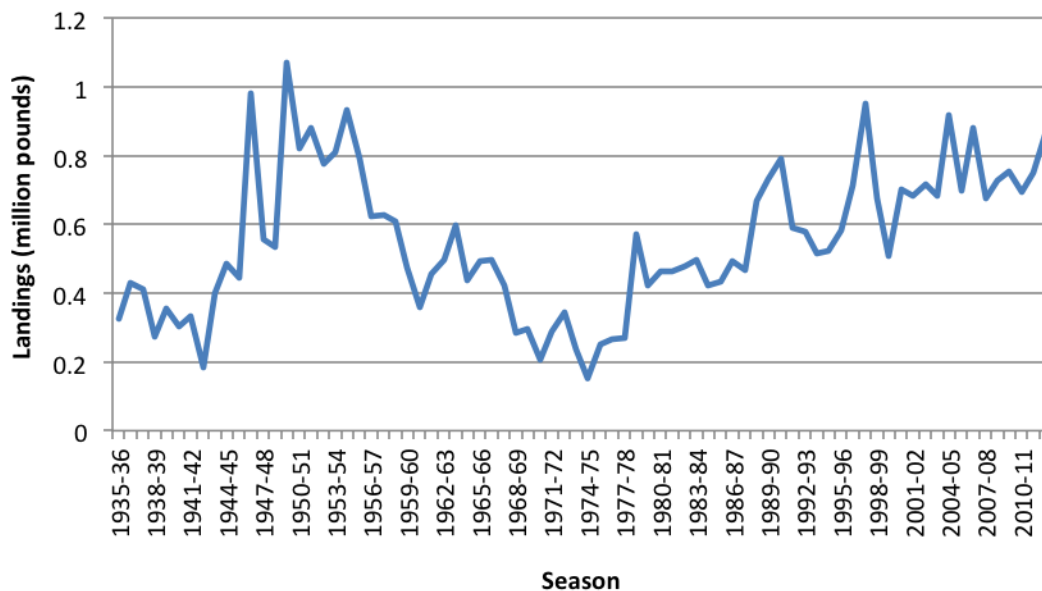
[From CDFW 2013a unless cited otherwise]:

California spiny lobster have been fished in southern California since at least 1872. The commercial fishery originated in Santa Barbara County and expanded as the number of fishermen increased. By 1900, the fishery encompassed the entire Southern California Bight (SCB) and most of the offshore islands. Today's lobster population is the product of a century of commercial fishing with few areas historically off limits to fishermen.

Each lobster fisherman typically uses from 300-400 traps on average (Barsky, pers. comm.). Lobster traps are typically constructed of wire and rectangular in shape that are baited with fish and placed on the sea floor in water less than 100 ft (30 m) in depth, or around rocky outcrops. Fishery boat size ranges from 15 to 50 ft vessels (5 to 15 m).

Individual landing receipts date back to 1969-70 season which include information on port of landing, business purchasing the catch, fisherman ID, pounds landed and where the catch originated (CDFW 2011b), and only seasonal or annual totals by port exist prior to 1969-70. Over the decades commercial landings have fluctuated, reaching a high in the early 1950s, followed by a decline until the mid 1970s (Figure 1). There were multiple reasons for this

decline, but a major contributing factor was the landing of sub-legal size (short) lobster. In 1957 the California Department of Fish and Wildlife (CDFW) implemented a minimum 2 in by 4 in (5 cm by 10.2 cm) mesh size requirement for commercial traps specifically to reduce the taking of short lobster. However, this gear requirement did not fully solve the problem. Consequently, in 1976, the Department required an escape port in all commercial traps. The size of this horizontal escape port enables a short lobster to freely exit the trap.



**Figure 1.** California spiny lobster commercial landings from 1935-36 to 2012-13 seasons based on commercial landing receipts, all gear types combined.

The abundance of California spiny lobster also fluctuates with broad-scale environmental changes caused by El Niño and La Niña events. Commercial catch data show inter-annual variations that correlate with changes in water temperature and oceanographic and weather patterns associated with these events (CDFG 2001; CDFG 2011a).

Since 2000, the total catch over time each season has accumulated at the same rate as each season progresses. The largest landings occur within the first two weeks of the 26-week season. Eighty percent of the season’s total catch is landed by the fifteenth week of the season. The catch is usually evenly divided between three regions: Santa Barbara/Ventura counties, Los Angeles/Orange counties, and San Diego County. A relatively small area extending from Point Loma to La Jolla in San Diego has dominated the catch since at least 1975, consistently accounting for approximately 15 percent of the total southern California catch. The 10-year average catch for the commercial fishery through the 2010-11 season is 734,000 lbs (332,937 kg) (CDFW 2011c). The ex-vessel value of the 2012-13 lobster season was \$14.3 million.

The average weight of an individual lobster in the catch has been fairly consistent over the last decade at 1.4 lbs (0.6 kg). CDFW lobster survey data shows that both recreational and commercial catch are composed mostly of lobster that have attained legal size within the last one or two years. Although larger sized lobster exist, the majority of the lobster catch consists of individuals that have just reached legal size. Further support for this is found in the number

of short lobster released each season. Over the last decade, fishermen have had to release 70 to 80 percent of the lobster caught within the SCB each season because they were undersized. Within each county, the percentage of lobster released has also remained fairly consistent over the last decade.

## **Recreational Fishery**

The Fish and Game Commission (FGC) regulates the recreational fishery, which includes snorkelers, scuba divers and baited hoop netting, the latter which was first allowed in 1955 (CDFW 2011a; CDFW 2011b). The recreational fishery landings of lobster were approximately 33% (2008), 38% (2009) and 33% (2010), 34% (2011), and 28% (2012) of total lobster landings (recreational and commercial combined) (CDFW 2011a).

Landings data was not collected until fall 2008 where CDFW introduced a Recreational Spiny Lobster Report Card. Now, every recreational lobster fisher must have a Spiny Lobster Report Card in their possession and record the month, day, location, gear used, and number of lobsters harvested. All report cards must be returned to DFW even if no lobsters were taken. Approximately 30,000 report cards are sold each year, with 37,193 sold in 2012 (CDFW 2013a). Initially, report card returns were low; however, in 2012 CDFW doubled the returns to 32% by sending out a reminder post card (Barsky, pers. comm.). A non-return fee goes in effect in 2014 and CDFW are also involved in an educational campaign on the topic which will further increase returns.

The recreational fishery is open from the Saturday proceeding the first Wednesday in October through the first Wednesday after the 15th of March (CDFW 2013b). The bag limit is seven lobsters per day and no more than seven in possession. Lobsters must have a carapace length of 3 ¼ in (8.26 cm) or greater to meet minimum size restrictions. Each person may possess a maximum of five hoop nets, and no more than 10 per vessel and nets must be inspected every 2 hours.

## **MSC Principle 1: Health of Fish Stock**

### **\*Sustainability of Target Stock**

In 2010 and 2011, CDFW performed a stock assessment of the spiny lobster population in southern California (CDFW 2013a). This assessment relied on Southern California Bight-wide (SCB) CDFW datasets, modeled results, and published life history parameters (e.g., growth rates). Based on this assessment, the spiny lobster population off southern California appears to be stable and the fisheries targeting this species can be considered sustainable at present. Support for this determination includes consistently large harvest levels, harvest rates, and sizes of animals caught by both the commercial and recreational fisheries. The sub-legal population appears large and robust. The number of short lobster released as a percentage of the total SCB-wide catch has remained consistent over the decade, regardless of the overall size of the seasonal harvest. This sub-legal population is also probably responsible for the majority of seasonal spawning.

Reference points (both target and limit/threshold), along with preventative measures (i.e. crossing a threshold or target reference point and thus triggering a management response) are currently being considered for the spiny lobster fishery and will be presented in the FMP (CDFG 2012a). Fishing mortality resulting in maximum sustainable yeild (Fmsy) was not quantifiable

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\*For California's Sustainable Seafood Program, this category must score an 80 or higher during an MSC assessment.

in the stock assessment because of limitations of the model used, and should only be used as a relative measure to compare yearly F estimates against (Neilson, pers. comm.). There was an increase in the level of recreational take in the final years before the stock assessment, thus CDFW used the commercial level of effort since there is not a comparable effort for recreational. Because of this, there was evidence of a decreasing stock biomass in one of the modeling scenarios; however, despite exceeding  $F_{msy}$ , there is no indication that fishing mortality (F) is unsustainable (Neilson, pers. comm.). Today, it appears that recreational hooping has stabilized relative to 2005-2010. All indications are that the fishery is currently sustainable (Neilson, pers. comm.).

### Evaluation against MSC Component 1.1: Sustainability of Target Stock

MSC Performance Indicators	Rating	Justification
1.1.1 Stock Status		Stock assessment concluded that the population is currently stable; consistently large harvest rates, and sizes of animals caught by both the commercial and recreational fisheries; short lobsters released has been consistent over the last decade
1.1.2 Reference Points		$F_{msy}$ not quantifiable due to model limitations; Reference points and preventative measures likely presented in 2015 FMP
1.1.3 Stock rebuilding		Not assessed

### Harvest Strategy (Management)

The FGC manages the California Spiny Lobster commercial fishery, and CDFW creates and implements fishery regulations (CDFG 2001). Essential commercial fishery information is collected using fishermen logbooks and dealer landing receipts (CDFG 2011a). Logbooks record location and date of catch, number of traps pulled, and number of lobster kept and released. Landing receipts record catch location, size of catch in pounds, and the price paid per pound.

Management of the lobster fishery is based on:

- a restricted access program (currently 194 permits as of the 2012-13 season, with the goal of reducing the number to 141 participants)
- a minimum size limit
- a closed season to protect breeding and molting animals
- escape ports in traps to prevent the take of undersized lobster in the commercial fishery
- 96-hour requirement to pull traps in the commercial fishery
- destruct devices are required in traps to prevent ghost fishing

- daily logbook requirement
- daily bag and possession limits
- divers may only take lobsters by hand
- a limit on the number of hoop nets for the recreational fishery
- lobster report card requirement

Lobsters of both sexes may be taken commercially from the first Wednesday in October through the first Wednesday after March 15 the following year (CDFG 2012a). Current regulations do not limit the number of traps that can be used or set catch limits.

A spiny lobster Fishery Management Plan (FMP), as required by the Marine Life Management Act (MLMA), is currently being developed by CDFW and is expected in 2015. With the implementation of new marine protected areas (MPAs) in Southern California in 2012, the spiny lobster FMP will evaluate how MPAs might be incorporated into the management of the state's lobster fisheries. The FMP will review fishery management methods used in lobster fisheries in other parts of the world, and examine any other conservation and management measures that should be considered for the sustainability of the resource and its fisheries.

#### Evaluation against MSC Component 1.2: Harvest Strategy (Management)

MSC Performance Indicators	Rating	Justification
1.2.1 Harvest Strategy		Limited entry fishery, gear restrictions, seasonal closure, minimum size limit, area closures; no limit or target reference points established
1.2.2 Harvest Control Rules and Tools		Currently, no designated limit or target reference points, though 2015 FMP will have a harvest control rule
1.2.3 Information/Monitoring		Fishery dependent data (logbooks, landings, CPUE) are collected to support the harvest strategy; Stock assessment is only informed by fishery-dependent data
1.2.4 Assessment of Stock Status		Stock assessment conducted in 2010-11

## MSC Principle 2: Impact on Ecosystem

### Retained Species

#### *Traps*

The only species allowed as incidental take in lobster traps are Kellet's whelk, octopus and crab

(except Dungeness). The commercial harvest of Kellet's whelks is regulated by a total allowable catch, while size limits restrict take of multiple crab species. The spiny lobster permittee is exempt from requiring a general trap permit to harvest Kellet's whelk (CDFG 2008).

**Evaluation against MSC Component 2.1: Retained Species**

MSC Performance Indicators	Rating	Justification
2.1.1 Outcome		Retained catch levels are low; whelk and crab management measures likely ensure harvest levels will not significantly impact populations
2.1.2 Management		Harvest strategy for whelk limited by total allowable catch per season; minimum size restrictions for crabs; octopus are allowed incidentally in several fisheries (no direct octopus fishery allowed)
2.1.3 Information		Logbooks, landings receipts

**Bycatch Species**

**Traps**

[From CDFG 2012b unless cited otherwise]:

The MLMA states that bycatch of marine animals should have no appreciable effect on the marine environment and calls for mitigation efforts when the amount or type is unacceptable. However, bycatch data in the spiny lobster fishery is limited. CDFG's understanding of the issue comes from three primary sources: commercial fishing logbooks, a sport hoop net study and incoming data from the California Lost Fishing Gear Recovery Project. CDFG also received preliminary bycatch information from the current at-sea lobster sampling research program that was funded by the MPA Monitoring Enterprise and is a collaborative project involving Drs. Carrie Culver, Steve Schroeter, and some commercial lobster fishermen. These sources suggest that the spiny lobster fishery appears to have relatively low bycatch. Bycatch occasionally involves sub-legal lobsters, Kellet's whelk, sheephead and other nearshore finfish, which can be released alive. Spiny Lobster traps generally allow undersize lobsters and other animals to escape. A recent study of the Mexican spiny lobster fishery recorded a small number of cormorants caught in commercial traps, but offered no information on trap specifics or the habitat where the traps were set in Mexico. Additionally, bycatch of California spiny lobsters in other fisheries is reported to be insignificant (CDFG 2001).

### Evaluation against MSC Component 2.2: Bycatch Species

MSC Performance Indicators	Rating	Justification
2.2.1 Outcome		Several data sources suggest relatively low bycatch, though results are preliminary
2.2.2 Management		MLMA indicates bycatch of marine animals should not impact the environment though unclear if management measures to minimize bycatch are implemented to date beyond sub-legal lobster escape ports and trap door fittings (preventing ghost fishing)
2.2.3 Information		Logbooks, hoot net study, CA Lost Fishing Gear Recovery Project, at-sea sampling research program preliminary data – more info on bycatch rates needed

### \*Endangered, Threatened, & Protected (ETP) species

#### Traps

National Marine Fisheries Service (NMFS) classifies all U.S. commercial fisheries into one of three categories (I, II, III) based on the level of incidental serious injury and mortality of marine mammals that occurs in each fishery. In 2012, NMFS List of Fisheries (LOF) classified the California spiny lobster fishery as a category III, indicating remote likelihood of/no known incidental mortality or serious injury of marine mammals (NMFS 2012). Because the fishery is conducted close in shore it is likely that interactions with whales occur very rarely, though NMFS reports one incident with a Gray whale in the Eastern North Pacific (no specifics were given). Given this information, it is unlikely that the California spiny lobster fishery poses a risk of serious or irreversible harm to endangered, threatened and protected species.

### Evaluation against MSC Component 2.3: ETP Species

MSC Performance Indicators	Rating	Justification
2.3.1 Outcome		NMFS LOF category III fishery - likely does not pose a threat to ETP
2.3.2 Management		Unlikely to impact ETP species, but management measures exist - CEQA, Migratory Bird Act, Marine Mammal Protection Act
2.3.3 Information		Logbooks

\*For California's Sustainable Seafood Program, this category must score an 80 or higher during an MSC assessment.



## Habitats

### Traps

Lobster traps are set along depth contours or around rocky outcrops on the seafloor at depths up to 210 ft (64 m) (CDFG 2001). The effect of a pot on the seabed is related to its weight and structure as well as to how far and fast it moves along the seabed before ascending. Observations of lobster and crab pots being hauled from rocky substrates in southern England revealed that the habitats and their communities appeared relatively unaffected by potting (Eno et al. 2001). In the Baja fishery, lobster traps did not appear to cause any short-term changes to benthic habitat cover when set for a 24-hour period, and damage to soft corals (the majority of the benthic cover in the study) was minimal (Shester 2008). Since corals are not the majority of benthic cover in southern California, more local studies are necessary to better understand habitat impacts from trap gear in the California spiny lobster fishery. An objective of the MLMA includes habitat conservation and minimizing damage from fishing; several management measures are currently in place (limited access permits, MPA/area and seasonal closures, 96 hr service requirement) to limit habitat impacts from trap gear.

### Evaluation against MSC Component 2.4: Habitats

MSC Performance Indicators	Rating	Justification
2.4.1 Outcome		Lobster traps likely do not irreversibly damage the seafloor according to Eno et al. 2001, Shester 2008
2.4.2 Management		MLMA objective of conserving habitat; some measures in place (limited access permits, MPA/area and seasonal closures, 96 hr service requirement) to limit habitat impacts
2.4.3 Information		Trap impacts to rocky substrate are documented in several research studies, but none specific to CA lobster fishery habitat

## Ecosystem

Spiny lobsters play a key role as predators in the southern California kelp forest ecosystem. Lobster predation on mussels and urchins is an important factor in maintaining diverse communities in these habitats (Tegner and Levin, 1983; Robles et al., 1990). In California's Anacapa Island marine reserve in the Santa Barbara Channel Islands where lobster fishing is prohibited, spiny lobsters were larger and more abundant than outside the reserve (Kay et al. 2012). In addition, the kelp forest ecosystem is more stable, associated with lobster predation upon kelp-eating sea urchins (PISCO 2002). The ecosystem impacts of fishing mortality in the California spiny lobster fishery are still unclear.

Management measures, including gear restrictions, may indirectly benefit ecosystem health. CDFW requires that trap doors of all spiny lobster traps be fastened with bare metal crimps that rust through seawater over time. This reduces the impact of 'ghost fishing', whereby lost

or abandoned fishing gear continues to catch animals over time (CDFG 2001; CSC 2006). In addition, the minimum size limit regulation prevents commercial and recreational fishers from keeping sublegal lobsters they incidentally catch (CDFG 2001).

Under the MLMA, CDFW must consider ecosystem impacts of a fishery, namely the conservation of not only the exploited species, but the other species that depend on that resource. However, the dynamics of many of the trophic relationships for spiny lobster are not well understood. At this stage, more information is needed to understand how the current management measures protect the ecosystem structure and function.

**Evaluation against MSC Component 2.5: Ecosystem**

MSC Performance Indicators	Rating	Justification
2.5.1 Outcome		Likely does not cause irreversible harm to ecosystem, but no quantitative measures available to assess
2.5.2 Management		Existing management may indirectly benefit ecosystem health (gear restrictions); MPAs will protect some habitat; Under MLMA, CDFW must consider ecosystem impacts
2.5.3 Information		More info needed on biology of spiny lobster to understand ecosystem impacts

**MSC Principle 3: Management System**

**Governance and Policy**

In state waters (0-3 miles offshore), the FGC manages various fisheries through measures that include but are not limited to determining seasons, bag limits, and methods of take. In each case, the Commission holds regular open public meetings throughout the state to receive and consider individual and group input prior to adoption of new or changed regulations. Recommendations also come from CDFW. Once the Commission votes to adopt a regulation, CDFW is responsible for enforcing it. The Legislature can increase the Commission’s powers by delegating further regulatory and management authority. The MLMA governs the way the majority of California fisheries are managed (OPC 2011). Regulations must comply with the goals and objectives outlined in the MLMA, including (but not limited to) sustainability, limited bycatch, and habitat conservation.

Fishery management measures must achieve the goals and objectives of the MLMA. The MLMA gave the Commission and CDFW specific authorities, goals, objectives, and mandates for managing marine resources. The MLMA also requires periodic review of management measures because environmental, social, and economic changes during the year may lead to consideration of regulatory changes under the framework described above.

### Evaluation against MSC Component 3.1: Governance and Policy

MSC Performance Indicators	Rating	Justification
3.1.1 Legal and/or Customary Framework		FGC and DFW manage the fishery within an effective framework for delivering sustainable fisheries
3.1.2 Consultation, Roles and responsibilities		Roles and responsibilities are clearly laid out; FGC meetings are open to the public and to public comments
3.1.3 Long-term Objectives		Goals and objectives outlined in MLMA
3.1.4 Incentives for Sustainable Fishing		Sustainability is an underlying goal of the MLMA

### Fishery Specific Management System

This fishery is regulated by the FGC and managed by the CDFW (CDFG 2001). CDFW is currently in the process of developing a Fishery Management Plan (FMP) for spiny lobster as required by the MLMA. FMPs evaluate and consider:

- Biological information about the marine resources under consideration
- Habitat needs and issues
- Economic and social factors related to the fishery
- An account of fishing activity
- Conservation and management measures already in place
- The ecological role of the resource
- The environmental effects that may have to be considered
- Fishery research protocols
- The most appropriate management tools for a sustainable fishery
- Procedures for amending the FMP to allow for possible adaptation in the future

CDFW convened a spiny lobster advisory committee (LAC) to involve appointed representatives of constituent groups with providing the CDFW advice, feedback, and recommendations regarding the issues and actions that need to be taken during the development of the spiny lobster FMP (CDFG 2012c). The LAC will give guidance on FMP objectives and end products, as well as provide ideas for management options that address the key issues put forth by constituents and members of the public. The spiny lobster FMP will ensure a sustainable lobster resource, and healthy commercial and recreational fisheries. The spiny lobster FMP effort is timely because of the recent implementation of MPAs along the south coast of California that impact both the recreational and commercial lobster fisheries. The spiny lobster FMP is a multi-year project, and the draft plan is scheduled to be delivered to the FGC for adoption in early

2015. The spiny lobster FMP will contain a management strategy evaluation procedure that will allow CDFW to monitor and evaluate the health of the fishery as future data becomes available. In addition to developing the spiny lobster FMP, continuing existing public education and CDFW enforcement efforts are essential because an illegal market has always existed for shorts, which are very important to the health of the population.

**Evaluation against MSC Component 3.2: Fishery specific management system**

MSC Performance Indicators	Rating	Justification
3.2.1 Fishery Specific Objectives	Yellow	No clear objectives, likely detailed in FMP; CDFW does present a rationale to the FGC for current management practices though (Barsky, pers. comm.)
3.2.2 Decision-making Processes	Green	CDFW provides recommendations that are vetted through the FGC; LAC providing recommendations for development of the Spiny Lobster FMP
3.2.3 Compliance & Enforcement	Green	An enforcement system exists and has demonstrated an ability to enforce relevant management measures, strategies and/or rules.
3.2.4 Research Plan	Yellow	No clear research plan in place, will likely be outlined in the FMP
3.2.5 Management Performance Evaluation	Green	MLMA requires periodic review of management measures; 2011 stock assessment was externally reviewed

**California Specific Requirements**

The California voluntary sustainable seafood program requires fisheries seeking certification to meet California specific standards in addition to the standards and requirements of the Marine Stewardship Council (MSC) sustainable fisheries certification program. These include:

1. Higher scores (80 instead of 60) for two performance indicators (PI) of the MSC program: “Stock Status” (PI 1.1.1) and “By-catch of Endangered, Threatened, or Protected (ETP) Species” (PI 2.3.1). These two PIs are highlighted in the report.
2. Additional independent scientific review: The OPC Science Advisory Team will be engaged in the certification process through early consultation in reviewing minimum eligibility criteria, and review of the MSC-required pre-assessments and full assessments. The reviews will be conducted in addition to MSC’s peer review, thus bringing additional credibility, transparency, and independence to California’s certification process.
3. Additional traceability components: The California program will develop a unique barcode for California certified sustainable fish. This barcode can be either scanned by a smart-phone

or linked to a website that will reveal additional information about the fishery, and information about toxicity when available.

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## References

- Barsky, Kristine. 2013. Personal communication. California Department of Fish and Wildlife.
- Booth, JD and BF Phillips. 1994. Early life history of spiny lobster. *Crustaceana* 66(3):271-294.
- California Department of Fish and Game (CDFG). 2001. California's Living Marine Resources: A Status Report. California Spiny Lobster. Available at: <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=34241&inline=true>
- California Department of Fish and Game (CDFG). 2011a. Review of selected California fisheries for 2010: Coastal pelagic finfish, market squid, ocean salmon, groudfish, highly migratory species, Dungeness crab, spiny lobster, spot prawn, Kellet's whelk, and white seabass. Fisheries Review CalCOFI Report, 51: 13-35.
- California Department of Fish and Game (CDFG). 2011b. Assessment of the California Spiny Lobster (*Panulirus interruptus*). Prepared by Neilson, D.J.
- California Department of Fish and Game (CDFG). 2011c. California Legislative Fisheries Forum Department of Fish and Game Annual Marine Fisheries Report. Available at: [nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=42564](http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=42564)
- California Department of Fish and Game and Sea Grant. 2008. California Spiny Lobster: fishing and life history information. DFG\_Marine\_Region\_lobster-Ver.1-08.08. 2p.
- California Department of Fish and Game (CDFG). 2008. Annual Status of the Fisheries Report through 2008, Kellet's whelk.
- California Department of Fish and Game (CDFG). 2004. Annual Status of the Fisheries Report through 2003, California Spiny Lobster.
- California Department of Fish and Game (CDFG). 2012a. California Commercial Fishing Digest.
- California Department of Fish and Game (CDFG). 2012b. Lobster Advisory Committee, Spiny Lobster Fishery Management Plan Meeting Summary, December 5, 2012. Available at: <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=58094&inline=true>
- California Department of Fish and Game (CDFG). 2012c. Lobster Advisory Committee Charter. Available at: <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=55156&inline=true>
- California Department of Fish and Wildlife (CDFW). 2013a. Annual Status of the Fisheries Report through 2011, California Spiny Lobster.
- California Department of Fish and Wildlife (CDFW). 2013b. California 13-14 Ocean Sport Fishing Regulations.
- California Seafood Council (CSC). 2006. California Spiny Lobster. Available at: <http://ca-seafood.ucdavis.edu/facts/species.htm#anchor1211912>
- Eno, N.C., MacDonald, D.S., Kinnear, J.A.M., Amos, S.C., Chapman, C.J., Robin A.C., Bunker,

- F. St P.D. & Munro C. (2001) Effects of crustacean traps on benthic fauna. *ICES Journal of Marine Science* 58:11-20.
- Johnson, Martin W. 1960. Production and Distribution of Larvae of the Spiny Lobster *Panulirus interruptus* (Randall) with records on *P. gracilis* Streets. *Bull., Scripps Inst. Oceanogr., Univ. Calif.* 413:461
- Lafferty, K.D. 2004. Fishing for lobsters indirectly increases epidemics in sea urchin. *Ecological Applications* 14:1566-1573.
- Kay, M.C., Lenihan, H.S., Kotchen, M.J., & Miller, C.J. (2012). Effects of Marine Reserves on California Spiny Lobster are Robust and Modified by Fine-Scale Habitat Features and Distance from Reserve Borders. *Marine Ecology Progress Series*, 450, 137-150.
- Kerstitch, Alex N. 1989. Sea of Cortez marine invertebrates. *Sea Challengers*. 114 p.
- Lafferty, K.D. 2004. Fishing for lobsters indirectly increases epidemics in sea urchin. *Ecological Applications* 14:1566-1573.
- Lindbergh, R.G. 1955. Growth, population dynamics, and field behavior in the spiny lobster, *Panulirus interruptus* (Randall). *Univ. California Publications in Zoology* 59:157-247.
- Loflen, Chad Lortscher. 2007. Behavioral Responses by the California Spiny Lobster (*Panulirus interruptus*) to Predation Inside and Outside a Marine Protected Area. M.S. Thesis, San Diego State University.
- Mai, Thien T., and Kevin A. Hovel. 2007. Influence of local-scale and landscape-scale habitat characteristics on California spiny lobster (*Panulirus interruptus*) abundance and survival. *Marine and Freshwater Research*, 58:419-428.
- Morgan, L.E. and R. Chuenpagdee. 2003. *Shifting Gears: Addressing Collateral Impacts of Fishing Methods in U.S. Waters*.
- Ocean Protection Council. 2011. California Fishery Management Overview. Available at: [http://www.opc.ca.gov/webmaster/ftp/project\\_pages/dctf/California\\_Fishery\\_Management\\_Overview\\_FINAL.pdf](http://www.opc.ca.gov/webmaster/ftp/project_pages/dctf/California_Fishery_Management_Overview_FINAL.pdf)
- PISCO 2002. The science of marine reserves. Publication of the Partnership for Interdisciplinary Studies of Coastal Oceans.
- National Marine Fisheries Service (NMFS). 2012. List of Fisheries. Available at: <http://www.nmfs.noaa.gov/pr/interactions/lof/final2012.htm>
- Neilson, Dough. 2013. Personal communication. California Department of Fish and Wildlife.
- Robles, C., D. Sweetnam and J. Eminike. 1990. Lobster predation on mussels: shorelevel differences in prey vulnerability and predation preference. *Ecology*. 71:1564-1577.
- Schmitt, W.L. 1921. The Marine decapod crustacean of California. *Univ. Calif. Publ. Zool.*, 23:1-470.
- Shester, G.G. (2008) Sustainability in small-scale fisheries: an analysis of the ecosystem impacts, fishing behavior and spatial management using participatory research methods. Doctor of Philosophy Degree Thesis. Stanford University, Stanford, CA, USA. September, 2008. 225 pp.

Tegner, M.J. and L.A. Levin. 1983. Spiny lobsters and sea urchins: analysis of a predator prey interaction. *Journal of Experimental Marine Biology and Ecology*. 73:125-150.

U.S. Fish and Wildlife Service (USFWS). 1988. Species Profile: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Southwest). Spiny Lobster.

Wilson, Robert C. 1948. A review of the southern California spiny lobster fishery. *Calif. Fish Game*. 34(2):71-80.

## Appendix A

MSC Assessment Tree			Spiny Lobster
Principle	Component	Performance Indicator	Trap All
<b>Principle 1: Health of Fish Stock</b>	Outcome	1.1.1: Stock status	
		1.1.2: Reference points	
		1.1.3: Stock rebuilding	<i>Did not assess</i>
	Harvest Strategy (Management)	1.2.1: Harvest strategy	
		1.2.2: Harvest control rules	
		1.2.3: Info/ monitoring	
		1.2.4: Stock assessment	
<b>Principle 2: Impact on Ecosystem</b>	Retained species	2.1.1: Status	
		2.1.2: Mgmt strategy	
		2.1.3: Information	
	By-catch species	2.2.1: Status	
		2.2.2: Mgmt strategy	
		2.2.3: Info	
	ETP species	2.3.1: Status	
		2.3.2: Mgmt strategy	
		2.3.3: Info	
	Habitats	2.4.1: Status	
		2.4.2: Mgmt strategy	
		2.4.3: Info	
	Ecosystem	2.5.1: Status	
2.5.2: Mgmt strategy			
2.5.3: Info			
<b>Principle 3: Management System</b>	Governance & Policy	3.1.1: Legal framework	
		3.1.2: Consultation, roles, and responsibilities	
		3.1.3: Long term objectives	
		3.1.4: Incentives for sustainable fishing	
	Fishery Specific Mgmt System	3.2.1: Fishery specific objectives	
		3.2.2: Decision making process	
		3.2.3: Compliance & enforcement	
		3.2.4: Research plan	
		3.2.5: Management performance evaluation	