

# **History of the U.S. West Coast Groundfish Fishery**

**May 15, 2008**



## Introduction

The United States West Coast groundfish fishery has undergone profound changes since initial exploitation. These changes include species harvested, fishery participant demographics, management methodology, allowable harvest levels, and regulatory mechanisms. Scientific, political, and economic developments in the 1990s and early 2000s have significantly reduced the groundfish catch from historical levels, resulting in significant impacts to fishermen and fishing communities alike. The West Coast groundfish fishery peaked in 1982 with landings of 290 million pounds and has since experienced a long-term decline<sup>33,25,28,13</sup>. Historically, the West Coast has largely avoided the large scale fisheries collapses that have occurred in other parts of the country<sup>12</sup>. This has now changed and the recent groundfish crisis represents a \$60 million annual loss to West Coast communities<sup>12</sup>. By the late 1990s, poor management, overfishing, and poor stock recruitment had led to regulations that sharply curtailed West Coast groundfish fishing<sup>33</sup>. Total groundfish harvest decreased to 150 million pounds by 1990 and the 2004 harvest was less than half this<sup>25</sup>. More specifically, rockfish landings peaked in 1983 and have since decreased 78% with a 69% decrease in ex-vessel revenue<sup>7</sup>. For flatfish, these figures are 41% and 73%, respectively. Overcapitalization in the fleet became evident by 1989 and managers took measures to address this alarming trend<sup>33</sup>.

The 80-90 groundfish species can be categorized as midwater, deep slope, shelf, slope rockfish, nearshore rockfish, and nearshore flatfish<sup>13</sup>. A diversity of user groups harvest groundfish in a multispecies manner using trawl, hook and line, and pot gear<sup>22</sup>. Bycatch commonly occurs during groundfish fishing and fishermen usually discard less valuable bycatch at sea in an attempt to “high-grade” and thus increase the value of landings<sup>31</sup>. Groundfish also occur as bycatch in other important fisheries such as the shrimp, prawn, sea cucumber, and halibut fisheries<sup>22</sup>. During the 1980s and 1990s, the *Sebastes* complex was the single largest source of revenue in the fishery<sup>22</sup>. Recently, sablefish and in particular Pacific whiting have become the most important components of the fishery.

These developments, combined with the shift in public attitude towards more responsible environmental practices, have motivated the search for more sustainable fishing methods. Attempts to completely stop fishing through regulations or vast Marine Protected Areas (MPA) ignore social and economic considerations and the fact that many stocks remain at healthy and exploitable levels. In February 2008, the Nature Conservancy (TNC) received an Exempted Fishing Permit (EFP) from NOAA Fisheries to fish trawl permits with longline, trap, pot, and hook-and-line gear in a community based fishing association off the central California coast. This EFP intends to test whether establishing a cooperatively managed, community based fishing association that employs commercial trawl permits to use alternative gear types can provide important economic and environmental benefits. TNC hopes to demonstrate that the use of more sustainable fishing practices in California waters will allow fishermen to continue to harvest groundfish while not negatively impacting overfished species. The purpose of this document is to outline the history of the West Coast groundfish fishery in an effort to highlight the evolution of the fishery to its current situation and where TNC’s EFP fits into the historical context of the fishery.

### **Early History**

West Coast inhabitants have utilized the groundfish resource since the beginning of human habitation and evidence shows that rockfish formed part of the diet of California natives<sup>29</sup>. The West Coast rockfish commercial fishery began in California in the early to mid-1800s<sup>6,29</sup>. In the early 1900s, demand began to increase and West Coast fishermen utilized certain species in significant numbers. Early regulations date back to this time and included area closures (San Francisco Bay closed to trawling in 1906) and gear restriction (particularly mesh size)<sup>11</sup>. Sablefish also became important commercially in the early 1900s<sup>29</sup>. Commercial fishing for California halibut began in the late 19<sup>th</sup> century and the largest commercial landing occurred in 1919 at 4.7 million pounds<sup>29,31</sup>. Overfishing during World War I led to a decline in halibut landings in the 1920s and 30s but strong landings occurred in the 1940s<sup>31,3</sup>. Commercial landings of lingcod peaked in 1930 and since then the species has been important to recreational fishermen<sup>29</sup>. Recreational fishing became important by the 1940s and in 1947 marine anglers spent almost 1.5 million angler hours in California alone<sup>29</sup>. Despite this activity, low demand for groundfish products and thus low fishing effort overall characterized the pre World War II West Coast groundfish fishery<sup>33</sup>.

### **Post-World War II Expansion**

World War II demand for protein led to a sharp increase in fishing during this time. In 1947, the Pacific States Marine Fishery Commission (PSMFC) began to oversee the West Coast groundfish fishery. The PSMFC had no regulatory power but acted as a coordinating entity between the individual states<sup>20,11</sup>. Fishing effort substantially increased after the end of the war as the military decommissioned many boats that had seen wartime service<sup>7</sup>. This led to increased capacity and landings but eventually falling prices as military demand for seafood decreased<sup>7</sup>.

Science had historically played an insignificant role in American fisheries management as political forces largely shaped decision making<sup>17</sup>. The U.S. government often intertwined fisheries policy with U.S. foreign policy, especially during the Cold War<sup>17</sup>. Eventually, in 1949 West Coast fisheries management adopted the Maximum Sustainable Yield (MSY) concept in an effort to implement science-based management<sup>17</sup>. California initiated management of groundfish in 1953 by banning trawling for rockfish in state waters<sup>27</sup>. Historically, the West Coast commercial fishing fleet had relied on salmon and tuna<sup>28</sup>. As availability declined in the 1950s, a shift began towards other resources such as groundfish, shrimp, and crab<sup>10,25</sup>.

### **1960 to 1976: Foreign Fleets**

The post-war expansion soon subsided and the U.S. generally ignored groundfish while foreign fishing pressure began to expand<sup>33</sup>. The first heavy pressure exerted on the West Coast groundfish fishery occurred in 1963 when foreign fleets started fishing<sup>6</sup>. Soviet factory trawlers began exploiting West Coast groundfish as early as the mid-1960s and Korean, Japanese, East and West German, and Polish factory vessels soon followed<sup>20,11</sup>. Fleets from Japan, Korea, and the U.S.S.R. began fishing for sablefish in the 1960s and this continued until 1976<sup>29</sup>. During the 1960s and 70s, groundfish landings increased

substantially off the West Coast<sup>23</sup>. By 1966, 115 foreign factory trawlers targeted groundfish off California, Oregon, and Washington<sup>6</sup>. Often these vessels fished within sight of land and presumably harvested large levels of what later became a domestic resource. Public fear of overexploitation and foreign competition led to a scramble to preserve stocks and the domestic fleet<sup>7</sup>. During this time, domestic landings averaged only about 30,000 metric tons annually<sup>11</sup>.

### **1977-1989 Expansion**

In the 1970s, public concern over the health and ownership of the resource mounted and eventually culminated in the Magnuson-Stevens Act of 1976 which established a 200 mile Exclusive Economic Zone (EEZ) throughout the United States and abroad. This act essentially claimed all continental shelf fishery resources for the United States and thus profoundly changed the nature of the groundfish fishery. Also, the Act created the Pacific Fishery Management Council (PFMC) to manage the fishery. Even though the U.S. fleet had utilized the groundfish fishery for many years, it wasn't until the passage of the Act that this substantially increased<sup>10</sup>. In 1976, landings equaled 60,000 metric tons and by 1982 domestic landings (excluding joint venture and foreign fleet) peaked at 116,000 metric tons with a \$71.5 million ex-vessel value<sup>11</sup>. During this time there were few limitations on fishing effort<sup>7</sup>. In 1978, the Canadian government closed British Columbia waters to American boats and these boats began to focus on West Coast waters, thus increasing pressure on U.S. West Coast stocks<sup>11</sup>. Overall commercial fishing landings peaked in 1981 and rockfish landings peaked in 1983<sup>7,25</sup>. From 1979-1981, all commercial landings had a high value due to high prices and quantities<sup>28</sup>.

The Magnuson-Stevens Act permanently changed U.S. fisheries management, including the West Coast groundfish fishery. During this time, the U.S. government actively sought to increase capacity in the West Coast groundfish fleet in an effort to assert domestic control over the resource. The main policy goal during this time was to prevent foreign fleets from fishing and to assist the U.S. fleet to actively compete with them<sup>33</sup>. Many policies, particularly the Capital Construction Fund, promoted the growth and development of the domestic fleet through investment in boats and gear<sup>10,33,7</sup>. As a result, the domestic groundfish fleet grew rapidly<sup>33</sup>. These policies successfully achieved the goals of building up the fleet but eventually led to the overcapitalization that still plagues the industry to this day.

### **Joint Venture and “Americanization”**

In an effort to “Americanize” the groundfish fishery, the U.S. implemented joint venture (JV) policies with foreign nations. In February 1967, the U.S. and the U.S.S.R. signed a bilateral agreement regarding trawl fisheries off Oregon, Washington, and California with the goal of reducing impacts on West Coast rockfishes, Pacific whiting, and sablefish<sup>20</sup>. From 1977-1982, NMFS implemented a management plan for the foreign trawl fishery<sup>20</sup>. In 1978, two U.S. boats entered into a JV with Soviet motherships<sup>22</sup>. Under this agreement, domestic catcher boats would harvest the resource but agreed to deliver to Soviet factory processors for processing. Because U.S. catcher boats offloaded to foreign processors, the U.S. onshore segment developed more slowly than the offshore

segment<sup>33</sup>. JV operations primarily targeted Pacific whiting off the Washington and Oregon coast<sup>33,20</sup>. By 1982, JV exceeded foreign harvest and by 1989, this system had completely replaced foreign fishing as the U.S. began to actively push foreign processors away, leaving the domestic fleet to catch and eventually process all it wanted<sup>33,20,22</sup>. By 1991, the fishery had been fully “Americanized”, foreign participation had ended and U.S. vessels and processors fully exploited the resource<sup>20,11,22</sup>. From 1977-1989 demand for groundfish skyrocketed and the industry experienced a boom<sup>33</sup>. From 1980-1989, groundfish landings as a percentage of total fishing landings almost doubled<sup>33</sup>.

### **1982 Fishery Management Plan**

A rapid expansion characterized the West Coast Groundfish fishery in the 1970s and 80s<sup>33,28</sup>. Prior to 1982, the individual states managed the groundfish fishery within their territories. State restrictions had existed for 80-100 years but overlapping fisheries and lack of uniformity in regulations led to problems<sup>20,11</sup>. Also, prior to 1982 the individual states managed groundfish without quotas, relying primarily on area closures, gear restrictions, bag limits, and size limits to manage the fishery<sup>20,11</sup>. Managers established trip limits for widow rockfish and sablefish in 1982<sup>5</sup>. The Secretary of Commerce approved the Pacific Coast Groundfish Fishery Management Plan on January 4, 1982 and implemented the plan on October 5, 1982<sup>20,22</sup>. The FMP covers 55 rockfish, 12 flatfish, 7 roundfish, and 9 other species<sup>22</sup>. The FMP built on state management by increasing catch monitoring and improving assessment of stock conditions<sup>20</sup>. Under the FMP, the PFMC must determine Optimum Yield (OY) based on Allowable Biological Catch (ABC) (if available) and must assess the biological, social, and economic condition of the groundfish fishery and update MSY as needed<sup>20</sup>. Also, the Council must develop rebuilding plans for individual depleted stocks as necessary. The PFMC had acted as a coordinating entity since its inception in 1947 (then called the PSMFC) and, particularly from 1977-1982, worked with the states to manage the groundfish fishery<sup>20,11</sup>. The FMP focused primarily on solving the problems associated with an open access fishery rather than changing the open access system<sup>11</sup>. The PFMC has amended the FMP 20 times since implementation, most significantly in 1994 and 1996<sup>20</sup>.

### ***1994-Limited Entry***

In an effort to address the increasingly apparent problem of overcapitalization in the groundfish fleet, the National Marine Fisheries Service implemented a limited entry (LE) program for the domestic groundfish fleet in 1994<sup>33,25,23,13,20,11,27</sup>. The primary goal of the LE program was to limit or reduce harvest capacity and to promote the economic viability of existing boats in the fishery<sup>25,20</sup>.

These LE permits were capped at prior to 1994 levels for groundfish<sup>25</sup>. The permits are transferable to any vessel within +/-5 feet and the PFMC based allocation on fishing history and length of the vessel<sup>25,11</sup>. The LE program allows vessels to combine these permits with the goal of reducing capacity, increasing trip limits, prolonging fisheries, reducing bycatch, and having more efficient vessel operations<sup>25</sup>. This program effectively capped capacity but most people involved felt the PFMC allocated too many permits<sup>23,11</sup>. Due to low eligibility requirements, many marginal boats received permits which led to latent capacity and thus more overcapitalization as these permits eventually transferred to

more active vessels<sup>23,22</sup>. Also, any transferring of permits probably led to increased effort as those who actively bought permits definitely wanted to use them<sup>22</sup>. All 629 LE permits went to catcher boats as no catcher-processor (CP) vessels received permits because they did not have a history in the fishery<sup>23,22</sup>. These vessels had to buy multiple permits to target the Pacific whiting stocks as they were larger than the original boats<sup>23,22</sup>. Nine CPs entered the LE fishery in 1994 and one more entered in 1995<sup>22</sup>.

There are separate caps on trawl and fixed gear and the PFMC added sablefish caps for fixed gear in 1997<sup>25</sup>. The LE fishery currently comprises 90% of the total fishery and there still exists a small open access fishery which comprises 10% of the total quota (30% of the rockfish quota)<sup>25,28,13</sup>. The PFMC allocated the open access portion based on historical catches between July 11, 1984 and August 1, 1998<sup>20</sup>. Many vessels entered this fishery from 1987-1992 in anticipation of the LE program<sup>28</sup>. Most of these boats did not qualify for historical allocation so the PFMC put aside 10% of the quota in the form of open access for them<sup>28</sup>.

Along with the LE program, other PFMC management measures during this period included shorter seasons, trip limits for individual species, bycatch limits, gear restrictions, and restriction of the recreational fishery<sup>5,33</sup>. Even though there was decreasing overall revenue for the fishery during this time, revenue for boats with LE permits increased after 1994<sup>25</sup>. The LE program represented a solid effort at addressing overcapitalization but in the end was insufficient and many began to feel that the latent capacity needed more active removal.

#### *1996- Sustainable Fisheries Act*

The 1996 Sustainable Fisheries Act (SFA) has been the most significant amendment to the Magnuson-Stevens Act. A precautionary approach to fisheries management underpins the SFA. The SFA mandates that the PFMC includes a description of essential fish habitat (EFH) in all management plans<sup>24</sup>. To date, scientists have identified over 400 EFH and have categorized these into 7 major habitat types<sup>24</sup>. Complicating this task is the fact that very little research exists on the effects of fishing gears on EFH, especially on the West Coast<sup>24</sup>. One study suggests that there are likely few, if any, virgin habitat areas left on the West Coast although, due to the high relief, there may still exist localized pockets that fishing has not significantly impacted<sup>24</sup>. Pot and longline gears may “ghost fish” if lost and researchers know little about the effects of pelagic trawling<sup>24</sup>. The SFA also placed a moratorium on any new government loans for fishing capacity until October 2001<sup>22</sup>. In addition to protecting EFH, the SFA mandates that the PFMC identify overfished stocks and develop formal rebuilding plans for depleted species<sup>13</sup>. The PFMC set strict limits to rebuild stocks in order to comply with the SFA<sup>23</sup>. To date, the PFMC has declared 7 West Coast groundfish species overfished and has developed rebuilding plans for these species.

### **Overcapitalization and Decline**

Overcapitalization and overexploitation characterized the fishery in the late 1980s and 1990s<sup>7</sup>. From 1987 to 2000, 11,000 vessels participated in the West Coast groundfish fishery<sup>33,32</sup>. Almost 2,000 vessels entered the fishery after 1994<sup>32</sup>. In 1997, 2,399 vessels

landed groundfish off the West Coast<sup>28</sup>. In 2000, 1,824 vessels recorded non-whiting landings<sup>32</sup>. Between 1983 and 1999, groundfish ex-vessel revenue decreased by 47%, rockfish revenue by 69%, and flatfish revenue by 73%<sup>23</sup>. These decreases were primarily due to declining prices and abundance<sup>28</sup>. In 1997, the groundfish fishery had a \$100 million ex-vessel value and this declined to \$50 million the following year due to quota restrictions<sup>11</sup>. With continental shelf fisheries under domestic control since 1976, government policy had led to large investment and the fleet had reached an unsustainable size. Government also had to respond to growing public environmental concerns about the resource. This atmosphere created the need for action and the government implemented a variety of management measures during this period to remedy the situation. Management could have avoided this crisis via a more precautionary approach, especially considering that data on species and habitat was lacking or non-existent and management methods were inappropriate for rockfish biology<sup>6</sup>.

### **2000-Availability of New Science**

In the late 1990s and early 2000s, it became apparent that incomplete science had guided past groundfish quotas. In the 1990s, the scientific community became concerned that they had overestimated the productivity of the fishery as oceanographic conditions had changed and thus reduced the survival of rockfish<sup>11</sup>. Rockfish harvest policy during the 1980s was to cap catches at historic levels and use a constant fishing rate policy of  $F=35\%$ <sup>6</sup>. These policies barely left room for the rockfish to replenish themselves<sup>6</sup>. Moreover, harvest limits often applied to stock assemblages and individual species within those assemblages were often overfished<sup>6</sup>. Many species were fished to near extinction and the \$30 million annually rockfish fishery was largely closed in the early 2000s<sup>15</sup>. Cowcod and bocaccio were both listed as “species of concern” under the Endangered Species Act<sup>6</sup>. Scientists, even today, know very little about the West Coast groundfish species, particularly the *Sebastes* species complex. NOAA Fisheries has assessed the status of only 26 of the 82 groundfish species it manages and only 16 of these have sufficient data to make conclusions<sup>12,13,20</sup>. Moreover, information about these species will probably not be available in the near future<sup>13</sup>. The available data suggested that the fleet had overfished bocaccio, cowcod, POP, lingcod, and canary rockfish and that other species were probably overfished as well<sup>13</sup>. Management had partially based quota recommendations on similar species in other parts of the world. It became apparent that the West Coast groundfish species had lower levels of productivity compared to similar species worldwide and that management had implemented unsustainable harvest levels<sup>13,20,22</sup>. Also, long-term declines in the productivity of the California Current occurred during the late 1970s<sup>13</sup>. Studies have shown that El Niño events may cause recruitment failure and the 1982 event was particularly harmful economically on the West Coast<sup>33,8</sup>. The PFMC began to restrict harvest levels significantly and explored mechanisms to reduce capacity in the fishery. In 2000, PFMC issued rebuilding plans for bocaccio, Pacific Ocean Perch (POP), and lingcod and in 2001 for canary rockfish and cowcod<sup>23</sup>.

Over the last 25 years, there has been a fundamental shift in the Pacific Ocean fish assemblage<sup>12</sup>. The entire community has apparently shifted from hard to soft substrate species and from rockfish to flatfish<sup>12</sup>. Flatfish and elasmobranch populations have

sharply increased as have populations of rockfish which utilize soft substrate habitats<sup>12</sup>. Rockfish associated with hard substrate habitats have declined dramatically<sup>1</sup>. Also, the size of individual flatfish and rockfish has been steadily decreasing since 1981<sup>12</sup>. This study suggests that the rockfish assemblage has shifted to an alternate stable state. For this reason, even severe reductions in fishing may not bring back large species. In conclusion, the demersal fish community of the West Coast is very different than 25 years ago.

### **2000 Disaster Declaration**

As this new science emerged, management responded to the alarming situation. In 1999, NMFS declared the groundfish fishery overfished and on January 26, 2000 the federal government formally declared the West Coast groundfish fishery an economic disaster<sup>5,33,25,11,27</sup>. California, Oregon, and Washington requested federal assistance and Congress allocated \$5 million in relief (California and Oregon received 35% of this money, Washington 30%)<sup>33</sup>. Value of landings has sharply declined in Oregon since the 1990s and in 2002, groundfish landings were the lowest in the history of the fishery<sup>16</sup>.

To address this problem, managers have used restrictions, limits, and vast MPAs<sup>25,28</sup>. The government created the Rockfish Closure Area (RCA) in an attempt to prevent complete closure of the fishery<sup>5</sup>. The government also limited fishing in areas of the highest rockfish bycatch<sup>5</sup>. Overall harvest guidelines have been drastically curtailed to rebuild 7 overfished species and this represents foregone revenue as many healthy stocks are inaccessible<sup>25</sup>. Recently, groundfish management has increasingly used time and area closures to minimize bycatch and rebuild threatened stocks<sup>30</sup>. In 2002, the PFMC closed large areas of the continental shelf to fishing for the first time ever<sup>32,33</sup>. As of July 1, 2002, regulations prohibited vessels from targeting groundfish between 20 and 150 fathoms south of Cape Mendocino and effective September 1, 2002 between 100 and 250 fathoms north of there<sup>32</sup>. On September 1, 2002 managers closed the central California nearshore fishery<sup>27</sup>. In January 2003, the PFMC implemented a coastwide conservation area to protect continental shelf species (6 of the 8 overfished species live here)<sup>20</sup>.

### **Overfished Species**

Recent groundfish management has heavily focused on rebuilding 7 individual overfished species<sup>25,19</sup>. These species are the canary rockfish, darkblotched rockfish, widow rockfish, yelloweye rockfish, Pacific Ocean perch (POP), bocaccio, and cowcod. The PFMC initially considered lingcod an overfished species but has recently removed this species from the list as it considers the stock rebuilt<sup>1</sup>. The PFMC defines overfished as less than 25% of the unfished biomass and because groundfish stocks are intermixed, eliminating targeting of species of concern does not solve the problem<sup>19</sup>. Unfortunately, managers must constrain all fishing and this has socioeconomic impacts and foregone revenue. Observer data show that canary rockfish are the only depleted species captured in the southern portion of the fishery while yelloweye, canary, and widow rockfish are most common in the northern part<sup>19</sup>. The trawl fishery has a relatively large bycatch of bocaccio, canary and darkblotched rockfish, cowcod, and POP<sup>19</sup>. The following section provides a brief overview of the status of each depleted species. For a complete survey of



the biology and status of these species, see the PFMC's March 2008 *Status of the West Coast Groundfish Fishery*<sup>18</sup>.

Bocaccio is an important species both recreationally and commercially and the PFMC manages the species as a separate northern and southern stock<sup>20</sup>. Due to high catch levels in the 1970s and early 80s, managers declared the southern stock overfished<sup>20</sup>. A 1999 stock assessment confirmed that the southern stock level was only 2.1% of its unfished biomass and 5.1% of MSY<sup>20</sup>. In 2000, the PFMC issued a rebuilding plan for bocaccio<sup>22</sup>. A 2003 rebuilding analysis suggests that the stock will be rebuilt by the year 2023 and measures to assure this include restricting fisheries and closing areas where bocaccio are taken as bycatch<sup>20</sup>. Scientists have not assessed the northern bocaccio stock<sup>20</sup>.

Exploitation of canary rockfish on the West Coast began in the early 1940s due to increased demand for protein<sup>20</sup>. From 1966-1976 the foreign fleet harvested canary rockfish but by 1977 only domestic vessels participated in the fishery<sup>20</sup>. A 1994 stock assessment suggested overfishing and in 2000, managers declared the stock overfished<sup>20</sup>. A 2005 study showed that canary rockfish population was only 9.4% of its unfished biomass<sup>20</sup>. LE trawlers targeting flatfish and arrowtooth flounder account for a large proportion of the canary rockfish bycatch and managers typically limit target species harvest to minimize this<sup>20</sup>. The PFMC issued a rebuilding plan for canary rockfish in 2001 with a rebuilding target year of 2074<sup>20,22</sup>.

Scientists know little about the cowcod except that it is not a major component of the groundfish fishery but that fishermen highly desire the species<sup>20</sup>. Managers declared the cowcod overfished in southern California in 2000 and a 2005 study showed stocks at 14-21% of unfished levels<sup>20</sup>. In 2004, the PFMC adopted a rebuilding plan for the cowcod with the year 2090 as the rebuilding target<sup>20</sup>.

The PFMC has historically managed the darkblotched rockfish as part of the rockfish complex and the species is exclusively caught by commercial vessels (primarily trawlers<sup>20</sup>). A 2000 study showed population levels at 14-31% of unfished levels and in this same year, managers declared the species overfished<sup>20</sup>. In September 2002, the PFMC established an emergency darkblotched rockfish conservation area north of 40 degrees latitude<sup>20</sup>. The PFMC implemented a rebuilding plan in 2003 with a target year of 2030<sup>20</sup>.

Soviet and Japanese factory trawlers targeted Pacific Ocean perch (POP) from 1965-1975 and in 1981, managers declared the species overfished<sup>20,22</sup>. In 1981, managers from the states proposed a rebuilding plan for POP and Oregon and Washington limited landings of the species<sup>20,11</sup>. During this period, managers typically discouraged target of the species but did not actually limit bycatch<sup>20</sup>. In this same year, the PFMC developed a plan for POP and later incorporated this into the 1982 FMP<sup>22</sup>. The POP rebuilding plan was the first of its kind and this development occurred much earlier than for the other groundfish species. A 1998 study showed the population at 13% of unfished levels and in 1999, managers again declared the species overfished<sup>20</sup>. LE commercial trawlers account

for 90% of the POP bycatch and foreign fleets had depleted POP populations during the 1960s and 70s<sup>22</sup>. The PFMC issued an additional rebuilding plan for POP in 2000<sup>22</sup>.

The widow rockfish has been an important commercial species since 1979 and midwater trawls typically targeted this species<sup>20</sup>. Managers declared the species overfished in 2001 and a 2003 study showed the population at 22.4% of unfished biomass<sup>20</sup>. In 2004, the PFMC implemented a rebuilding plan for the widow rockfish with a target year of 2038<sup>20</sup>. Pacific whiting pelagic trawlers account for about 75% of all widow catch<sup>20</sup>.

Yelloweye rockfish occur in rocky habitat and therefore are more vulnerable to commercial and recreational hook and line gear<sup>20</sup>. The first ever stock assessment in 2001 showed populations at 13% and 7% of unfished biomass in Oregon and northern California, respectively<sup>20</sup>. The 2004 rebuilding plan has a target year of 2058<sup>20</sup>.

The PFMC must manage the groundfish fishery to protect these overfished species while also maintaining economic activity in the fishery. The goal is to develop long-range plans that maximize economic benefit while responsibly managing fisheries<sup>20</sup>. In an attempt to minimize the economic impact, the PFMC reduced allowable take of target species with the lowest price per pound in order to rebuild depleted stocks<sup>19</sup>. In other words, they reduced bycatch of species which were less costly to reduce (in terms of the target species). Managers commonly restrict those fisheries with high impacts on depleted species and this has implications for those sectors and communities<sup>19</sup>. Canary rockfish potentially affects the largest number of ports along the West Coast, followed by bocaccio, yelloweye rockfish, and cowcod<sup>19</sup>. Also, southern ports are typically affected by only 2 or 3 depleted species while northern ports can be affected by up to 5 species<sup>19</sup>. Overall, reducing bycatch of darkblotched rockfish and POP is generally more expensive because they occur as bycatch in deeper waters where the target species are more valuable<sup>19</sup>. In contrast, bocaccio and cowcod occur as bycatch in shallower waters where the fishery targets low value flatfish<sup>19</sup>.

PFMC has two management strategies regarding overfished species. These are 1) to minimize bycatch of overfished species by reducing the targeting of the least valuable target species first and 2) to restrict sectors with the largest impact on depleted species<sup>19</sup>. Managers use the first strategy on a within-sector basis and the second on an across sector basis<sup>19</sup>. In other words, management maintains targeting of the most valuable species within a sector and if a coastwide reduction is necessary, will tend to use the second strategy. Also, some species occur in many ports and thus reducing targeting of these would impact more ports. The strategy used depends on whether management wants to minimize the number of impacted ports or minimize the overall coastwide reduction in ex-vessel value. The reality is probably some combination of the two<sup>19</sup>.

### **Overcapitalization and How to Reduce It**

NOAA defines capacity as “the amount of fish (or fishing effort) that can be produced over a given period of time by a vessel or fleet if fully utilized and for a given resource condition”<sup>9</sup>. In 2000, the Scientific and Statistical Committee of the PFMC declared overcapitalization the number one problem in the West Coast groundfish fishery and

stated that the PFMC must develop a program to reduce capacity as waiting for boats to leave the fishery was not sufficient enough to address the problem<sup>22</sup>. Overcapacity indicates that the fleet can harvest well in excess of a desired level (MSY) and this leads to severe biological overfishing, economic waste, and requires expensive management measures and regulations<sup>9,32</sup>. In 2001, overcapacity in the West Coast groundfish fishery equaled 150.2 million pounds and eliminating this required removal of some 1,260 boats valued at \$145.8 million<sup>9</sup>. Of all U.S. fisheries, the West Coast groundfish fishery had the greatest degree of overcapitalization and needed the largest buyback program<sup>9</sup>. In this context, it is important to make the distinction between excess capacity and overcapacity. Excess capacity is short-term and likely to self-correct while overcapacity is long-term and likely to persist for an infinite duration<sup>9</sup>.

The Pacific Marine Conservation Council and Ecotrust identified four scenarios for capacity reduction in the West Coast groundfish fishery<sup>32</sup>. These are removing all excess capacity, reducing capacity by 50% randomly in each sector, removing 50% of vessels in each size class within each sector, and reducing capacity in each sector while preserving economic viability (vessels making a living can stay).

Government or industry funded buyback programs represent the most common ways to reduce capacity worldwide<sup>22</sup>. There are three methods to reduce overcapitalization: market strategies, vessel buyback, and regulatory mechanisms<sup>23,9</sup>. Area closures are not capacity reduction measures unless they shut down an entire fleet as they simply lead to a reallocation of effort<sup>32</sup>. Market strategies (IFQ, permit stacking) and buyback programs ensure compensation for those leaving the fishery, while regulatory mechanisms do not. For this reason, capacity reduction measures typically attempt to use market strategies as they are more economically efficient and politically feasible. Vessel buyback programs can target groundfish specifically and are more effective and popular as fishermen can move to other fisheries.

### *2003 Vessel Buyback*

By 2003, PFMC realized that the LE system was insufficient to limit capacity in the fishery. It also became apparent that passively waiting for boats to exit the fishery was not sufficient to solve the problem. Capital utilization rates for the fishery were 9-12% for fixed gear, 41% for shoreside trawlers, and 6-13% for open access vessels<sup>7</sup>. Another study found that only 9% of LE fixed gear sablefish vessels and 27-41% of the trawl fleet were needed to harvest the total sablefish and groundfish allocation<sup>23,22</sup>. Evidence also exists that there was an important degree of latent capacity in this fishery indicating that many vessels had permits but did not make landings. A 2003 study by the Pacific Marine Conservation Council and Ecotrust showed a 12-17% latency rate for the groundfish fishery<sup>32</sup>. This has important implications for a buyback program because when managers reduce capacity, the latent boats may simply re-enter the fishery, thus negating the effect of the buyback.

In 2003, NMFS implemented a vessel buyback program to reduce capacity in the West Coast groundfish fishery<sup>10,25,20</sup>. The federal government and the industry combined efforts to implement this program through a loan which those fishermen who remained in

the fishery would repay over time<sup>10</sup>. PFMC determined that the groundfish fleet was roughly twice that needed and committed to a 50% reduction in capacity in each sector while maintaining its long-standing goal of long-term year round fishing<sup>27,23,32</sup>. The Council separated groundfish into a target sector and a bycatch sector<sup>23</sup>. Groundfish commonly occur as bycatch in the shrimp, prawn, halibut, and sea cucumber fisheries<sup>23</sup>. Overall, 92 LE permits were purchased out of a total of 284<sup>10,21,25,20</sup>. Subsequently, two permits were retired through permit combination, leaving 180 remaining permits<sup>21</sup>. In 2003, the LE trawl fishery had an ex-vessel value of \$42 million and an ex-processor value of \$62 million<sup>21</sup>. There is an estimated \$82 million total community income impact associated with the fishery (18% of all West Coast EEZ fisheries)<sup>21</sup>.

Evidence suggests that community members had mixed feelings about this vessel buyback program as some felt that fishermen simply switched to other boats and fisheries<sup>10</sup>. Also, gear stripped from decommissioned boats flooded the market, thus depressing prices<sup>10</sup>. Others were concerned that the buyback only helped the local community if the boats were local, otherwise the funds simply left the area<sup>10</sup>. Some felt that the funds should have been used for more research instead of for buying the boats<sup>10</sup>. Within Oregon's commercial fisheries, landings per vessel increased only slightly following the buyout<sup>16</sup>.

#### *Permit Stacking and Individual Fishing Quotas*

At its June 2005 meeting, the PFMC voted unanimously to explore a multispecies Individual Fishing Quota (IFQ) program for the LE trawl groundfish fishery<sup>21</sup>. The U.S. Congress implemented a moratorium on IFQs from the late 1990s to the early 2000s, complicating efforts to establish market based management controls<sup>10</sup>. The PFMC had been considering IFQs since the 1990s but the congressional moratorium delayed this<sup>21</sup>. In 2001, the Council implemented a tiered permit stacking program with the intent of transitioning to IFQ and this measure received unanimous support from industry, communities, processors, and environmentalists<sup>21</sup>. The goal of this policy was to reduce capacity while motivating individual vessels to minimize bycatch of depleted species<sup>25,23</sup>. The policy also sought to maintain harvest levels for species with healthy stocks as there is significant foregone economic opportunity due to bycatch cap closures<sup>21</sup>. The PFMC will consider making the permit stacking system mandatory if Congress continues to prohibit IFQs<sup>22</sup>. The stacking permit system has base permits, which allow a boat to harvest, and additional permits which vessels can "stack", thus allowing more harvest for an individual vessel<sup>22,20</sup>.

Under this system, vessels need a special LE permit to fish sablefish. This is called a "fixed gear sablefish endorsement" and these vessels must attach this endorsement to the LE permit<sup>20</sup>. The goal of this was to prevent movement of traditional non-sablefish boats into the sablefish fishery and the endorsement remains valid if a vessel transfers the LE, but the owner cannot separate the endorsement from the LE<sup>20</sup>. Allocation criteria for these endorsements were that between 1984 and 1994, the vessel caught at least 60,000 pounds of sablefish in any one year<sup>20</sup>.

### **Groundfish Processing and Products**

The West Coast groundfish processing industry has also undergone profound changes during the last 20 years. These developments are important in understanding the evolution and current status of the West Coast groundfish fishery. The six major trends occurring in the processing industry since the 1990s are infrastructure issues, decreased seafood product wholesale prices, the major expansion of offshore Pacific whiting, centralization of processing plants, vertical integration into harvesting and distribution activities, and the return of small processors offering niche markets<sup>25,16</sup>.

In the early 2000s, West Coast processors processed 150 million pounds annually, primarily Pacific whiting<sup>25</sup>. Whiting is always in competition with Pollock from Alaska and is subject to Japanese demand<sup>25</sup>. Products from elsewhere represent substitutes for all West Coast fish products and supermarket chains typically do not buy local seafood products, although restaurants may<sup>25</sup>.

Processing has become concentrated in just a few geographical areas on the West Coast<sup>25,16</sup>. On the U.S. West Coast, there are three processors that can process 20 million pounds a week<sup>25</sup>. These three processors bought 60% of the groundfish harvest and 98% of the Pacific whiting harvest in 2004<sup>25</sup>. This represents a significant change in the groundfish industry that agencies and NGOs must consider when looking at when considering community level impacts and groundfish market development on the West Coast.

Vertical and horizontal integration is occurring as processors increasingly desire ownership over groundfish quotas and fishermen have sought to sell directly to consumers<sup>25</sup>. More and more harvesters are selling products from their boats and this typically gets them double the normal price<sup>25</sup>. While they earn a higher price, time spent selling means they are not fishing and they end up competing with local markets<sup>25</sup>. Another issue is the asymmetry of information that exists as processors know the value of the products while harvesters often do not<sup>25</sup>. Processors in general advocate for Individual Processing Quotas (IPQ) during discussions regarding ITQ allocation, although small processors often fear this will concentrate profits<sup>10</sup>. Likewise, processors fear ITQs<sup>25</sup>. IPQs may reduce the influence local communities have on maintaining fleets<sup>25</sup>.

A medium sized processing plant capable of handling salmon, shrimp, and groundfish would cost at least \$10 million to construct and this does not include land acquisition or startup and working capital<sup>25</sup>. Due to high debt servicing, these plants must operate year round<sup>25</sup>. Processing operations generally need large quantities of electricity and water, imposing further costs and limitations where infrastructure and availability may be lacking<sup>25</sup>. Groundfish processing demand for water varies depending on product with filleting requiring much more than head and gut operations and surimi being very water intensive<sup>25</sup>. Groundfish are typically filleted and as fillets generally comprise 25-33% of total weight, the remainder needs processing into fish oil or meal<sup>25</sup>. Groundfish fillet processing operations typically have a high labor cost per pound<sup>16</sup>. Low value,

intensively processed fish products, such as whiting, have a multiplier effect of 7 to 10 while minimally processed products such as salmon have a multiplier of only 2<sup>25</sup>.

One interesting development is the live rockfish industry that developed in the San Francisco Bay Area in the 1990s. Demand peaked for this high-value fishery in the late 1990s and the potential for growth seems limited<sup>29</sup>. There also exists a small live groundfish niche market in Oregon<sup>16</sup>. Live fish are naturally caught using fixed gear methods, either hook and line or pots<sup>25</sup>. In 2005, the California nearshore livefish fishery captured 78.6% of the harvest via hook and line and 19.9% via pot gear<sup>1</sup>. Fixed gear caught sablefish fish fetch a price 50% greater than trawl caught and recently price per pounds has increased due to strong demand from Asia<sup>29</sup>.

### **Sustainable Fisheries and EFPs**

In addition to the capacity reduction programs, various state agencies and NGOs have expressed interest in testing new harvesting methods which will allow continued fishing activity. Many stocks of West Coast groundfish maintain healthy, exploitable levels. The new methods are designed to harvest fisheries in a more sustainable manner with the goal of realizing economic gain from abundant species without negatively impacting overfished species. There exists opportunity for vessels to earn revenue by participating in experiments such as research via EFPs<sup>16</sup>. Various actors have recently used three EFPs in California and Oregon. This section summarizes these three efforts.

#### *ODFW Study*

This section summarizes the Oregon Department of Fish and Wildlife's EFP efforts and results<sup>26</sup>. ODFW used selective flatfish trawls to estimate bycatch rates in the continental shelf flatfish fishery off the Oregon and Washington coast. The experiment occurred from May to October of 2003 and included 8 vessels with observer coverage. ODFW had previously developed the modified flatfish trawl which under previous experiments had shown bycatch reduction of 34-97% of certain overfished species. This occurred even though the modified trawl was larger and had larger catches of targeted flatfish than the traditional trawl. Regulations closed large areas of the continental shelf to fishing in order to protect some overfished rockfish species. Unfortunately, these areas also contain highly productive flatfish habitat but regulation restricts access to these areas because of the non-selectivity of conventional bottom trawl gear. Because previous experiments had demonstrated the selectivity of this modified trawl, this presents an opportunity to re-open some areas that the RCA had previously closed. This EFP allowed fishermen to harvest within the RCA and provided financial incentives to adopt this new gear type. The project resulted in 141 trips and 1,371 hauls in waters along the Oregon and Washington coast with 89.4% observer coverage. All vessels in this study reported excellence net performance and high catch rates of flatfish while bycatch of all overfished species was below the caps established under the EFP. All fishermen involved had positive impressions of the gear and suggested they would continue to use it, even outside the RCA, because it caught flatfish well and minimized sorting of bycatch. The ODFW recommends use of this modified flatfish trawl as a bycatch reduction method in the West Coast groundfish fishery.

### *CDFG Study*

The California Department of Fish and Game conducted a similar experiment using an EFP in California waters from October 18 to December 29, 2004<sup>2</sup>. This experiment used the ODFW modified flatfish trawl and also used a modified Scottish seine. Two boats participated in this experiment and made 34 trips and 116 hauls with 100% observer coverage. These vessels operated out of San Francisco and Monterey harbors and were allowed to fish within the RCA although under bycatch caps of overfished species. Target species amounted to 78% of the retained catch weight although the vessels reached bycatch caps for bocaccio in October and November, thereby terminating fishing for the month. CDFG reports positive results from this experiment although the agency cautions that due to the small number of vessels and tows, these results are not conclusive. The agency also suggests that the federal government remove Scottish seine gear from its list of bottom trawl gear.

### *TNC Proposal*

The TNC proposal involves 6 LE trawl vessels using fixed gear targeting groundfish off the southern California coast. TNC purchased these permits and all vessels make landings in Morro Bay, California. The goal of this experiment is to minimize bycatch of overfished species but goes a step further by considering the socioeconomic effects of alternative gear types and cooperative-based fishery management. Other goals include increasing harvest efficiency, commanding higher prices, and pooling risk among the members. This experiment requires 100% observer coverage and uses shared hard caps for target and bycatch species. Fishing is set to begin in April 2008 and any conclusions regarding the success and performance of this experiment will be presented as available. The experiment will last through 2008, with the possibility of renewal for the following year.

## **Fishing Communities**

The Magnuson-Stevens Act defines a fishing community as “a community which is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such community.” Recent developments in the groundfish fishery have impacted all West Coast fishing communities. For each pound of groundfish landings, there is a \$1-4 income impact in the local community<sup>32</sup>. Evidence shows that communities with greater socio-economic and cultural diversity and with a strong civic and amenity infrastructure will generally be more resilient to fishery restrictions<sup>19</sup>. “Vulnerable” communities are those that are “highly engaged” or “high dependent” on fisheries and have a “low resilience” to restrictions<sup>19</sup>. Many studies have investigated community by community effects of groundfish fishery evolution. This section provides an overview of the situation regarding two fishing communities on the West Coast: Morro Bay, California and Astoria, Oregon.

### *Morro Bay*

Morro Bay is located on the California Coast approximately equidistant from Los Angeles and San Francisco. The 2000 U.S. Census indicated that Morro Bay had a population of 10,350, which was a 7.1% decrease from the 1990 census<sup>26</sup>. Local

Chumash Indians utilized marine resources since the beginning of human habitation in the Morro Bay area<sup>26</sup>. Spanish explorers accessed Morro Bay's safe harbor as early as 1542 and in 1870 the town of Morro Bay was officially founded<sup>26</sup>. By the 1930s, Morro Bay began to focus on improving its harbor and commercial fishermen soon began to land large quantities of albacore, cod, and salmon<sup>26</sup>. In the 1940s, abalone fishing developed as an important industry in Morro Bay, though recently stocks have declined<sup>26</sup>.

Morro Bay currently remains an important fishing port with significant landings of halibut, rockfish, sole, and other species<sup>26</sup>. In 2000, 249 commercial vessels made landings in Morro Bay with the most important species being highly migratory, coastal pelagic, salmon, groundfish (in terms of tonnage) and highly migratory species and shrimp (in terms of value)<sup>26</sup>. Morro Bay residents own 62 of these vessels and 31 of them participate in the federally managed groundfish fishery<sup>26</sup>. Five Morro Bay vessels participated in the 2003 buyback program<sup>26</sup>. While the town has small groundfish landings compared to other West Coast ports, the recent continental shelf closure resulted in a 50% decrease in groundfish landings<sup>30</sup>. Also, Morro Bay is one of the top California ports regarding revenue from the open-access portion of the groundfish fishery<sup>18</sup>. No large commercial processors currently operate in Morro Bay and landings are trucked to other areas for processing<sup>26</sup>. Morro Bay is also home to an aquaculture facility which specializes in Pacific oysters, bay mussels, and manila clams<sup>26</sup>.

According to the PFMC, the most important commercial groundfish species for the port of Morro Bay from 2004-2007 were petrale sole, sablefish, thornyheads, dover sole, and English sole<sup>18</sup>. During this same period, there was a significant decline in groundfish revenue in Morro Bay. Total revenue had been \$526,944 in 2004 and this declined to \$58,000 in 2006 and \$15,560 in 2007<sup>18</sup>. For this reason, the city has recently tried to improve business opportunities regarding its marine resources. Recently, residents of Morro Bay have embraced the tourism industry and a number of charter vessels now operate out of this port. In 2003, at least 27 businesses serviced sport fishermen in Morro Bay and sport vessels targeted albacore, rock cod, salmon, and other species and also offered seasonal whale watching tours<sup>26</sup>. In 2000, charter vessels catches were approximately 94% rockfish and 5% albacore<sup>26</sup>.

Morro Bay has high groundfish dependency and low resiliency to restrictions<sup>19</sup>. Foreign competition, MPAs, and area closures have impacted local fishermen<sup>4</sup>. Recently, San Luis Obispo County Harbors received a \$130,000 grant from the Coastal Conservancy to help develop a sustainable fisheries plan<sup>4</sup>. According to San Luis Obispo County, the community needs a long-term investment in infrastructure to realize significant gains in the fishing industry<sup>4</sup>. TNCs EFP fits into the context of this plan and should help to provide opportunities for local fishermen to utilize species in a more environmentally responsible way.

### *Astoria*

The town of Astoria, Oregon is bordered by the Pacific Ocean to the west and the Columbia River to the north and in 2000 had a population of around 9,800<sup>14</sup>. Commercial interest in the area began in the late 1700s and the Lewis and Clark expedition arrived in



the area in 1805-1806<sup>58</sup>. The party noted that the natives of the area were adept seafarers who relied on local fish species for subsistence<sup>14</sup>. The Pacific Fur Company later arrived in the area and established Fort Astoria, thus making Astoria the oldest U.S. settlement west of the Rocky Mountains<sup>14</sup>.

The history of Astoria area fishing dates back to the 1850s and by the end of the 19<sup>th</sup> century, it was the most important commercial hub between Seattle and San Francisco<sup>14</sup>. More recently, groundfish species have become important as salmon availability has declined<sup>10</sup>. In the 1980s, the groundfishery was strong and this increased as the Pacific whiting fishery moved onshore in the 1990s<sup>10</sup>. Since 2000, the Astoria sardine fishery has seen a large increase in landings with the Asian bait market as the prime destination<sup>10</sup>. In September 2004, managers closed the groundfish sport fishery for the first time in history<sup>10</sup>. Because of the Labor Day holiday, this was bad timing and the sport charter boats had to cancel reservations<sup>10</sup>.

In 2000, 334 commercial vessels made landings in Astoria, with crab, groundfish, highly migratory species, and shrimp being the most economically important<sup>14</sup>. In this same year, Astoria residents owned 184 vessels which participated in a variety of fisheries<sup>14</sup>. Also, four processing plants operate in Astoria and in 2000 they processed a total of about 10 million pounds of product worth approximately \$16 million<sup>14</sup>. For the period 2004-2007, the most important commercial groundfish species for the port of Astoria were Dover sole, petrale sole, Pacific whiting, sablefish, and Pacific cod<sup>18</sup>. Ex-vessel revenue of all groundfish species has been relatively stable at around \$8-10 million over this period for the port of Astoria<sup>18</sup>. Groundfish, particularly Pacific whiting, will continue to be an important source of revenue for the town. Astoria may also benefit from EFPs that explore more sustainable ways to harvest and manage local fisheries.

### **Conclusion**

This paper has documented the history of the West Coast Groundfish Fishery and its recent decline. Great changes have occurred in the demographics of the fishery, the species harvested, and in management techniques and restrictions. The current status of the fishery is not good as managers have restricted harvest levels due to concern about the overfished species. Federal law mandates that the PFMC restrict fishing to rebuild these stocks as the 90 or so groundfish species co-occur and fishermen cannot select for specific species. Moreover, environmental concerns have pushed for vast MPAs to protect ecosystems as well as individual species. These issues will not subside in the near future so fishing communities will need to work within these confines in order to ensure that some fishing activity can continue. EFPs such as those in the TNC proposal represent a good opportunity for communities, such as Morro Bay, to revive its local fishing industry while promoting sustainable harvest of groundfish species.

Recent developments regarding management of the fishery indicate a significant shift by the PFMC. The groundfish trawl rationalization process is progressing and the PFMC will make significant decisions at its June and November 2008 meetings. In particular, the Council must decide on what form the rationalization will take and how intersector allocations will occur. The Council will likely implement an IFQ system for the

groundfish fishery and this will lead to discussions regarding allocation and entry of new participants into the fishery. These decisions will impact the overall makeup of the fishery and may affect TNCs EFP in southern California. For these reasons, TNC should keep abreast of these developments to ensure that its EFP will benefit the community of Morro Bay and promote the sustainable harvest of groundfish species. While some groundfish fishing activity will always occur on the U.S. West Coast, harvest levels will probably not reach historic levels for many years.

## Sources Cited

1. California Department of Fish and Game. 2006. *Review of Some California Fisheries for 2005: Coastal Pelagic Finfish, Market Squid, Dungeness Crab, Sea Urchin, Abalone, Kelleys' Whelk, Groundfish, Highly Migratory Species, Ocean Salmon, Nearshore Live Fish, Pacific Herring, and White Seabass*. Fisheries Review, CalCOFI Rep., Vol.47, 2006.  
[http://www.calcofi.org/newhome/publications/CalCOFI\\_Reports/v47/Vol\\_47\\_Fisheries\\_Review.pdf](http://www.calcofi.org/newhome/publications/CalCOFI_Reports/v47/Vol_47_Fisheries_Review.pdf)
2. California Department of Fish and Game. 2005. *2004 California Department of Fish and Game Exempted Fishing Permit Study*. California Department of Fish and Game, Marine Region.
3. California Department of Fish and Game. 2004. *Annual Status of the Fisheries Report Through 2003*. California Department of Fish and Game, Marine Region.  
[http://www.dfg.ca.gov/marine/asfr\\_2003.pdf](http://www.dfg.ca.gov/marine/asfr_2003.pdf)
4. Coastal Conservancy. 2006. *Transitioning San Luis County Harbors and Commercial Fisheries to a Sustainable Future*. Coastal Conservancy Staff Recommendation, File No. 06-095.  
[http://ceres.ca.gov/coastalconservancy/sccbb/0611bb/0611Board08\\_Heritage\\_Harbors\\_Morro\\_Bay.pdf](http://ceres.ca.gov/coastalconservancy/sccbb/0611bb/0611Board08_Heritage_Harbors_Morro_Bay.pdf)
5. Dalton, Michael. 2006. *Simulated Maximum Likelihood Estimation and Analysis of Covariance in a Panel Tobit Model of California's Groundfish Trawl Fishery, 1981-2001*. California Sea Grant Working Paper.
6. Enticknap, Ben and Whit Sheard. 2005. *Conservation and Management of North Pacific Rockfishes*. Alaska Marine Conservation Council.  
<http://www.akmarine.org/publications/Conservation%20and%20Management%20of%20North%20Pacific%20Rockfishes%20August2005.pdf>
7. Hanna, Susan. 2000. *Setting the Fishery Management Stage: Evolution of West Coast Groundfish Management*. Oregon State University, Oregon Sea Grant.  
<http://oregonstate.edu/dept/IIFET/2000/papers/hanna.pdf>
8. Karpov, Konstantin; Albin, Douglas P. and Wade H. Van Buskirk. 1995. *The Marine Recreational Fishery in Northern and Central California: A Historical Comparison (1958-1986), Status of Stocks (1980-1986), and Effects of Changes in the California Current*. State of California, The Resources Agency, California Department of Fish and Game Fish Bulletin 176.
9. Kirkley, James E. et al. 2006. *Reducing Capacity in U.S. Managed Fisheries*. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NMFS-F/SPO-76. <http://spo.nmfs.noaa.gov/tm/tm76.pdf>

10. Langdon-Pollock, Jennifer L. 2006. *A Pilot Study of Two West Coast Marine Fishing Communities, Astoria and Newport, Oregon: Perspectives from Fishing Community Members*. Pacific States Marine Fisheries Commission.  
[http://www.psmfc.org/efin/docs/2004AstoriaNewport/Port\\_Project\\_White\\_Paper\\_Final.pdf](http://www.psmfc.org/efin/docs/2004AstoriaNewport/Port_Project_White_Paper_Final.pdf)
11. Leipzig, Peter. 2001. *Pacific Groundfish Buy-Back Proposal and the Final Summary and Analysis*. Fishermen's Marketing Association, Eureka, California.  
<http://www.trawl.org/Archived%20Papers/FINAL.PDF>
12. Levin, Phillip S.; Holmes, Elizabeth E. and Kevin Piner. 2005. *Fishing-induced Shifts in a Pacific Ocean Fish Assemblage*. National Marine Fisheries Service, Northwest Fisheries Science Center.  
[http://faculty.washington.edu/eeholmes/Files/Levin\\_et\\_al\\_for\\_Ecol\\_Letters.pdf](http://faculty.washington.edu/eeholmes/Files/Levin_et_al_for_Ecol_Letters.pdf)
13. National Marine Fisheries Service. ??? *Research Plan for West Coast Groundfish*. National Marine Fisheries Service.
14. NOAA Fisheries Service, Northwest Fisheries Science Center. *Astoria Community Profile*.  
[http://www.nwfsc.noaa.gov/research/divisions/sd/communityprofiles/Oregon/Astoria\\_OR.pdf](http://www.nwfsc.noaa.gov/research/divisions/sd/communityprofiles/Oregon/Astoria_OR.pdf)
15. NOAA Fisheries Service, Northwest Fisheries Science Center. *Morro Bay Community Profile*.  
[http://www.nwfsc.noaa.gov/research/divisions/sd/communityprofiles/California/Morro\\_Bay\\_CA.pdf](http://www.nwfsc.noaa.gov/research/divisions/sd/communityprofiles/California/Morro_Bay_CA.pdf)
16. Oregon Department of Fish and Wildlife. 2007. *Oregon's Commercial Fishing Industry: Year 2005 and 2006 Review and 2007 Outlook*. Oregon Department of Fish and Wildlife and Oregon Coastal Zone Management Association.  
[http://www.dfw.state.or.us/fish/commercial/commercial\\_fishing\\_report.pdf](http://www.dfw.state.or.us/fish/commercial/commercial_fishing_report.pdf)
17. Oreskes, Naomi and Carmel Finley. 2007. *A Historical Analysis of the Collapse of the Groundfish: U.S. Fisheries Science, Development, and Management, 1945-1995*. California Sea Grant College Program Research Compilation Report, Paper MA07\_01.  
<http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1158&context=csgc>
18. Pacific Fishery Management Council. 2008. *Status of the Pacific Coast Groundfish Fishery: Stock Assessment and Fishery Evaluation Volume 1: Description of the Fishery*. Pacific Fishery Management Council.  
[http://www.pcouncil.org/groundfish/gfsafe0308/SAFE\\_2008\\_March.pdf](http://www.pcouncil.org/groundfish/gfsafe0308/SAFE_2008_March.pdf)

19. Pacific Fishery Management Council. 2006. *Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2007-2008 Pacific Coast Groundfish Fishery and Amendment 16-4: Rebuilding Plans for Seven Depleted Pacific Coast Groundfish Species: Draft Environmental Impact Statement*. Pacific Fishery Management Council.  
[http://www.pcouncil.org/groundfish/gfspex/07-08/F0708GF\\_Spex\\_FEIS.pdf](http://www.pcouncil.org/groundfish/gfspex/07-08/F0708GF_Spex_FEIS.pdf)
20. Pacific Fishery Management Council. 2006. *Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery as Amended through Amendment 19 Including Amendment 16-4*. Pacific Fishery Management Council.
21. Pacific Fishery Management Council. 2005. *Groundfish Trawl Individual Quotas for the Pacific Coast: July 2005 Informational Report*. Pacific Fishery Management Council.
22. Pacific Fishery Management Council. 2000. *Overcapitalization in the West Coast Groundfish Fishery: Background, Issues, and Solutions*. Pacific Fishery Management Council.  
<http://www.pcouncil.org/groundfish/gfother/sscovercap0300.pdf>
23. Pacific Fishery Management Council. 2000. *Pacific Fishery Management Council Groundfish Fishery Strategic Plan: "Transition to Sustainability"*. Pacific Fishery Management Council.  
<http://www.pcouncil.org/groundfish/gfother/stratplan.pdf>
24. Pacific Fishery Management Council. 1998. *Essential Fish Habitat: West Coast Groundfish*. Pacific Fishery Management Council.
25. Pacific States Marine Fishery Commission. 2006. *Review of the West Coast Commercial Fishing Industry in 2004*. Pacific States Marine Fishery Commission.  
<http://www.psmfc.org/efin/docs/PSMFC%20WACA%20comm%20rpt.pdf>
26. Parker, Steven J.; Saelens, Mark; Kupillas, Steven A. and Robert W. Hannah. 2004. *Using an Exempted Fishing Permit for a Large-scale Test of a Selective Flatfish Trawl in the Continental Shelf Flatfish Fishery*. Oregon Department of Fish and Wildlife Information Report Number 2004-01.  
<http://oregonstate.edu/dept/ODFW/inforeports/2004-01.pdf>
27. Pomeroy, Caroline and Michael Dalton. 2003. *Socio-Economics of the Moss Landing Commercial Fishing Industry: Report to the Monterey County Office of Economic Development*. UC Santa Cruz and CSU Monterey Bay.  
[http://www.psmfc.org/efin/docs/otherpublications/ML\\_Cmcl\\_Fishing\\_Ind\\_Report.pdf](http://www.psmfc.org/efin/docs/otherpublications/ML_Cmcl_Fishing_Ind_Report.pdf)

28. Radtke, Hans and Shannon W. Davis. 2000. *Description of the U.S. West Coast Commercial Fishing Fleet and Seafood Processors*. Pacific States Marine Fishery Commission.  
<http://www.psmfc.org/efin/docs/exesummry.pdf>
29. Scholz, Astrid; Steinback, Charles; Klain, Sarah and Amy Boone. ????. *Socioeconomic Profile of Fishing Activities and Communities Associated with the Gulf of the Farallones and Cordell Bank National Marine Sanctuaries*. Ecotrust.  
[http://www.inforain.org/reports/JMPRsocioeco\\_final.pdf](http://www.inforain.org/reports/JMPRsocioeco_final.pdf)
30. Scholz, Astrid; Mertens, Mike; Sohm, Debra; Steinback, Charles and Marlene Bellman. 2005. *Estimating Economic Effects of Fishery Management Measures Using Geospatial Methods*. Fisheries Assessment and Management in Data-Limited Situations, Alaska Sea Grant College Program, AK-SG-05-02.  
<http://www.inforain.org/reports/Economic%20Effects%20of%20Fisheries%20Manageme nt%20Using%20Geospatial%20Methods.pdf>
31. Scholz, Astrid; Mertens, Mike; Sohm, Debra; Steinback, Charles and Marlene Bellman. 2005. *Place Matters: Spatial Tools for Assessing the Socioeconomic Implications of Marine Resource Management Measures on the Pacific Coast of the United States*. American Fisheries Society Symposium 41:000-000,2005.  
<http://www.inforain.org/reports/Place%20Matters%20Spatial%20Tools%20for%20Asses sing%20the%20Socioeconomic%20Implications%20of%20Marine%20Resource%20Ma nagement.pdf>
32. Scholz, Astrid. 2003. *Groundfish Fleet Restructuring Information and Analysis Project: Final Report and Technical Documentation*. Pacific Marine Conservation Council and Ecotrust.  
<http://www.inforain.org/reports/Groundfish%20Fleet%20Restructuring%20Information% 20and%20Analysis%20Project.pdf>
33. Shaw, Wesley and Flaxen D.L. Conway. 2007. *Response to the West Coast Groundfish Disaster: Lessons Learned for Communities and Decision Makers*. Oregon State University, Oregon Sea Grant.  
<http://seagrant.oregonstate.edu/sgpubs/onlinepubs/g07006.pdf>