West Coast Groundfish Case Study: 
Using ACLs and Other MSA Tools to Bring 
a Multispecies Fishery Back from the Brink

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The Groundfish Fishery Management Plan Includes a Wide Variety of Species

<table>
<thead>
<tr>
<th>Species</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Rockfish”</td>
<td>63</td>
</tr>
<tr>
<td>Roundfish</td>
<td>6</td>
</tr>
<tr>
<td>Flatfish</td>
<td>12</td>
</tr>
<tr>
<td>Elasmobranchs</td>
<td>6</td>
</tr>
<tr>
<td>“Others”</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>90</strong></td>
</tr>
</tbody>
</table>
Clark’s Seminal Publication Was the Basis of PFMC Harvest Rates During the 1990’s

- Coastwide groundfish surveys began in 1977 and were repeated on a triennial basis

- Expanded port sampling programs followed the passage of the MSFCMA

- Due to insufficient data, stock-specific optimal harvest rates could not be estimated

- Measured per capita compensation as ratio of R/S at low stock size relative to R/S at unfished

Initial Range of Productivity
Conditions Considered was Broad

productivity at the origin relative to unfished level
Stocks Fished at an F_{35\%} Rate Should Produce a Sustainable Yield of at Least 75\% of MSY
Early Groundfish Harvest Policy Was To Fish at a Constant $F_{35\%}$ Rate

- Hightower and Lenarz (1989) recommended a constant harvest rate policy for widow rockfish
- Amendment 5 to the FMP was passed (1990) establishing $F_{20\%}$ as the overfishing rate
- In 1990 the Groundfish Management Team (GMT) and the PFMC adopted $F_{35\%}$ as a proxy for $F_{MSY}$
- By 1996 concerns had developed

The 1996 Sustainable Fisheries Act (SFA) – A New Reality

- Amended the MSFCMA to include reference points
- Develop target fishing mortality rates ($F_{MSY}$) and target biomass levels ($B_{MSY}$)
- Defined “overfishing” ($F > F_{MSY}$)
- Established conditions for declaring a stock “overfished” ($B < 0.5 B_{MSY}$)
- Determined requirements for rebuilding overfished stocks
- Required identification of Essential Fish Habitat (EFH)
In 1998 the rockfish harvest rate was reduced to $F_{40\%}$ because some stocks were not approaching an equilibrium.

West Coast Groundfish Exhibit Low Productivity

A Bayesian Prior Probability of Rockfish Productivity Was Estimated

mean = 0.67
stdev = 0.17

Groundfish Harvest Policy was Revised to Incorporate a Minimum Stock Size Threshold (MSST) and Precautionary Catch Reductions

- overfished
- precautionary
- healthy

**MSST**

**target**

- FSPR
  - F_{40\%} - hake & flatfish
  - F_{50\%} - rockfish
  - F_{45\%} - other groundfish

ABC (F_{SPR})

40:10 OY
Houston – we have a problem...

Relative Stock Size


unexploited level

Sustainable Fisheries Act

rebuilding target

minimum stock size threshold
PFMC Actions Directed Towards Rebuilding Overfished Stocks

- Develop rebuilding plans
- Reduce trip limits
- Limited entry permit buyback
- Rockfish Conservation Area (RCA)
- Trawl footrope restrictions
- Streamline management cycle
Different Stocks Had Different Rebuilding Criteria Applied

<table>
<thead>
<tr>
<th>Stock</th>
<th>$P_{\text{rebuild}}$ by $T_{\text{max}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bocaccio</td>
<td>70%</td>
</tr>
<tr>
<td>Canary Rockfish</td>
<td>60%</td>
</tr>
<tr>
<td>Widow Rockfish</td>
<td>60%</td>
</tr>
<tr>
<td>Pacific Ocean Perch</td>
<td>70%</td>
</tr>
<tr>
<td>Darkblotched Rockfish</td>
<td>$&gt;90%$</td>
</tr>
<tr>
<td>Yelloweye Rockfish</td>
<td>92%</td>
</tr>
<tr>
<td>Cowcod</td>
<td>60%</td>
</tr>
<tr>
<td>Lingcod</td>
<td>60%</td>
</tr>
</tbody>
</table>

To Meet the Required Catch Reductions
Groundfish “Trip Limits” Were Reduced
Rockfish Conservation Area

RCA is a narrow spatial band, but is highly effective at protecting the majority of overfished rockfish biomass.

~70% of historical triennial survey rockfish catch was taken between 75-150 fathoms.
The RCA Became Latitudinally Stratified To Maximize Opportunities To Provide Access to Healthy Stocks

GMT report, March 2007
The RCA Also Became Temporally Stratified for the Same Reason
Exploitation Rates of Rebuilding Species Were Sharply Reduced

Xi et al. 2009
Groundfish Science and Management Practices Were Revised

- STock Assessment Review (STAR) process implemented 1997
  - Greater public participation
  - Improve quality and rigor of scientific review
  - Created a “Wall of Science”
- Amendment 17 to the FMP (2003) moved groundfish management to a multi-year cycle (on year – off year)

PFMC Agenda Time (April 2009–March 2010)
Some Key Mandates of the Magnuson-Stevens Reauthorization Act (MSRA) of 2006

- End overfishing of all managed stocks using ACLs
- Use Accountability Measures (AMs) to insure ACLs are not exceeded
- Council SSCs determine scientific uncertainty in the development of precautionary buffers
- Established conditions for implementation of catch share programs
- Effectuated in FMP Amendment 23 (2010)
Some New Definitions of Terms

ACLs should not be exceeded more than once in four years.

In-season monitoring of landings & discards to insure an ACL is not exceeded is a suitable accountability measure.
How to Define and Quantify Scientific Uncertainty?
Pooled Variation Over All Groundfish

**Figure 6**

Aggregate distribution of log-deviations pooled over all 17 stocks with the fit of a normal distribution shown as the line with symbols ($\sigma = 0.36$).

The ABC Control Rule Used by the PFMC for Data-Rich Tier 1 Stocks

PFMC adopted a policy of limiting $P^*$ to 0.45.
Revised 40:10 Harvest Policy Incorporates a “Scientific Uncertainty” Buffer
Petrale Sole – A New Casualty

Relative Depletion

Target

MSST

T_{target}

2009  2011  2013

0%  5%  10%  15%  20%  25%  30%
Petrale Sole Rebuilding Follows the PFMC’s Default Flatfish Harvest Policy
Improving on Restrepo et al. – Developing ACLs for All Groundfish Stocks

- Depletion-Based Stock Reduction Analysis (Dick & MacCall 2010) applied to 40+ stocks during the 2011-2012 cycle
  - Requires complete historical catch reconstructions
  - OFL estimates aggregated into stock complexes

- Extended DBSRA and extended Simple Stock Synthesis applied to stocks in the 2013-2014 cycle
  - Models include CPUE time series and priors
  - Stock status is informed by data (Tier-2)
  - Greater throughput (6 stock assessments from 1 STAR panel)

Trawl Rationalization: Limited Access Privileges And Trawl Individual Quotas (TIQ)

The Problem
- “Groundfish Disaster” – rockfish stocks declared overfished
- Minimizing bycatch of overfished stocks creates economic losses due to foregone harvest opportunity
- Unknown discard of overfished stocks

The Solution: Catch Shares
- Allocate a portion of ACL based on historic participation
- Species-specific quota shares (e.g., depleted rockfish)
- Gives share holders flexibility when to harvest
- Holders can transfer annual “quota pound” allotment
- FMP Amendment 20 passed in June 2010
- 100% observer coverage, which is costly
- Pools established to spread risk of catch overages
Canary Rockfish

Depletion

Wallace & Cope 2013
Methot & Piner 2002

target
MSST
Darkblotched Rockfish

- Rogers et al. 2000
- Gertseva & Thorson 2014

Depletion

- Target
- MSST
Widow Rockfish

Depletion

- Williams et al. 2000
- Xi et al. 2011

Target

MSST

Year:
- 1970
- 1975
- 1980
- 1985
- 1990
- 1995
- 2000
- 2005
- 2010
- 2015
Bocaccio

Depletion

Field 2013

MacCall 2002

target

MSST

0% 25% 50% 75% 100% 125% 150% 175% 200%

Pacific Ocean Perch (POP)

Depletion

- Hamel and Ono 2011
- Hamel et al. 2003

Target

MSST
Management Response To Rockfish Depletions Was Dramatic

![Graph showing the exploitation rate of different rockfish species over time. The graph includes lines for canary, widow, yelloweye, darkblotched, bocaccio, and cowcod, with notable decreases around 1990 (SFA) and 2005 (MSRA).]
West Coast Groundfish Trawl Revenues (2012 adjusted – tribal & whiting catches excluded)

Ex-Vessel Value

$0

$20,000,000

$40,000,000

$60,000,000

$80,000,000

$100,000,000

$120,000,000


PACFIN, April 2014
PFMC Groundfish Management Timeline

1975
- FCMA Passed
- Hake Joint Venture
- Groundfish FMP

1980
- POP Rebuilding

1985
- Amend. 5
  - Overfishing $F_{20\%}$
  - $F_{35\%}$ proxy adopted

1990
- Amend. 4
  - Framework Process
- Amend. 6
  - License Limitation
- Sustainable Fisheries Act

1995
- Amend. 10
  - STAR Review Process
- Harvest Policies Revised
- Harvest Specifications and NS-1 Guidelines Under MSRA
- Amendment 17
  - Biennial Management

2000
- Amend. 11
  - MSST 40:10 $F_{MSY}$ limit
  - $F_{40\%}$ for Rockfish

2005
- Amend. 16
  - Rebuilding Plans
- Amend. 20
  - Trawl ITQ

2010
- Amend. 23
- Overfishing $F_{20\%}$
- $F_{35\%}$ proxy adopted
Rebuilding Analysis: as Harvest Rate \( \sqrt{\frac{\text{the Prob(\text{rebuild})}}{\text{the Prob}} \} \)
Bottom Trawl Roller Gear Reduced to 8” Based on Industry Proposal

Spatial Changes in Trawl Fishing Effort in Response to Footrope Diameter Restrictions in the U.S. West Coast Bottom Trawl Fishery

ROBERT W. HANNAH*