Draft 2010 Biological Opinion: Supporting Documents

Libby Logerwell
Status of Stocks and Multispecies Assessment
Resource Ecology and Fisheries Management
Alaska Fisheries Science Center
Outline of presentation

• Biomass projections cited in Chapter 8 “Reasonable and Prudent Alternatives”
• Atka mackerel research
  – Tagging estimates of movement and abundance
  – Food web model estimates of production and consumption
• Sea lion fishery and oceanographic analysis
Biomass projections

• White papers by Ianelli, et al.
  – “Projections of Atka mackerel and Pacific cod catch reductions”
  – “Aleutian Islands trawl survey biomass summary”

• Examine how much biomass of Aleutian Islands Atka mackerel and Pacific cod could increase as a result of reductions in commercial catch
Methods

• Projection model from groundfish stock status determinations (100 replicates, 100 years)

• Assumptions
  – Population dynamics within NPFMC management areas are the same as region-wide dynamics
  – No fish migration between areas
  – Biomass of other groundfish species (e.g., rockfish, flatfish) does not change

• Initial population biomass from 2009 SAFE

• Projections apportioned into NPFMC areas based on 2002-2006 trawl survey data
### Survey biomass estimates
#### Western Aleutians (543)

<table>
<thead>
<tr>
<th>Groundfish species</th>
<th>2002</th>
<th>2004</th>
<th>2006</th>
<th>Average</th>
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<tbody>
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<td>212,639</td>
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<td>59,387</td>
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Summer bottom-trawl survey estimates of groundfish biomass (t) by year and average for the Aleutian Islands region 543.
Survey biomass estimates
Western Aleutians (543)

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Summer bottom-trawl survey estimates of groundfish biomass proportions by year and average for the Aleutian Islands region 543.
## Survey biomass projections, no fishing

### Western Aleutians (543)

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Average Pacific cod and Atka mackerel Aleutian Islands bottom-trawl survey biomass estimates projected from the BSAI-wide and Aleutian Islands-wide (respectively) models under no fishing. The other species groundfish biomass (kt) values are set equal to their averages. Data are from the 2002, 2004 and 2006 surveys for region 543.
Survey biomass estimates
Central Aleutians (542)

<table>
<thead>
<tr>
<th>Groundfish species</th>
<th>2002</th>
<th>2004</th>
<th>2006</th>
<th>Average</th>
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</thead>
<tbody>
<tr>
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Survey biomass estimates
Central Aleutians (542)

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<th>Groundfish species</th>
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<th>Average</th>
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<td>1%</td>
<td>9%</td>
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<td>5%</td>
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Summer bottom-trawl survey estimates of groundfish biomass proportions by year and average for the Aleutian Islands region 542.
survey biomass projections fishing at 50% max. permissible Central Aleutians (542)

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Relative % 100% 97% 97% 99% 101% 102% 104% 105% 106% 107% 107%

Average Pacific cod and Atka mackerel Aleutian Islands bottom-trawl survey biomass estimates projected from the BSAI-wide and Aleutian Islands-wide (respectively) models under fishing at half of maximum permissible rate. The other species groundfish biomass (kt) values are set equal to their averages. Data are from the 2002, 2004 and 2006 surveys for region 542.
Mean biomass relative to 2009 estimates under no fishing (F=F0.0) and fishing at maximum permissible levels (F=FABC).
Results

Mean biomass relative to 2009 estimates under no fishing ($F=F_{0.0}$) and fishing at maximum permissible levels ($F=F_{ABC}$).
Mean total biomass over simulations (solid thick line) compared to some of the Monte Carlo realizations (no fishing).
Atka mackerel
Tagging project overview

• P.I.s
  – Susanne McDermott and Libby Logerwell

• Evaluate efficacy of trawl exclusion zones
  – Do fish move from inside to outside?
  – What is the abundance of fish inside?

• Auxiliary studies
  – Physical oceanographic characteristics of habitat
  – Food habits
  – Reproductive biology
  – Zooplankton sampling
- Tagged fish release locations
Tag release and recovery locations

Seguam Pass

Amchitka Island

Tanaga Island

Kiska Island

Legend: rookery10mm polygon, core habitat polygon

Release locations
Recovery locations

East
West
North
South
Methods

• Model structure:
  – Integrated tagging model using maximum likelihood Estimates
  – 4 different data sources
  – Several likelihoods combined in joint likelihood (admodelbuilder)
  – MCMC estimation procedure
Abundance estimates

- Seguam (2002)
- Tanaga E (2002)
- Tanaga W (2002)
- Kiska (2006)
Biomass estimates of the National Marine Fisheries Service groundfish survey (averaged by area over the years 2002-2006) and the current tagging study.
Exploitation rate

- Outside TEZ
- Out- and inside TEZ

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<td>Amchitka S</td>
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</tr>
<tr>
<td>Amchitka N</td>
<td>2003</td>
</tr>
<tr>
<td>Kiska</td>
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</tbody>
</table>
Small-scale food web model

- White paper “Efficacy of trawl exclusion zones for preserving Atka mackerel” by Ivonne Ortiz and E. Logerwell
- Is there enough Atka mackerel production inside Trawl Exclusion Zones (TEZs) to support Steller sea lions?
- Construct a food web model for each TEZ
Small-scale food web model

Steller sea lions

Atka mackerel Production

Fish predators:
Pollock
Halibut
Pacific cod
Arrowtooth Flounder
Skates
Small-scale food web model

Data

• Atka mackerel
  – Biomass from tag model
  – Production rate (P/B) from Aleutian EcoPath model

• Steller sea lions
  – Biomass from derived counts, age-structure, sex ratio, pregnancy rate, and weight-at-age
  – Diet from scat collections
  – Consumption rate (Q/B) from Aleutian EcoPath model

• Fish predators
  – Biomass from trawl survey
  – Diet from trawl survey collections
  – Consumption rate (Q/B) from Aleutian EcoPath model
Current SSL population

“Recovered” (1977) SSL population
Future Atka mackerel research

• Special issue *Marine and Coastal Fisheries*
  – S.McDermott
  – Fall 2010

• NPRB grant for tagging in western Aleutian Islands
  – Summer 2011
  – Collaborate with North Pacific Fisheries Foundation
Contact information

http://www.afsc.noaa.gov/refm/stocks/fit/FIT.htm

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206-526-4231
Fishery Footprint Analysis

• White paper “Steller sea lion fishery and oceanographic analysis BiOp 2010” by Fritz and Logerwell

• Examine relationships between:
  – Adult and juvenile SSL counts at rookery and haul-out sites
  – Biomass and catch estimates of Atka mackerel, pollock, Pacific cod and arrowtooth flounder
  – Oceanographic variables

• 1991-2008

• Regional spatial scale
Spatial distribution of groundfish catch

- Observed catch expanded to total catch for each haul location
- Estimated catches assigned to regions
Spatial distribution of groundfish biomass

• Aleutian Islands
  – AFSC bottom trawl survey
    • Proportion of survey biomass in each region, each year
    • Linear interpolation between survey years
    • Stock assessment biomass multiplied by regional proportion
      – 16% of BSAI P. cod
      – No arrowtooth flounder

• Gulf of Alaska
  – AFSC bottom trawl survey
  – Winter hydroacoustic survey (pollock)
  – No Atka mackerel

• Bering Sea
  – Bering Sea and Bogoslof pollock
    – 84% of BSAI P. cod
    – 82% of BSAI arrowtooth
    – No Atka mackerel
Harvest rate

- Each region
- Average catch ÷ average biomass
- Three time periods
  - 1991 to 2008
  - 1991 to 1999
  - 2000 to 2008
Statistical analyses

- Linear regression, P<0.25
- Aleutian Islands – Bering Sea (regions 1-6)
- Gulf of Alaska – Bering Sea (regions 6-11)
- Non-pups
- All SSL trend sites
- Rookery trend sites
Bering Sea – Aleutian Is.

Non-pups at ALL trend sites

1991-2008

1991-1999

2000-2008

Atka mackerel

Pacific cod

Pollock

P=0.21

P=0.37

P=0.05

P=0.09

P=0.17

P=0.20

P=0.36

P=0.71

P=0.26
# GOA – Bering Sea

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<th>Pacific cod</th>
<th>Pollock summer</th>
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<th>Pollock annual</th>
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<td>P=0.38</td>
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<td>P=0.33</td>
<td>P=0.84</td>
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</table>

Non-pups at ALL trend sites

<table>
<thead>
<tr>
<th></th>
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<td>P=0.84</td>
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</tr>
</tbody>
</table>
GOA – Bering Sea

Pacific cod

Pollock summer

Pollock winter

Pollock annual

Arrowtooth flounder

Non-pups at ROOKERY trend sites

1991-2008

1991-2000

2000-2008

1% 2% 3%
Conclusions – Groundfish harvest rate

• No association between harvest rates and SSL population growth rates where prey species has a low frequency of occurrence in SSL diets and where harvest rates were relatively low
  – arrowtooth flounder in the GOA-BS
  – 5 of 6 associations for summer Pollock in the GOA-BS

• Positive associations between harvest rates and SSL population growth rates where prey species has a low frequency of occurrence in annual SSL diets, where SSL consumption of the prey species may be seasonal, or where harvest rates for the prey species were low
  – 5 of 6 associations for Pollock in the AI-BS
  – 1 of 6 associations for Pacific cod in the AI-BS
Conclusions – Groundfish harvest rate (cont.)

- Negative associations between harvest rates and SSL population growth rates where prey species has a high frequency of occurrence in SSL diets and where there was contrast between SSL regions in fishery harvest rates
  - 3 of 6 associations for Atka mackerel in the AI-BS
  - 5 of 12 for Pollock in the GOA-BS
  - 2 of 6 associations for Pacific cod in the GOA-BS
- Predominantly in the 1990s
Oceanographic variables

- Spring (May-June) and summer (Aug-Sept)
  - Sea surface temperature
  - Wind mixing
  - Sea surface height (fronts and eddies)
  - Chlorophyll
- Winter (Nov-Mar)
  - Surface air temperature (storminess)
  - Sea surface height
- Regional means for each time period calculated
Aleutian Islands
Spring and summer
Aleutian Islands

Winter

Non-pups ALL trend sites

1991-2008

1991-2000

2000-2008

P=0.06

P=0.20

P=0.13

P=0.21

P=0.11
Non-pups ALL trend sites

2000-2008

Spring SSH variability (cm)

SSL Growth Rate

P = 0.04

1991-2000

Summer SSH variability (cm)

SSL Growth Rate

P = 0.18

Gulf of Alaska

P = 0.18

Winter Surface Air Temperature (°C)

SSL Growth Rate

P = 0.22

P = 0.04
Conclusions – Oceanography

• Aleutian Islands
  – Spring and summer ocean production was related to SSL population growth rates
  – Oceanographic prey aggregating mechanisms, such as fronts and eddies
  – Winter storminess

• Gulf of Alaska
  – Few oceanographic variables examined showed associations to SSL population growth rates and the patterns were difficult to interpret.
Conclusions – Oceanography (cont.)

• Oceanographic processes may be more important to SSL population growth rates in the Aleutians Islands than in the GOA, and that the western Aleutians may be a particularly unproductive and harsh environment for sea lions.