Recovery of the Bristol Bay Stock of Red King Crabs Under a Rebuilding Plan

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Outline of Presentation

- Red king crab biology and life history
- Fishery overview
- Stock and fishery management history
- Ingredients of stock rebuilding plan
- Stock response after implementation
- Conclusions
Red King Crab Biology

- Anomurans (not true crabs)
- Mating
  - Tied to female annual molting
  - ♂’s must be present at fertilization
- Females carry up to 500,000 embryos ~11 mo.

Photo: T. Shirley, UAF

[Links to www.afsc.noaa.gov and www.fakr.noaa.gov]
Early Life History of Red King Crab

- Embryos hatch in February – March off Kodiak Island and April to June in Bristol Bay
- Larvae pass through four zoeal stages
- Then they transform to glaucothoe while searching for suitable nursery habitat.
- With the next molt, they become benthic juveniles.
Red King Life History

- Distributed from intertidal zone to >200 m from British Columbia to Hokkaido, Japan
- Young-of-the-year live <50 m in high-relief habitat
- Juveniles form aggregations (pods)
- Young molt several times per year through age 3
- After age 3, molting is annual, until maturity
- After maturity, “skip molting” occurs in males with increasing probability
- Longevity > 20 years

Photo: L. Barr, Auke Bay, AK

www.afsc.noaa.gov
Red King Crab Fishery

http://rcrawford79.files.wordpress.com

www.accentalaska.com
Fishery Management through 1995

- **3-S (Size-Sex-Season) Management**
  - **Sex** – Only males are legal for harvest
  - **Size** – Males ≥165 mm CW (≥ 135 mm CL). Legal size defined as one molt increment above size of maturity
  - **Season** – no fishing during spring molting & mating periods. Current opening Oct. 15th

- Pot limits

- **Target harvest rate:**
  - **Pre-1990**: 20-60% of legal males, depending on population size, pre-recruit abundance and relative abundance of post-recruits
  - **Post-1990**: 20% of mature males, with maximum 60% legal male harvest rate
Historical Abundance & Landings

- Peak Catch: 59,000 mt or 130 million lbs
Concerns in mid 1990s

**Conservation Concerns**
- Stock declines
- Harvest rates – too high?
- Too much fishing effort
- Handling mortality
- Bycatch in other fisheries
- Trawling/dredging effects on crab habitats

**Socio-economic Concerns**
- High variability in catches
- Loss of employment and default on bank loans
- High rates of crew injury and mortality
Development of Rebuilding Plan

Length-based Analysis

Mgmt. Strategy Evaluation:
1. Long-term harvest strategy
2. Stock rebuilding strategy

Handling Mortality Studies

Analysis of Crab Bycatch from Observer Data

Area Closures and Crab Bycatch Caps in Trawl Fishery

Crab TACs
Stock-recruit & Rebuilding Target

![Graph showing effective spawning biomass (1000 t) vs. total recruits (millions). The graph includes a general Ricker curve and an autocorrelated Ricker curve. The x-axis represents effective spawning biomass, ranging from 0 to 90 and the y-axis represents total recruits, ranging from 0 to 120. The rebuilding target is marked at 25,000 mt.]
Bristol Bay RKC Harvest Strategy

Effective Spawning Biomass (mt) vs. Mature Male Harvest Rate (%)

Threshold 6,600 mt ESB

Other thresholds:
- 8.4 million females >89 mm CL
- Minimum TAC of 1,814 mt

Rebuilding Target 25,000 mt
Trawl Bycatch Controls and Area Closures

- **Zone 1** – Prohibited species caps (PSCs) of 35,000, 100,000, or 200,000 red king crab depending on crab abundance
- **Closure of Red King Crab Savings Area** protects adult male red king crab
Nearshore Trawl Closure Area

- **Nearshore Bristol Bay Closure** – Protects juvenile red king crab habitat
Historical Abundance & Landings

Year

Legal Abundance (millions)

Foreign Harvest
Domestic Harvest
Legal Abundance

Landings (mt)
0 10 20 30 40 50 60
0 5 10 15 20 25 30
0 5 10 15 20 25 30

0 10 20 30 40 50
0 5 10 15 20 25 30
0 5 10 15 20 25 30
Some Stock Improvement since 1990s

[Graph showing the number of recruits to the model by year for males and females.]
Historical Abundance & Landings

Mature Male or Female
Abundance (millions)

Year

Effective Spawning Biomass
(Thousands mt)

Mature Males
Mature Females
Effective Spawning Biomass

Rebuilding Target
25,000 mt
Crab Rationalization Program (2002)

- Allocates BSAI crab resources among harvesters, processors, and coastal communities.
- Addresses problems with previous derby fishery by reducing bycatch and increasing vessel safety.

Created entitlements:

**Quota share (QS)** – a long-term privilege to harvest a percentage of the crab harvest.

**Individual fishing quota (IFQ)** – QS x TAC.

**Processor Quota Share (PQS)** – long-term privilege to receive a percentage of crab harvest in a fishery.

**Individual Processor Quota (IPQ)** – PQS x TAC.
Benefits of Rebuilding Plan

- Length-based analysis provides annual estimates of abundance
- Reduced harvest rates and threshold provide for more conservative harvest strategy
- Bycatch caps and area closures constrain crab bycatch and habitat impacts
- Decline from 302 vessels in 1991 to 81 vessels in 2006 reduced overcapitalization
- Stock recovery seems attributable to ecosystem-based management approach including reduced fishing mortality, lower bycatch, habitat protection, and reduced fishing effort.
Questions?