Reduced Minimum Size Limits Improve Tanner Crab Fishery Management in the Eastern Bering Sea

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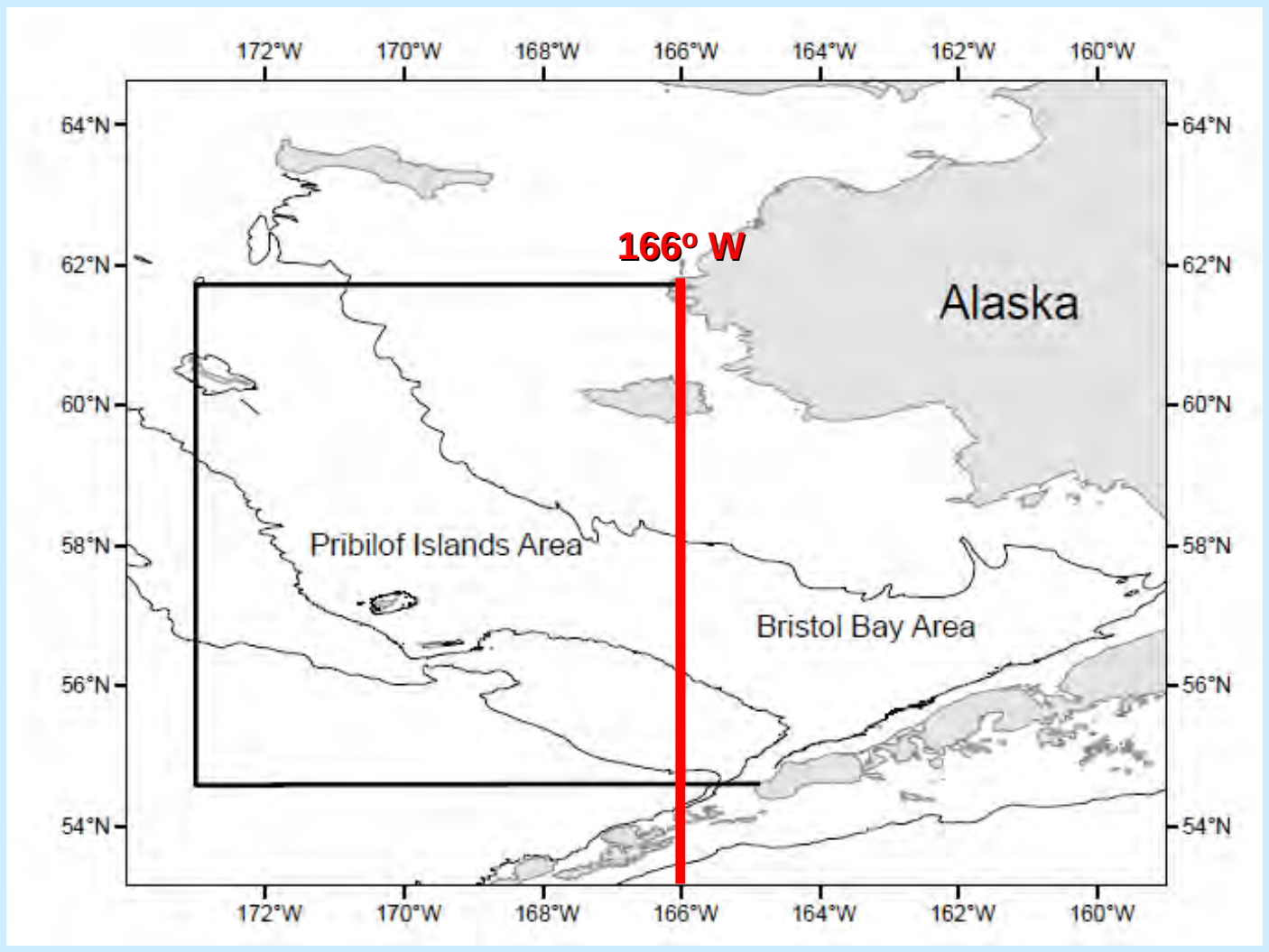
Tanner Crab Biology

- ***Chionoecetes bairdi***, one of four species of *Chionoecetes* in the North Pacific Ocean and Bering Sea

- Two zoeal stages and megalops stage
- Maturity: males ~6 years, females ~5 years
- Maturity molt is a terminal molt
- Females carry 85,000 – 425,000 embryos
- Maximum age approximately 14-16 years

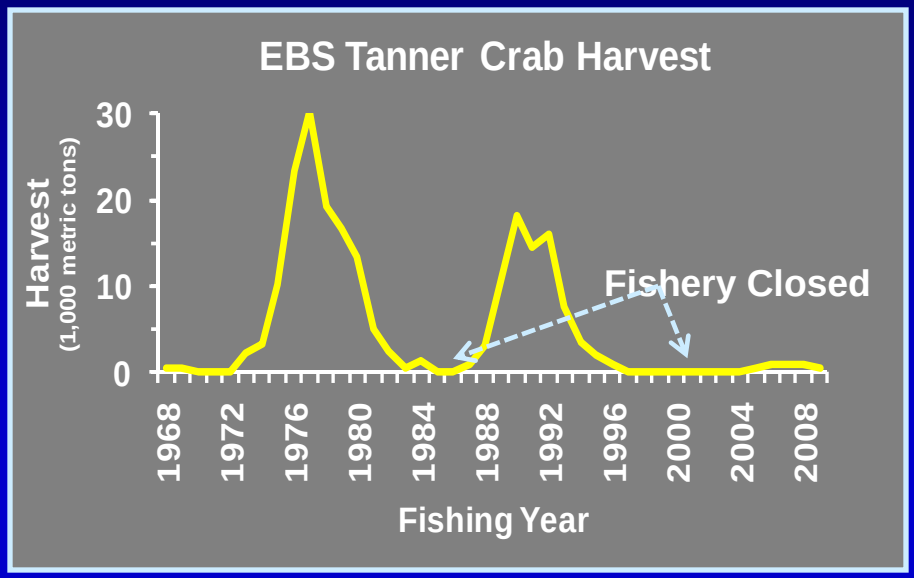
Eastern Bering Sea Management Areas



Source: Zheng (2008)

Eastern Bering Sea Fishery

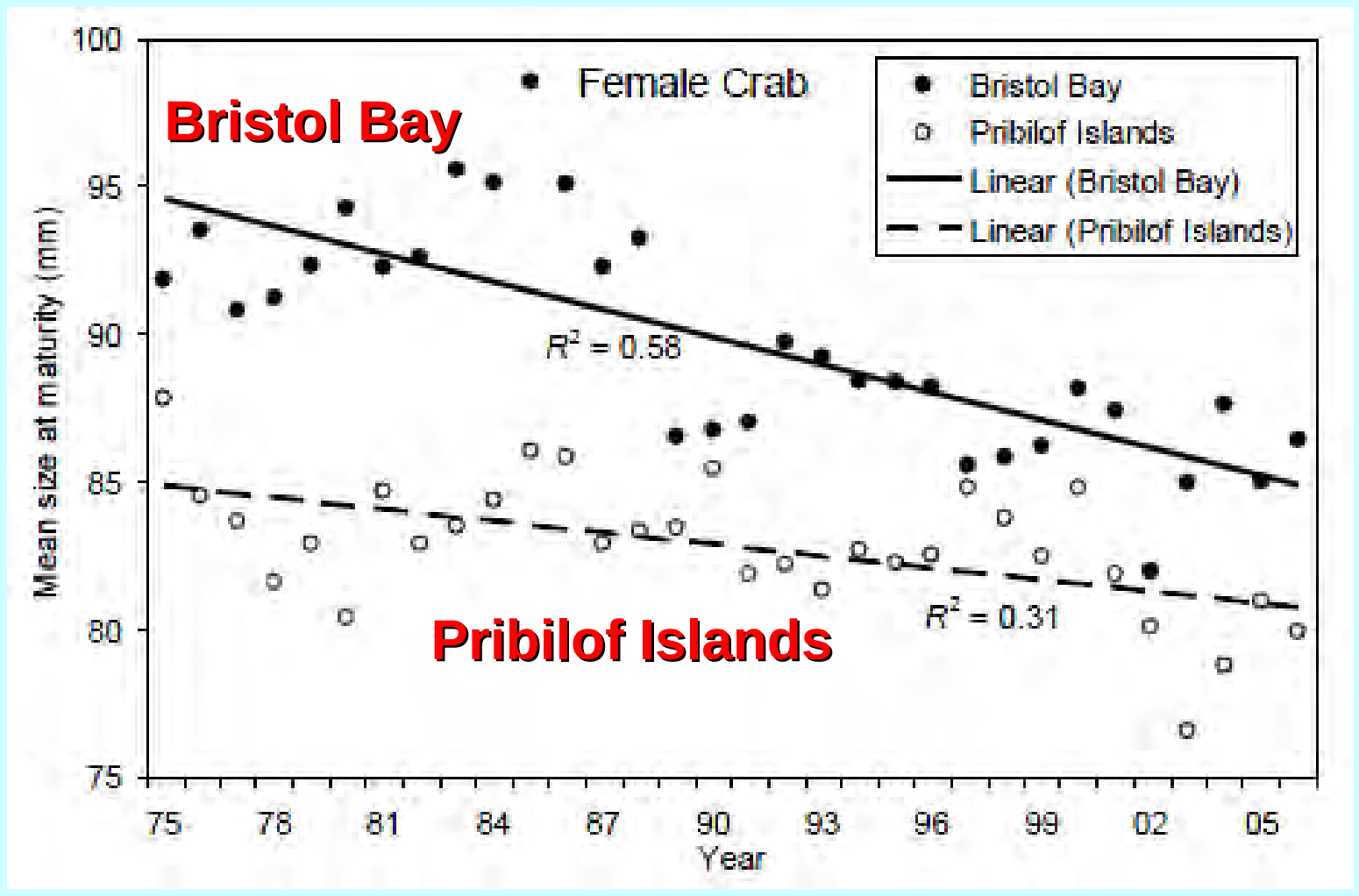
- Fishery began in 1961
- Baited pots (traps)
- Male-only fishery
- Mean wt. = 1.0-1.3 kg
- Peak catch of 31,300 t in 1978



- Boom-bust cycles, closures in 1986-1987 and 1997-2004
- Now listed as “overfished”

Other Fishery Management Issues

- Female size at maturity declined since 1975

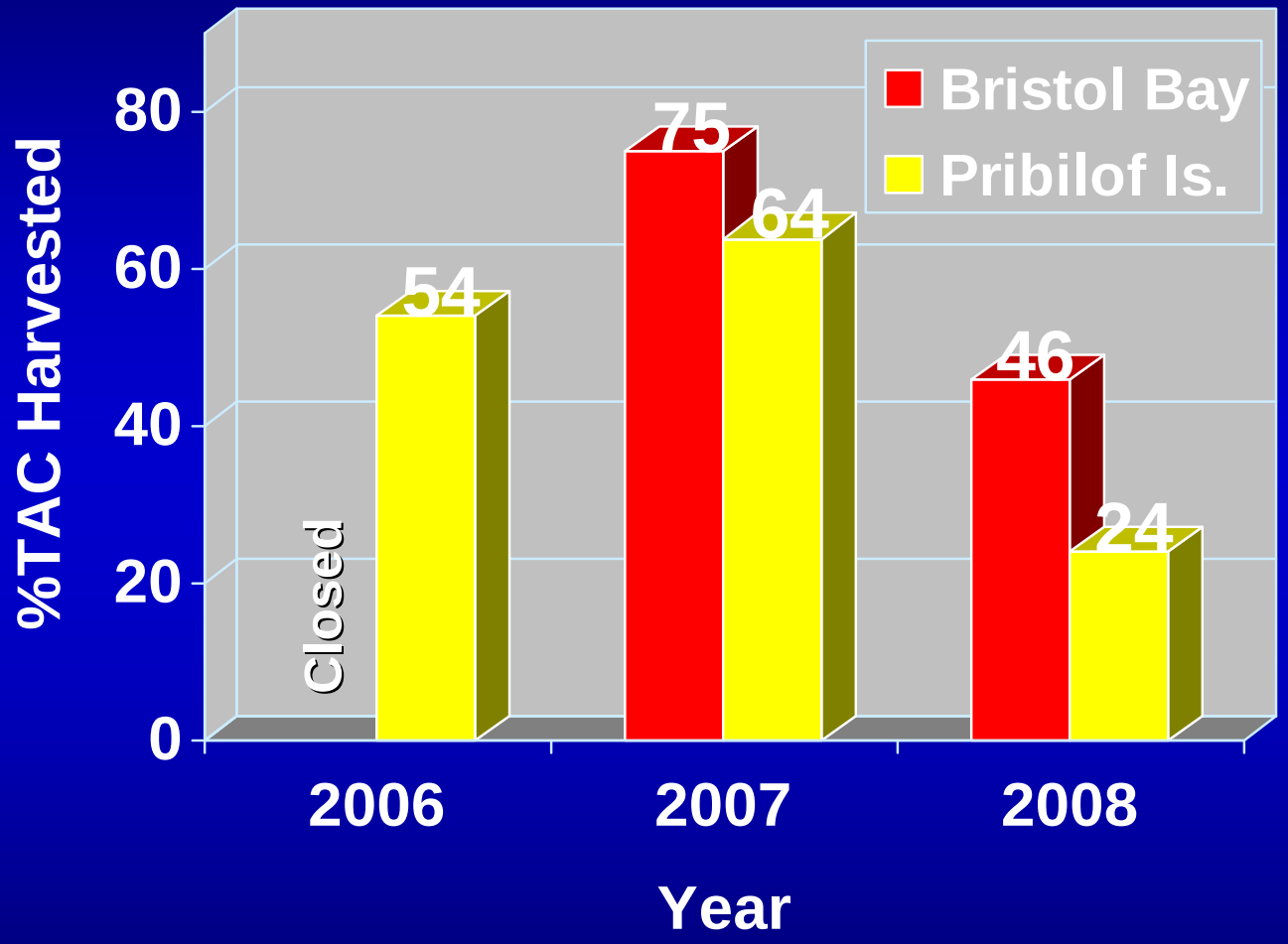


Source: Zheng (2008)

Other Fishery Management Issues

- Male size of 50% maturity has declined in Bristol Bay since 1990 (no data prior to 1990)
- Decline in proportions of the large (>112 mm carapace width (CW)) male Tanner crab that were of commercially legal size (≥138 mm CW) in Bristol Bay and around the Pribilof Islands during 1975–2006
- Increased abundance of mature sublegal males has increased sorting and discards
- TACs have not been fully harvested in recent years; reduced economic viability of fishery

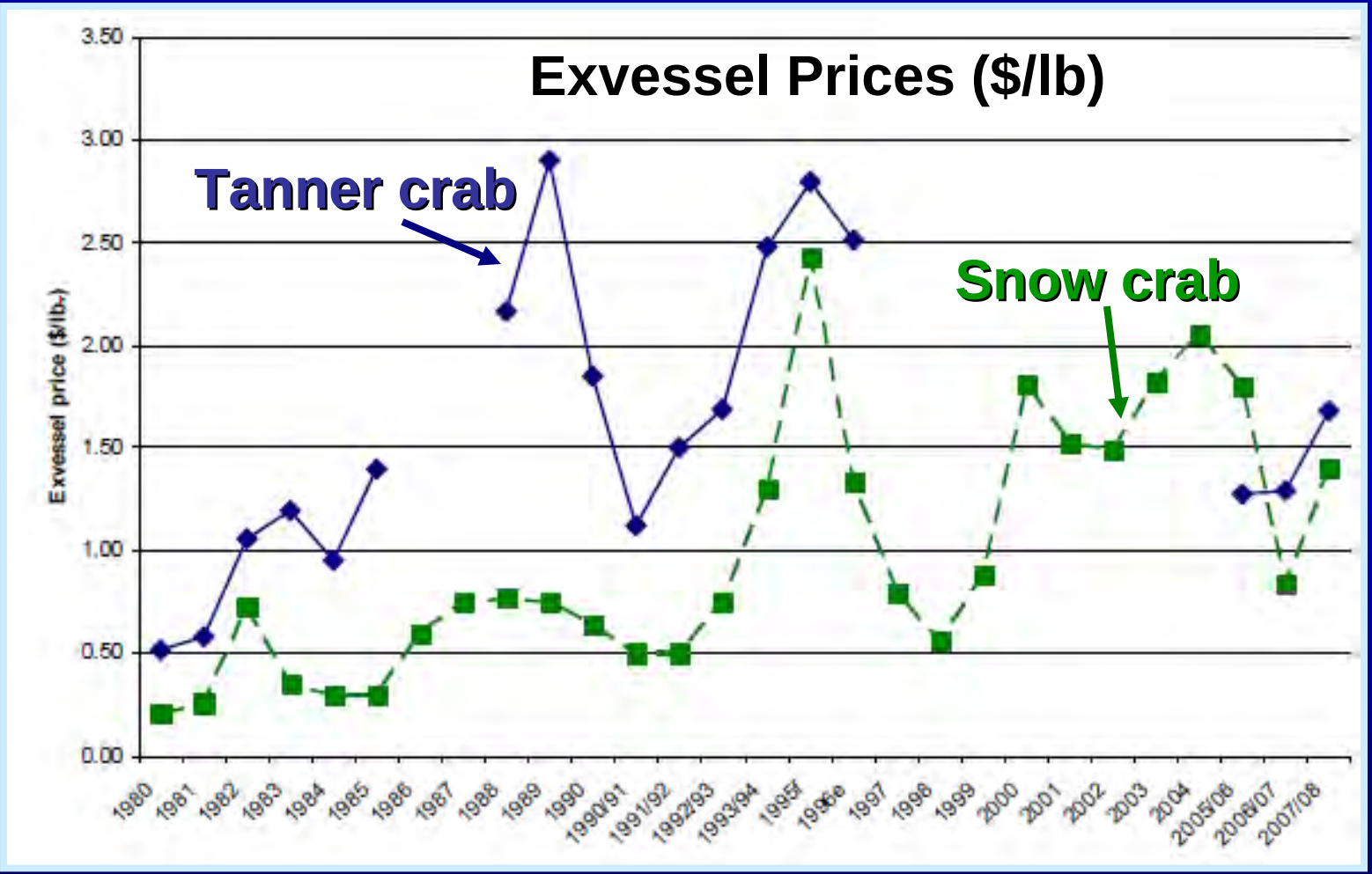
Other Fishery Management Issues



- Efficiency gains from fleet consolidation have been overwhelmed by low fishery productivity

Market considerations

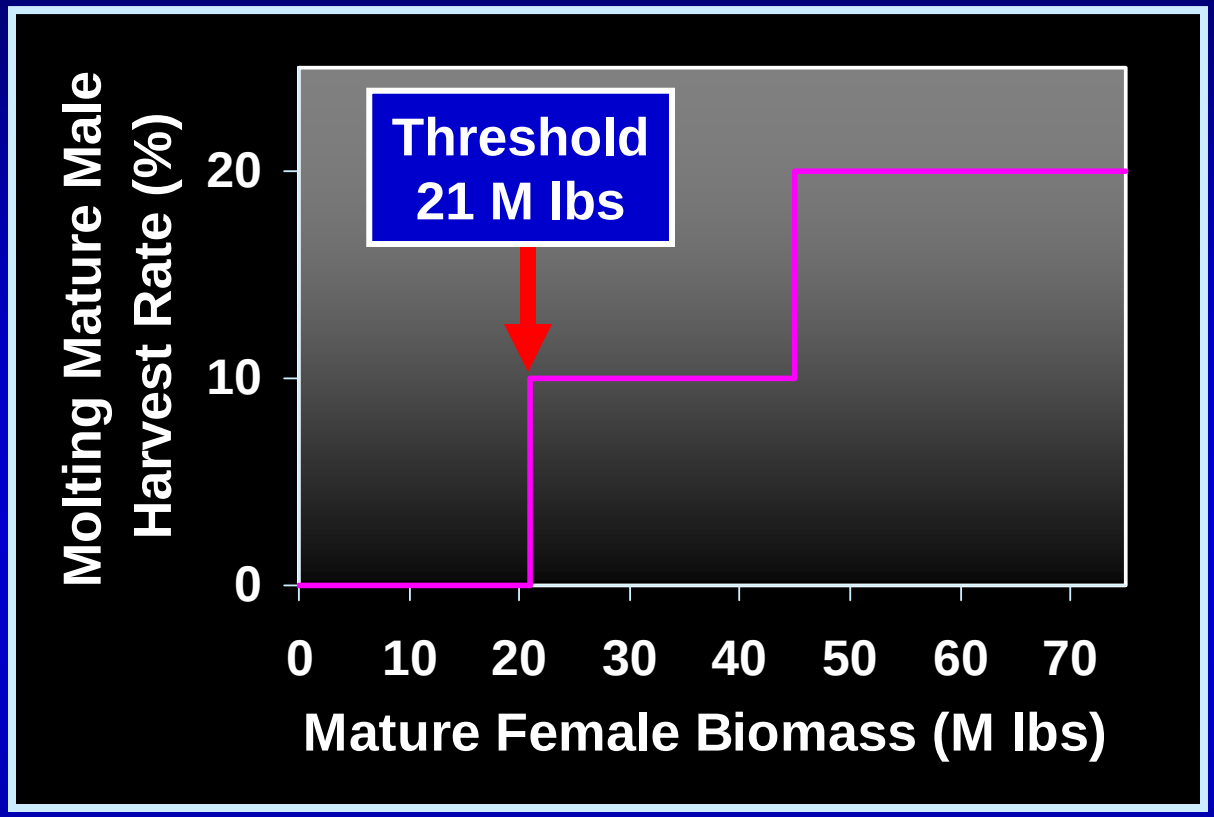
- Former price advantage of Tanner crab over snow crab has been lost



Project Goal

- Analyze merits of reduced minimum size limits for Tanner crab fisheries in the eastern Bering Sea
- "Current" size limit = 138 mm CW (5.5 inches)

EBS Tanner Crab Harvest Strategy



- Mature female = females ≥ 80 mm CW
- Molting mature males = 100% newshell + 15% oldshell males >112 mm CW
- Exploitable legal males (TAC_{cap}) = 100% newshell + 32% oldshell legal (≥138 mm CW) males

Tanner Crab Harvest Strategy

- Total Allowable Catch (TAC, M crabs) =

Smaller of:

- harvest rate X molting mature male abundance
- 50% exploitable legal males (TAC_{cap})

- TAC (M lbs) = TAC (M crabs) X average weight of legal males

Project Data

Biological

- Annual NMFS trawl surveys
- Recent ADF&G pot surveys
- Commercial fishery landings
- Onboard observer records

Economic

- Exvessel & wholesale prices
- Fishery revenues
- Fishing fleet performance
- Interviews of selected fishery participants

Aspects Examined

Range of size limits (120-140 mm CW) :

- **Yield-per-recruit**
- **SSB-per-recruit**

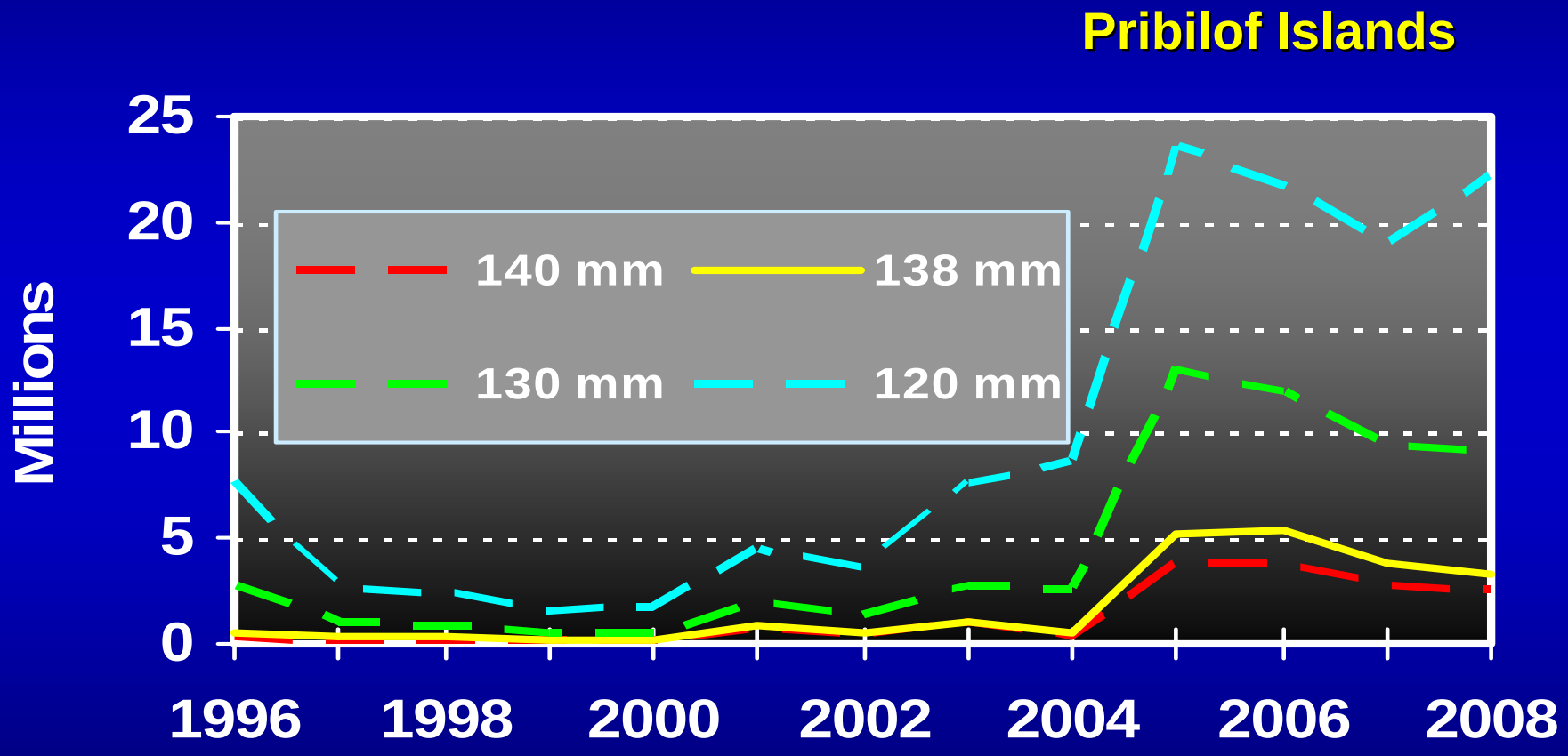
Retrospectively for years 1996-2008:

- **TAC and TAC_{cap}**
- **CPUE, including discards**
- **Economic considerations**

Findings:

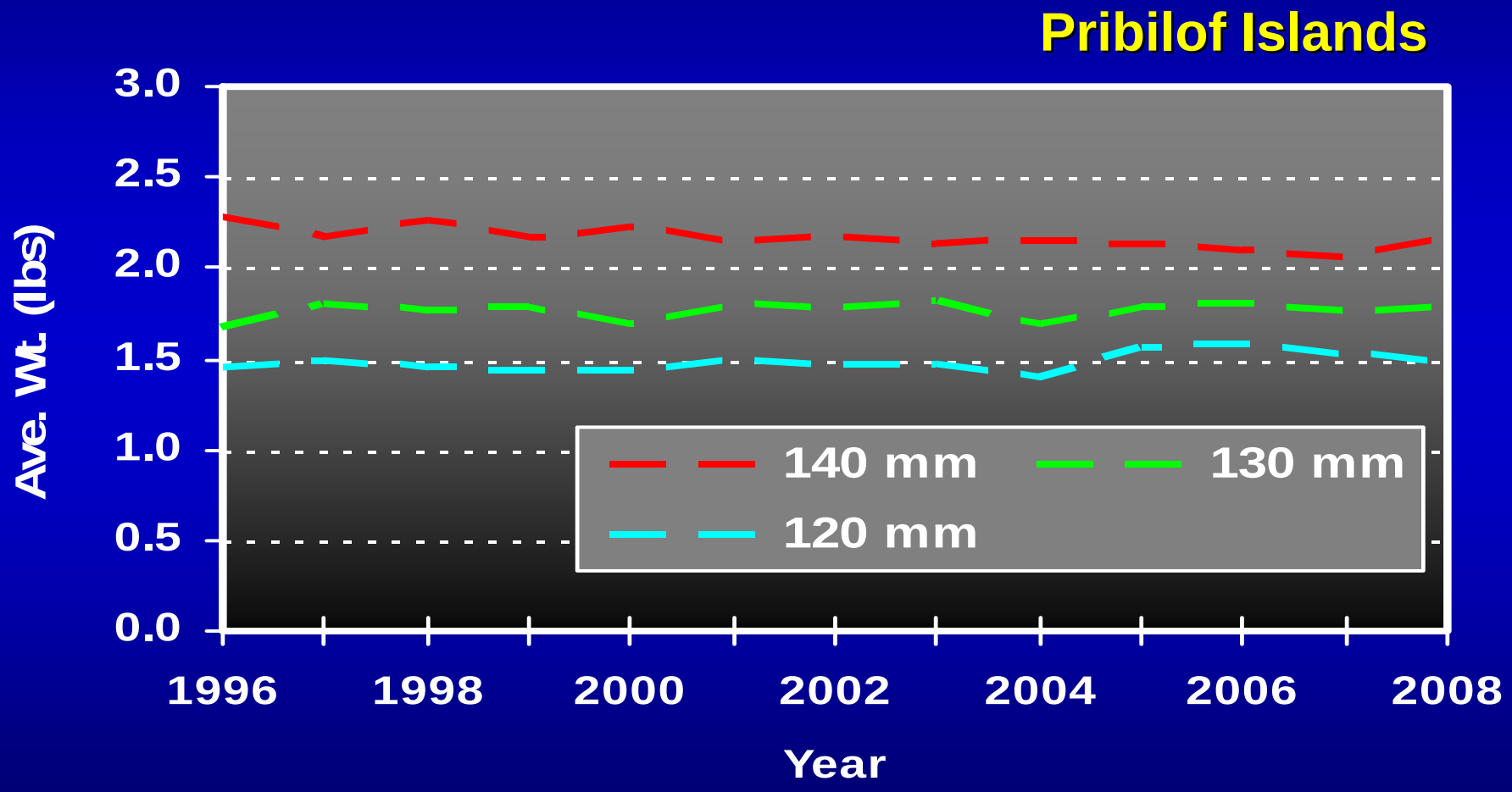
- Yield-per-recruit maximized at high harvest rates and small size limits
- Spawning biomass-per-recruit maximized at lowest harvest rates and large size limits
- Under reduced size limit, there is ***no change*** in:
  - Mature female abundance
    - Fishery threshold
    - Harvest rate
  - Molting mature male abundance

Legal Male Abundance at Alternative Size Limits



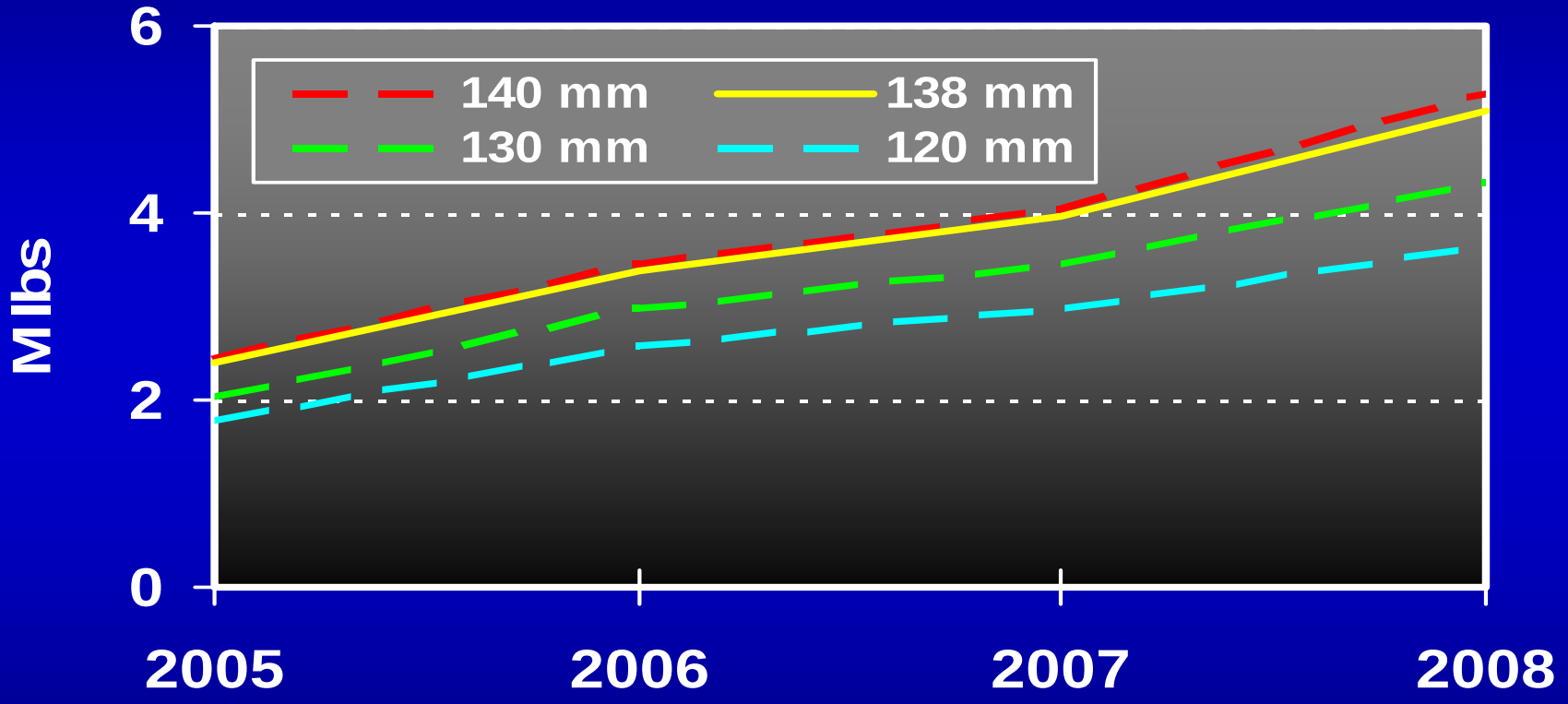
- Legal male abundance is higher under lower size limits

Average Weight of Legal Males Under Alternative Size Limits



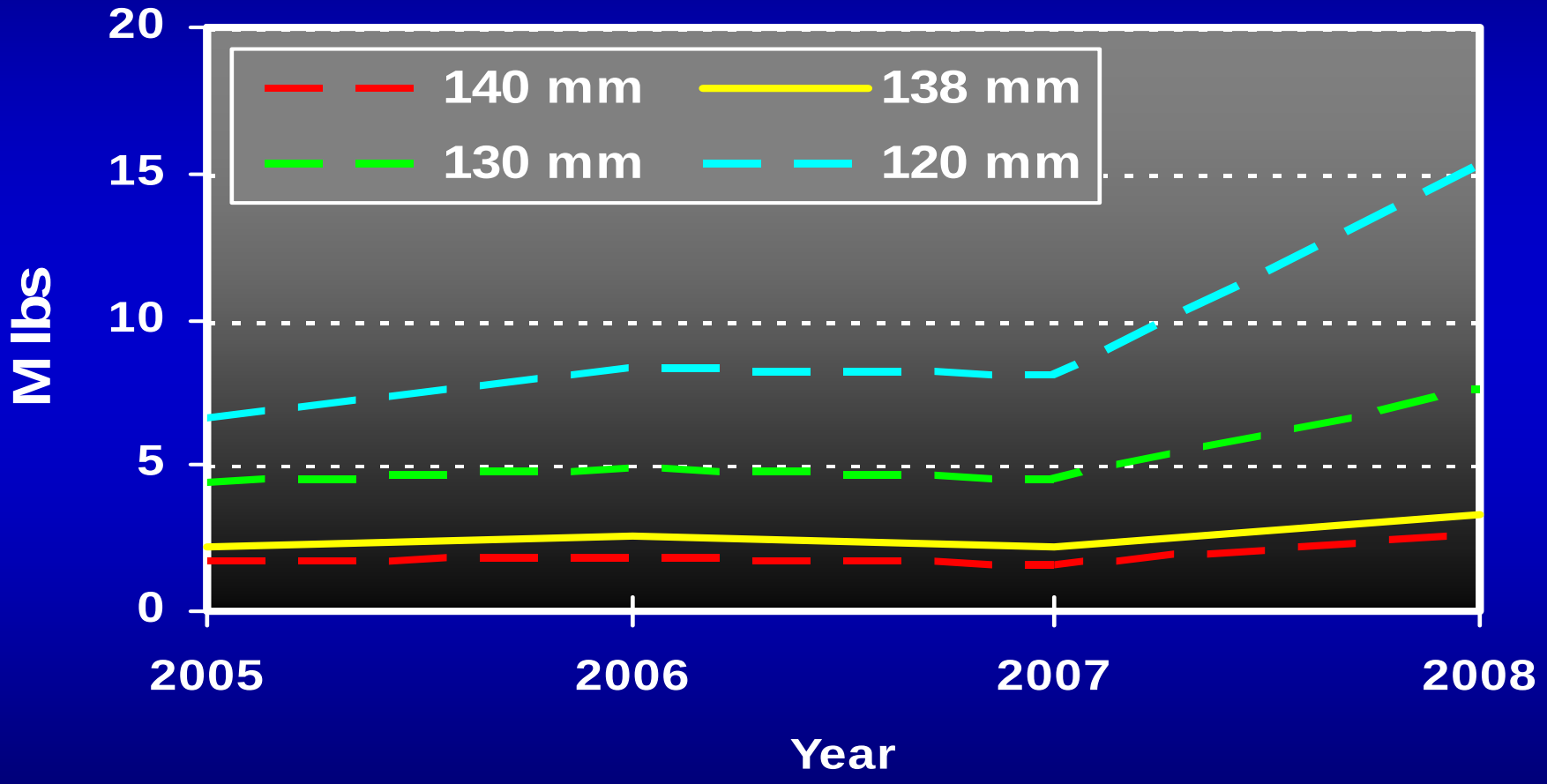
- Average weight is lower under lower size limits

TAC Under Alternative Size Limits for Pribilof Islands

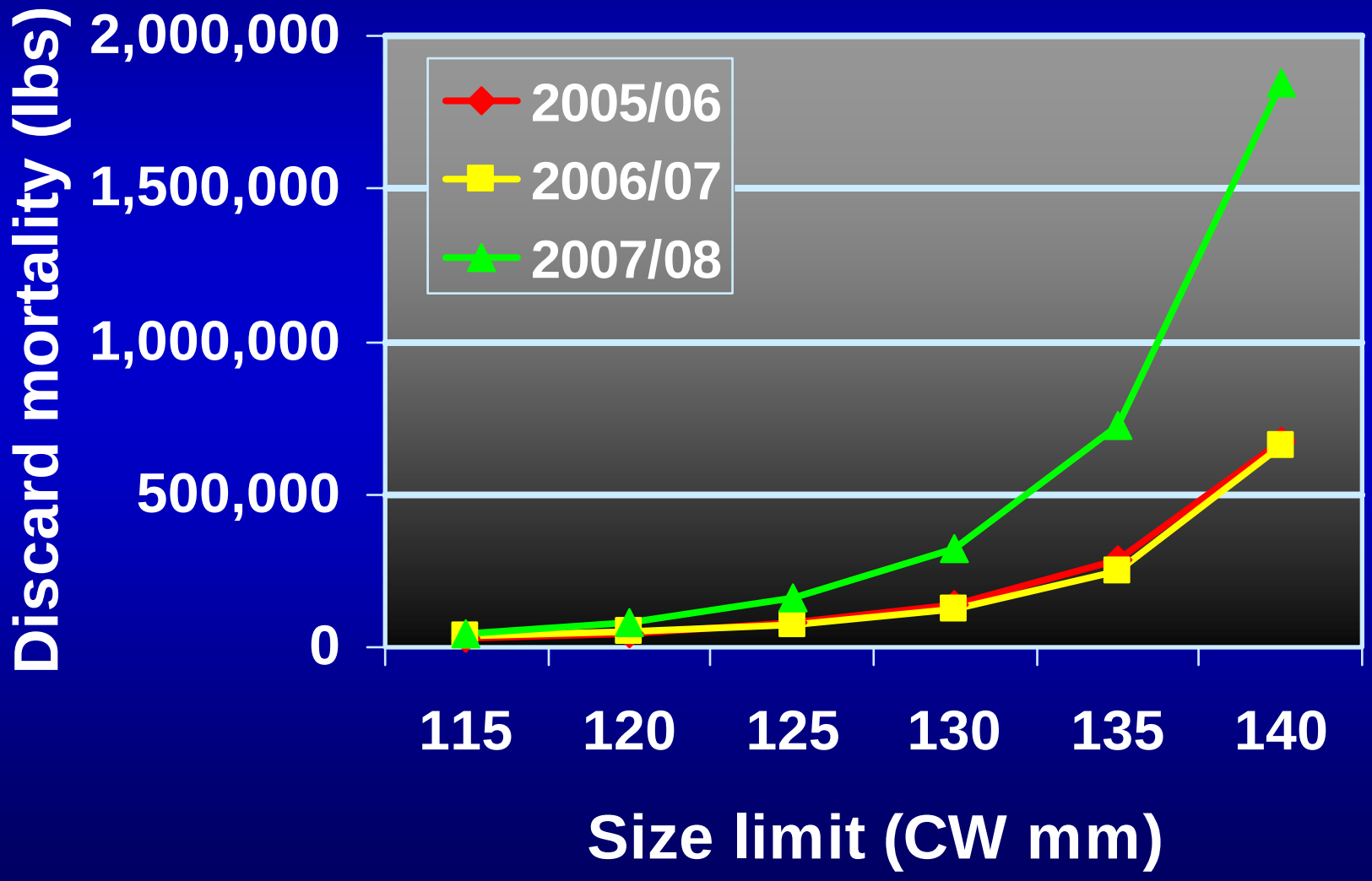


- TAC is lower under reduced size limits

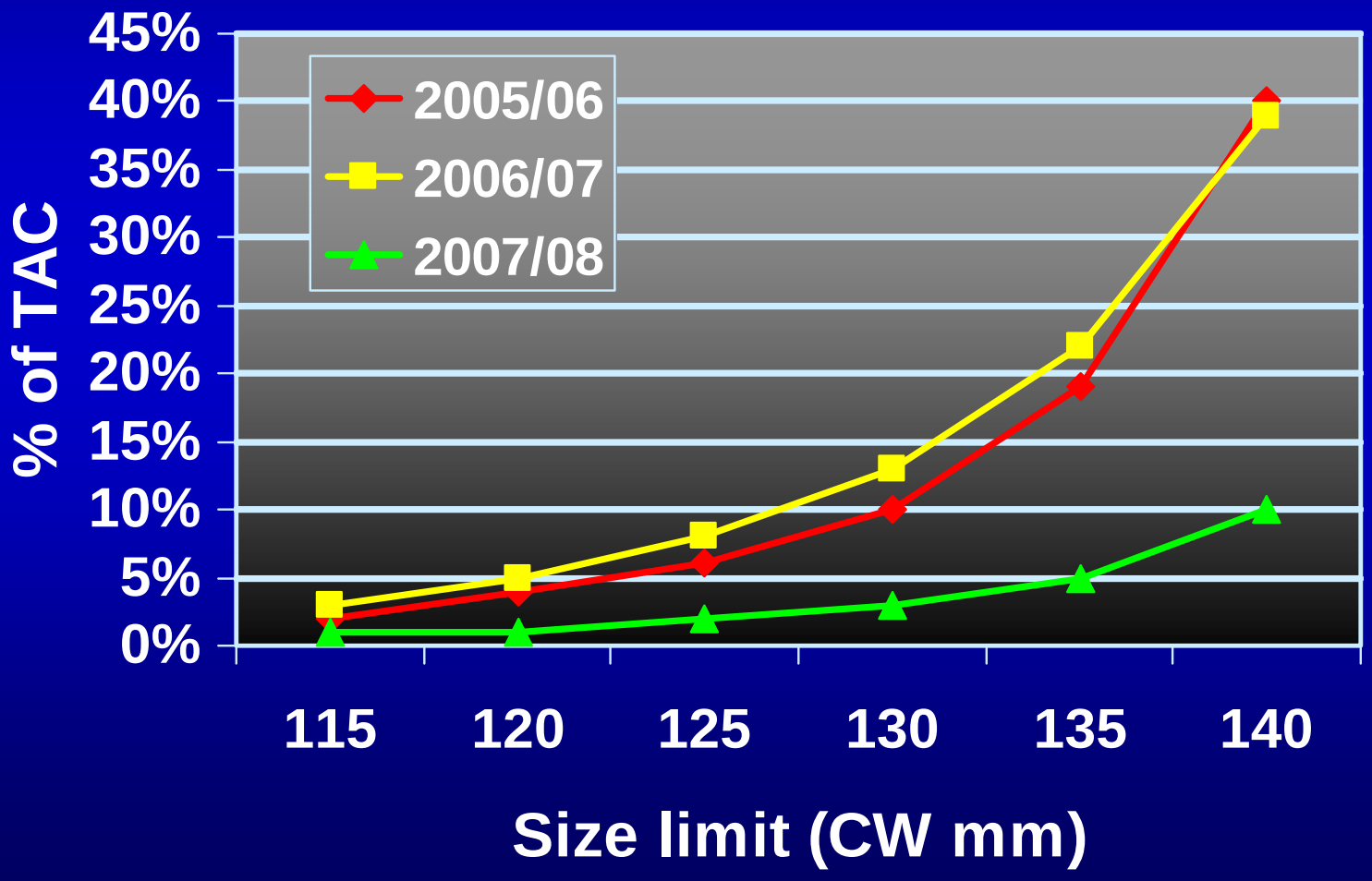
TAC_{cap} Under Alternative Size Limits for Pribilof Islands



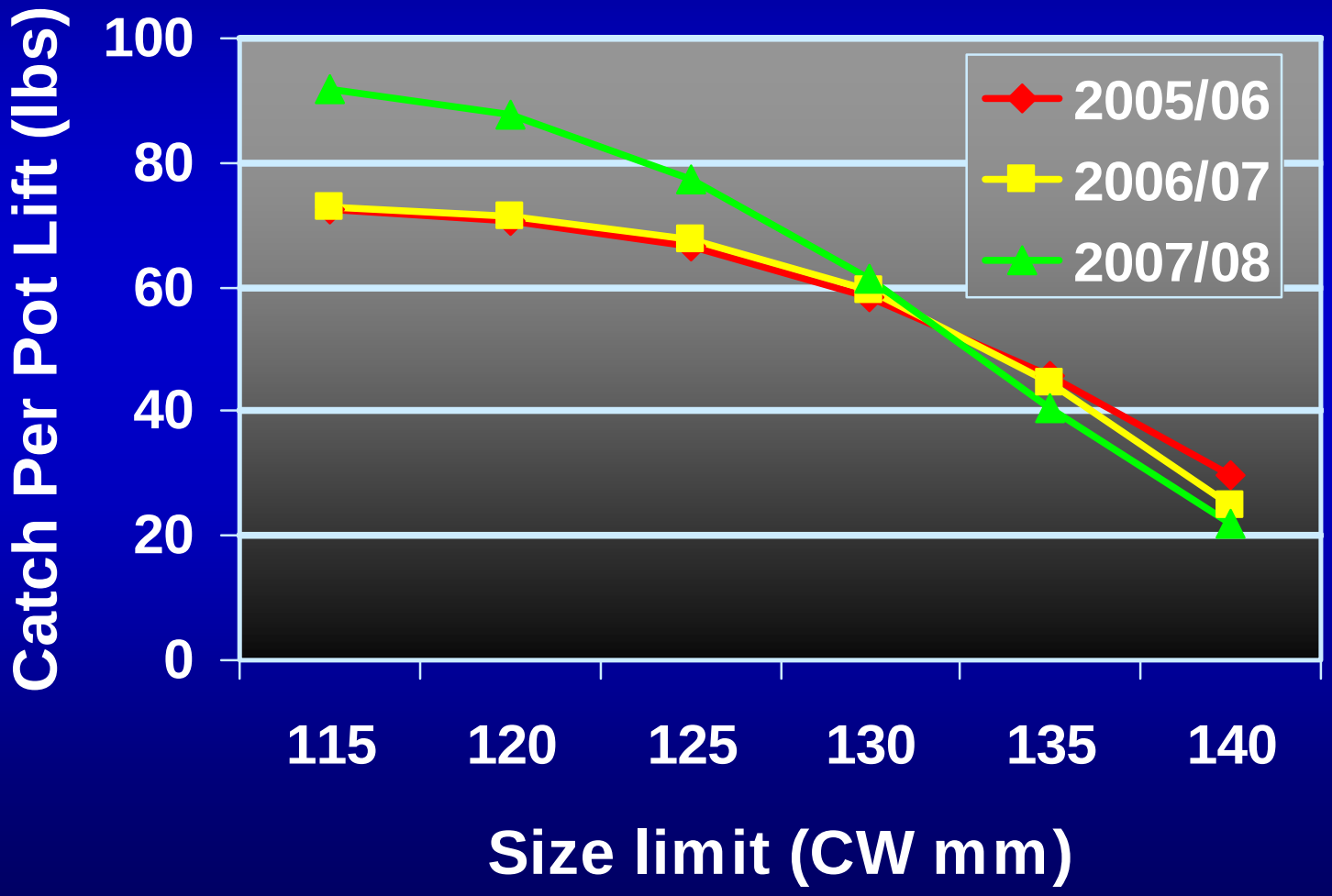
Findings: Discard Mortality, Pribilof Is.



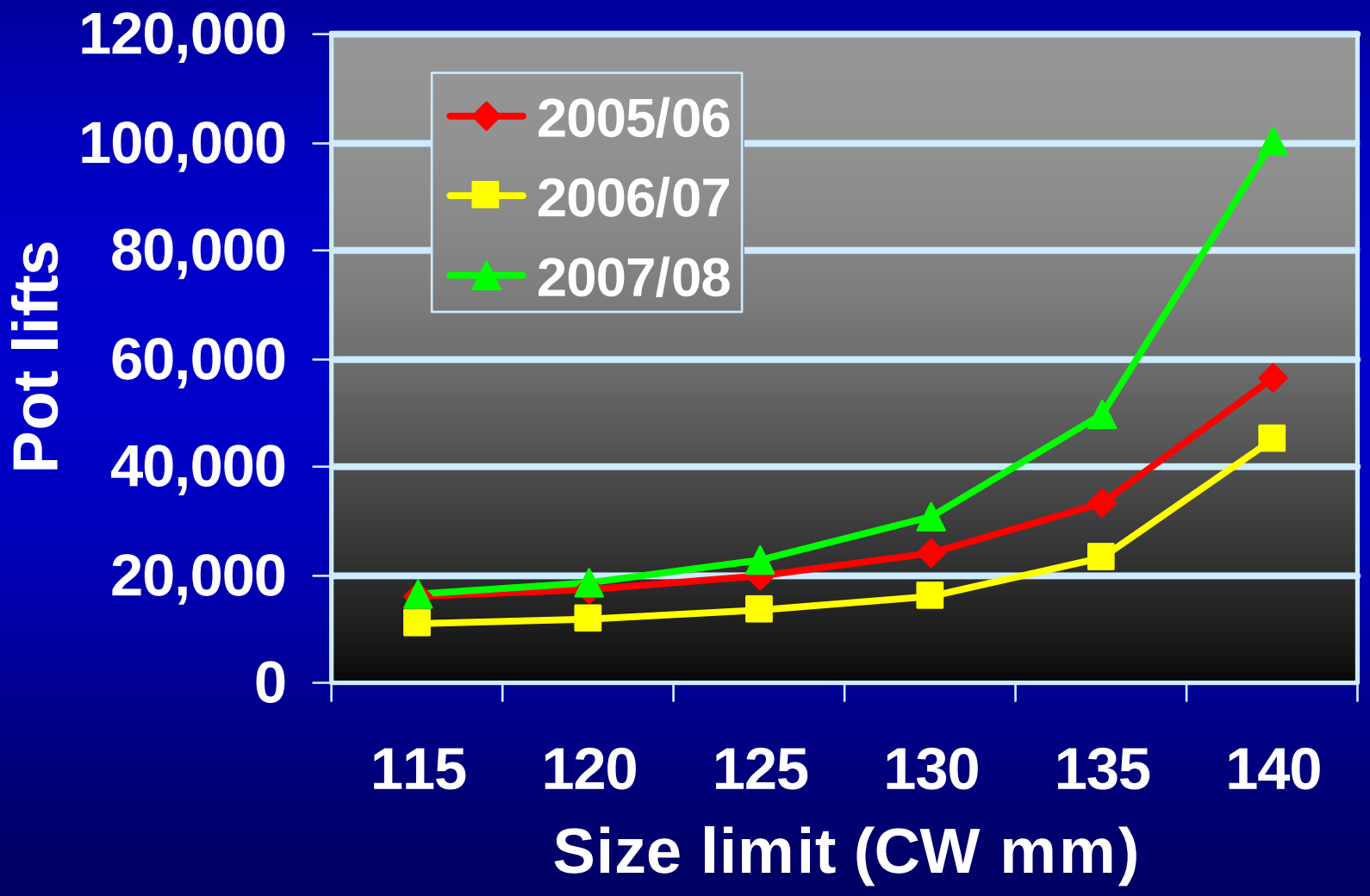
Findings: Discard Mortality as Percentage of TAC, Pribilof Islands



Findings: Retained weight per pot lift, Pribilof Islands



Findings: Pot Lifts, Pribilof Islands



Conclusions

- Recognition of a terminal molt in Tanner crab substantially modifies our management approach relative to historical concepts
- A reduced size limit appears to result in: reduced discard mortality, higher legal CPUE, higher yield per recruit, less sorting per pot, higher revenue per pot lift, lower marginal fishing costs
- One tradeoff is a slight reduction in spawning stock biomass per recruit, although the reduction is relatively small in Pribilof Islands

Conclusions

- Most Tanner crab now enter market as “large” snow crab, so likely little effect on price
- Consistency in market share is more important than price
- Choice of size limit depends on particular weighting of management objectives, but it seems that a reduction in size limit is warranted in this case

Epilogue

- Based on our analysis, in March 2011:
  - Alaska Board of Fisheries reduced the size limit from 138 mm CW to:
    - 112 mm CW for the Pribilof Is. area
    - 122 mm CW for the Bristol Bay area
  - ADF&G developed a revised harvest strategy that addresses the TAC_{cap} issue