Drivers of Blue Crab Population Dynamics

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Purpose

- Recent population declines
- Disconnect between spawning stock, recruitment, and fishery performance
- Want to identify most likely causes of these declines
- September workshop

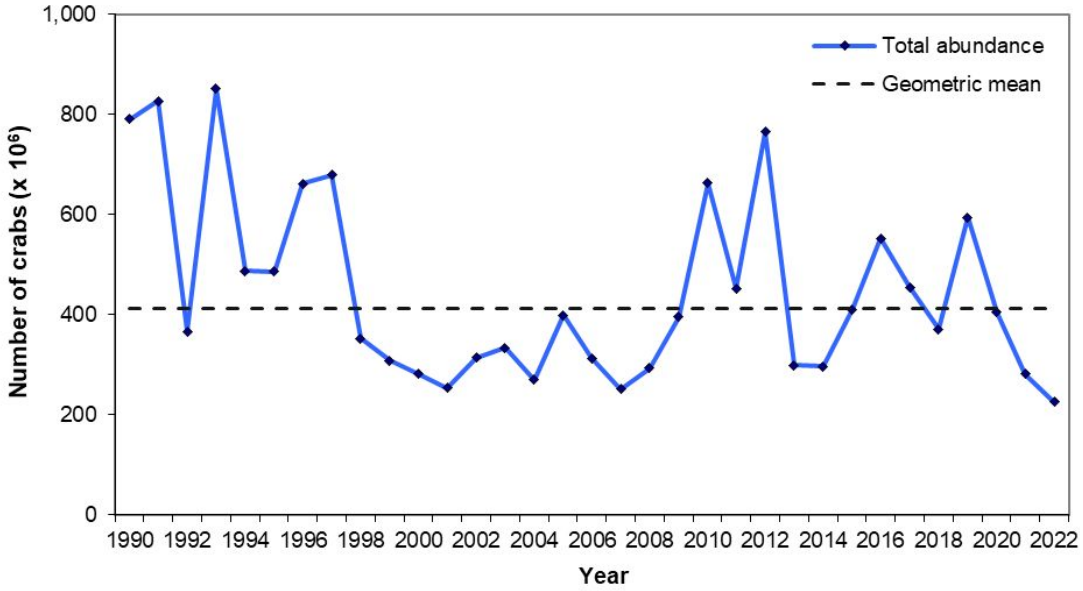
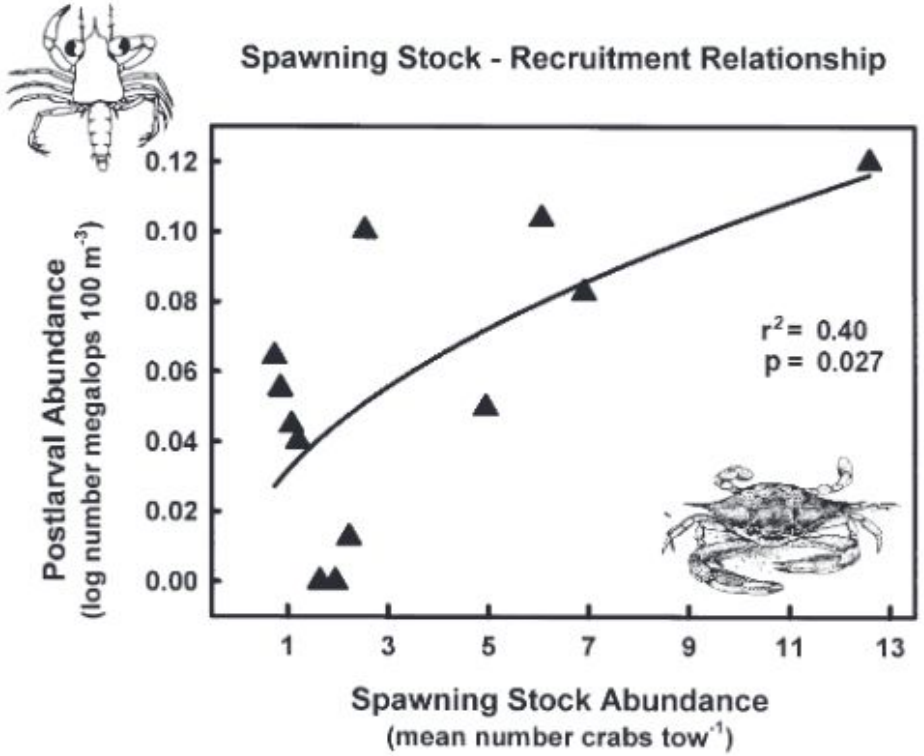


Figure 1. Winter Dredge Survey estimate of abundance of all crabs (both sexes, all ages) in Chesapeake Bay, 1990-2022.

Factors Affecting Recruitment Variability



Blue crab biology determines the number of eggs/larvae produced

- **Spawning stock size** is significantly, positively correlated with recruitment (Lipcius & Stockhausen 2002)
- **Sperm limitation** due to selective harvest may reduce reproductive output (Ogburn et al. 2019)

Factors Affecting Recruitment Variability

Coastal conditions regulate larval recruitment into the Bay

- **Wind and currents** entrain zoeae in coastal waters near the mouth of the Bay after spawning and drive onshore transport of megalopae back into the Bay (Epifanio & Tilburg 2008)

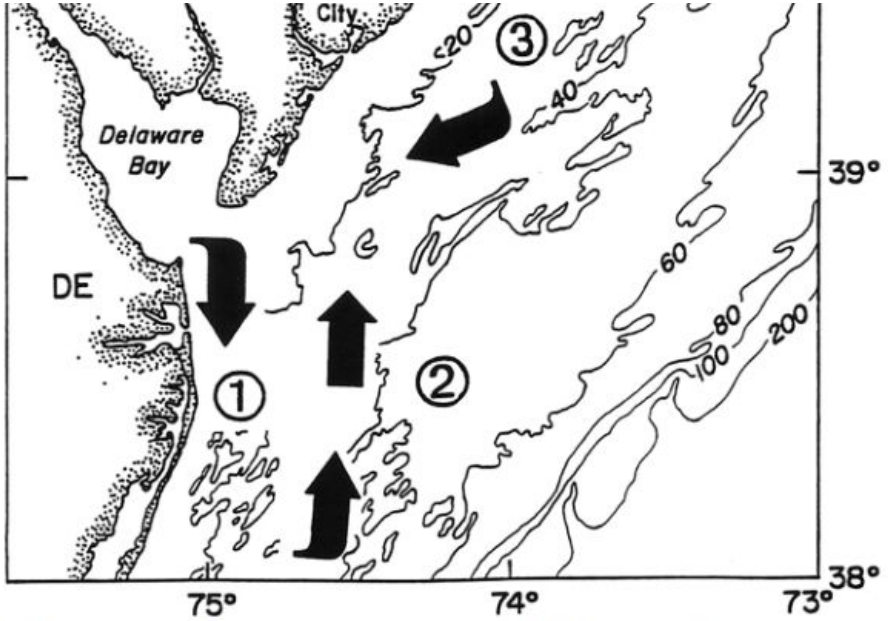
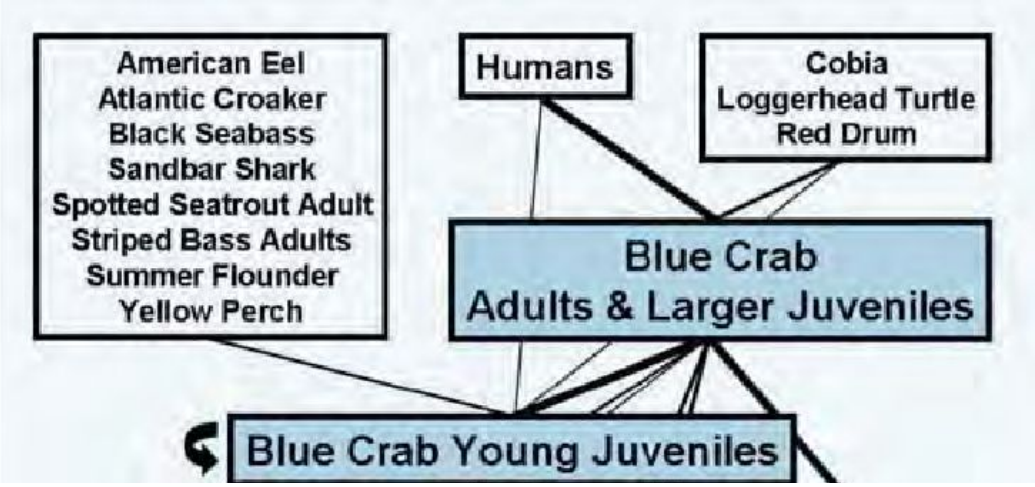


Figure 7. Map of Delaware Bay region in southern Middle Atlantic Bight illustrating conceptual model for transport of blue crab larvae in late summer and early autumn. (1) Southward transport in buoyancy-driven flow originating in Delaware Bay. (2) Mixing offshore in wind-driven upwelling circulation with associated northward transport. (3) Onshore and southward transport as part of downwelling circulation driven by southward wind events in late summer and autumn. (From Epifanio and Garvine, 2001)

Factors Affecting Natural Mortality



- **Predation** can reduce abundance of larval, juvenile, and adult blue crabs
  - Striped bass
  - Red drum
  - Blue catfish
- **Cannibalism** is a key component of juvenile mortality

Factors Affecting Natural Mortality

- **Disease** outbreaks can lead to significant mortality events
  - Quantitative impacts not well known
  - Particularly concerning in shedding facilities

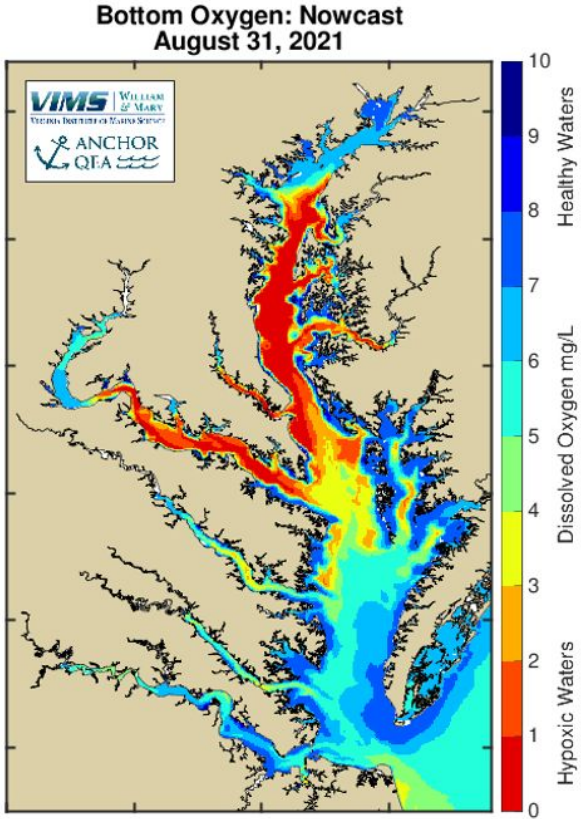
Factors Affecting Growth and Survival

- **Prey availability** may exert bottom-up controls on the blue crab population (Seitz et al. 2003)
- **Habitat availability** (SAV, marsh) may regulate juvenile growth and survival by providing refuge and a food source

Factors Affecting Growth and Survival

Water quality is an important component of suitable habitat

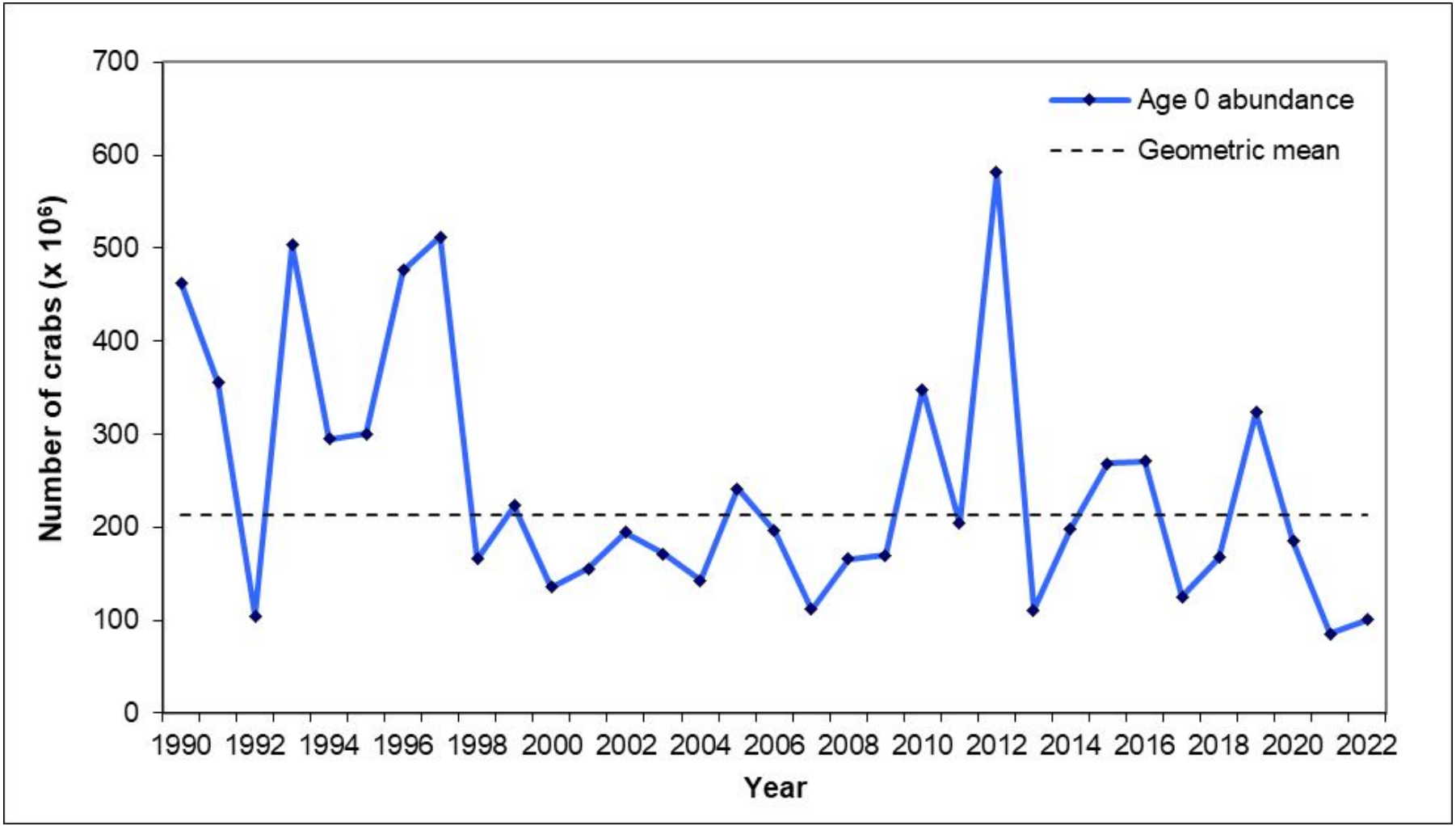
- **Hypoxia** can alter blue crab behavior and distribution, indirectly increasing mortality (Liang et al. 2021)
- **Water temperature** affects growth and survival in winter, and can contribute to hypoxia in summer

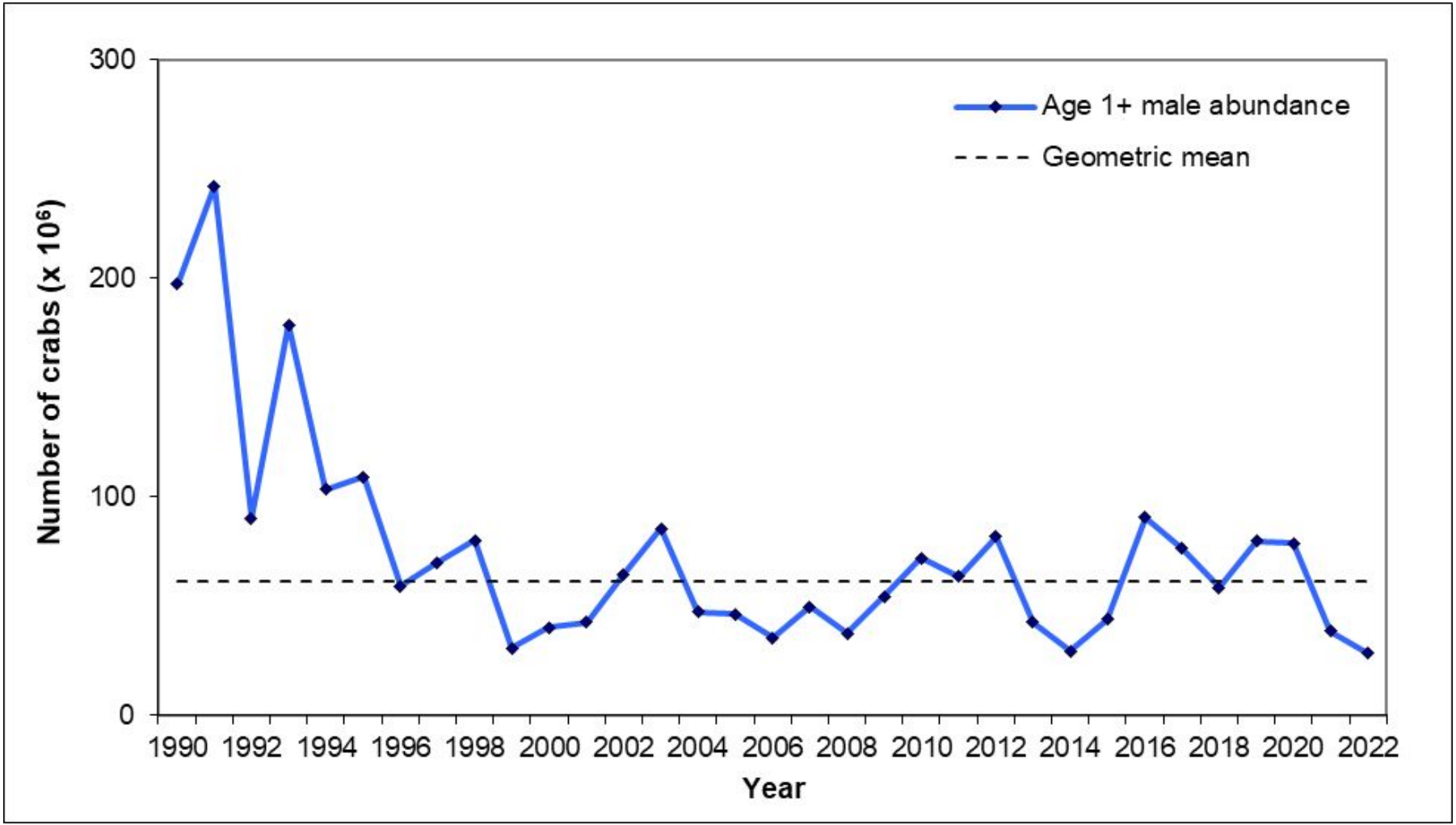


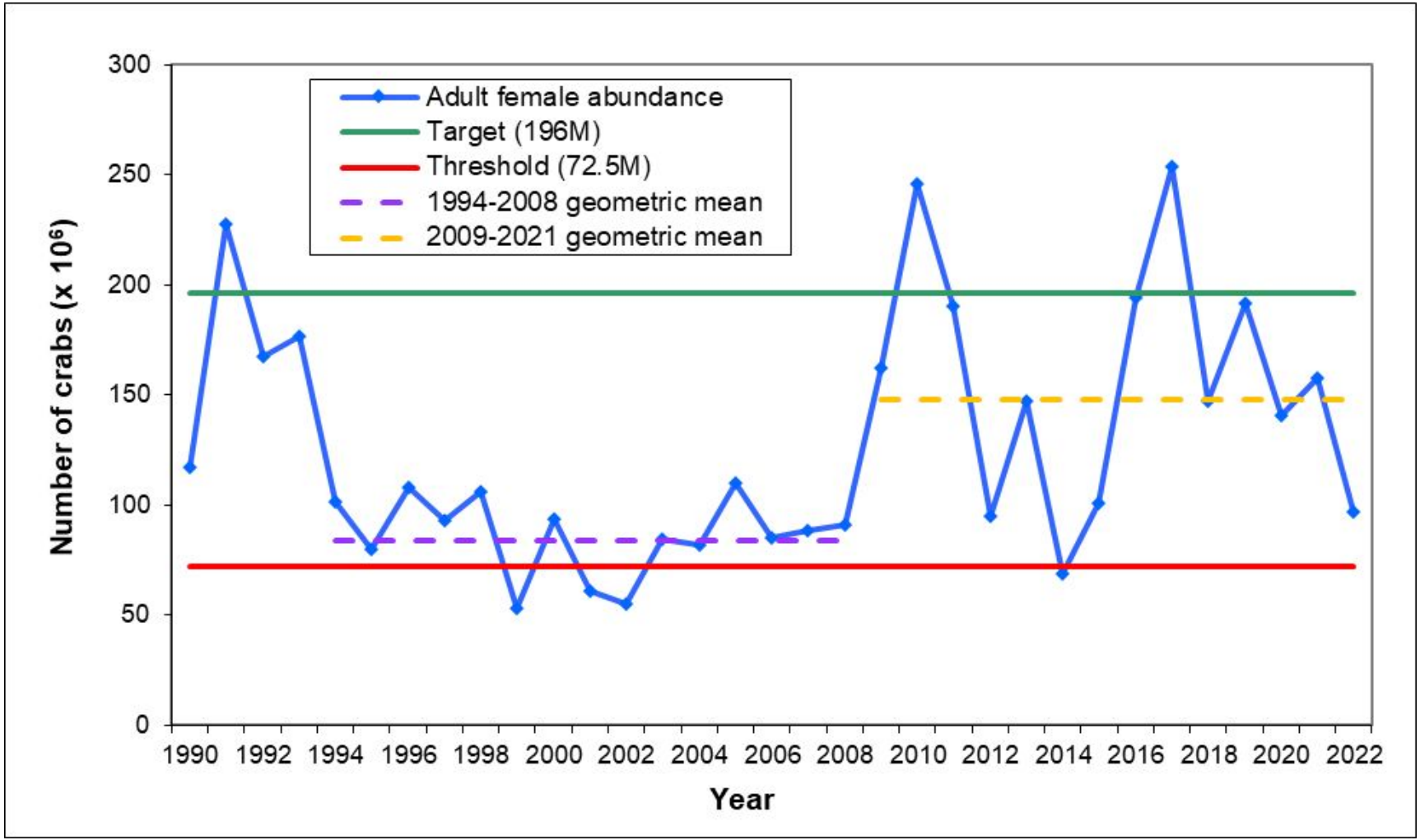
Fishing Mortality

Uncertainty around fishing mortality estimates

- Incidental mortality and unreported discards, particularly in the peeler fishery
- Limited or inaccurate reporting of commercial and recreational harvest


Age 0 abundance
Geometric mean
Number of crabs (x 10⁶)
Year
0
100
200
300
400
500
600
700
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022


Age 1+ male abundance
Geometric mean
Number of crabs (x 10⁶)
300
200
100
0
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
Year


Adult female abundance
Target (196M)
Threshold (72.5M)
1994-2008 geometric mean
2009-2021 geometric mean
Number of crabs (x 10⁶)
Year
0
50
100
150
200
250
300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022