Population Impacts of Sperm Limitation in the Chesapeake Blue Crab Stock

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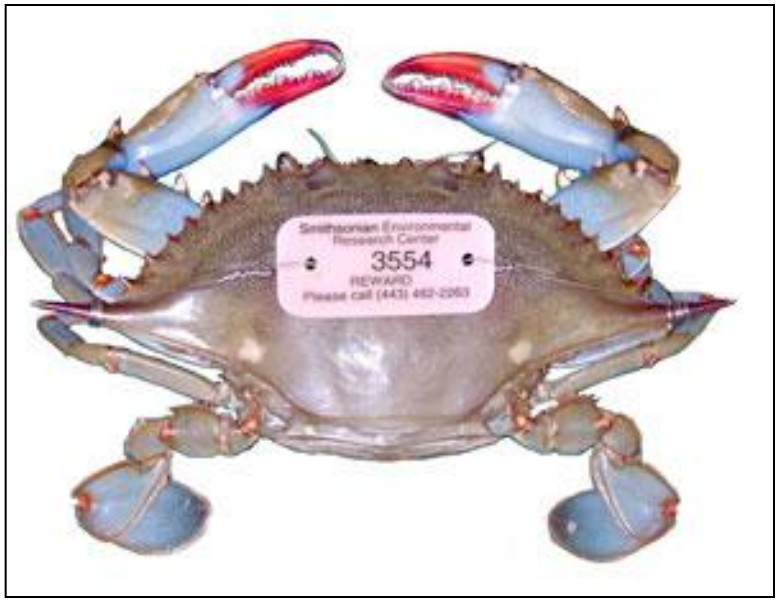
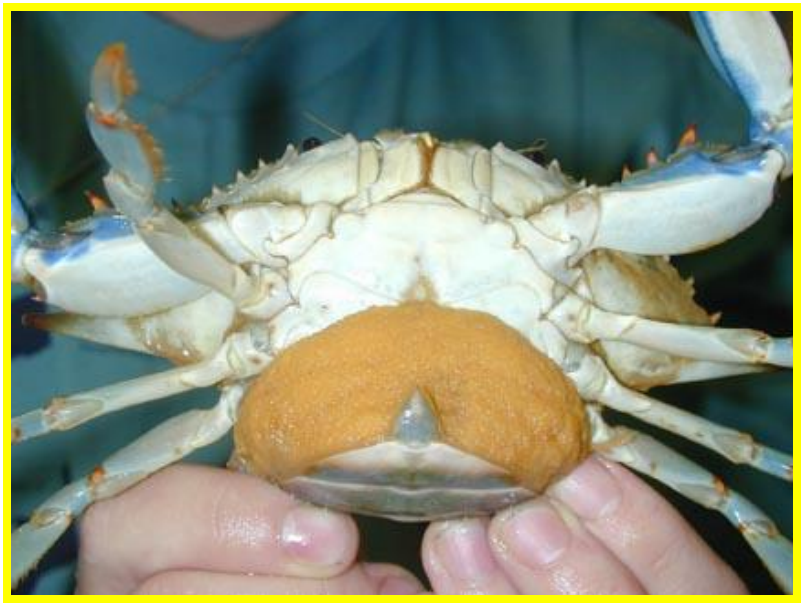


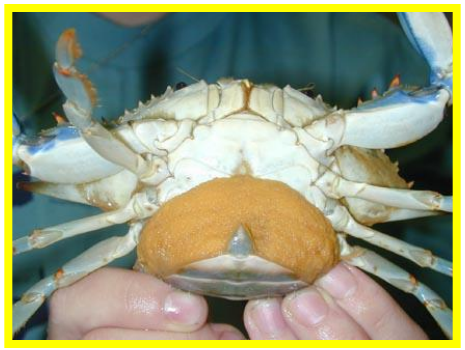
Are Males Cheap ????



Males with the right stuff are crucial !

Stock Abundance Decline

(fishery independent)



Winter bay-wide total Age 1+

Summer Female Spawning

Total abundance of crabs (millions)

Mature females (CPUE)

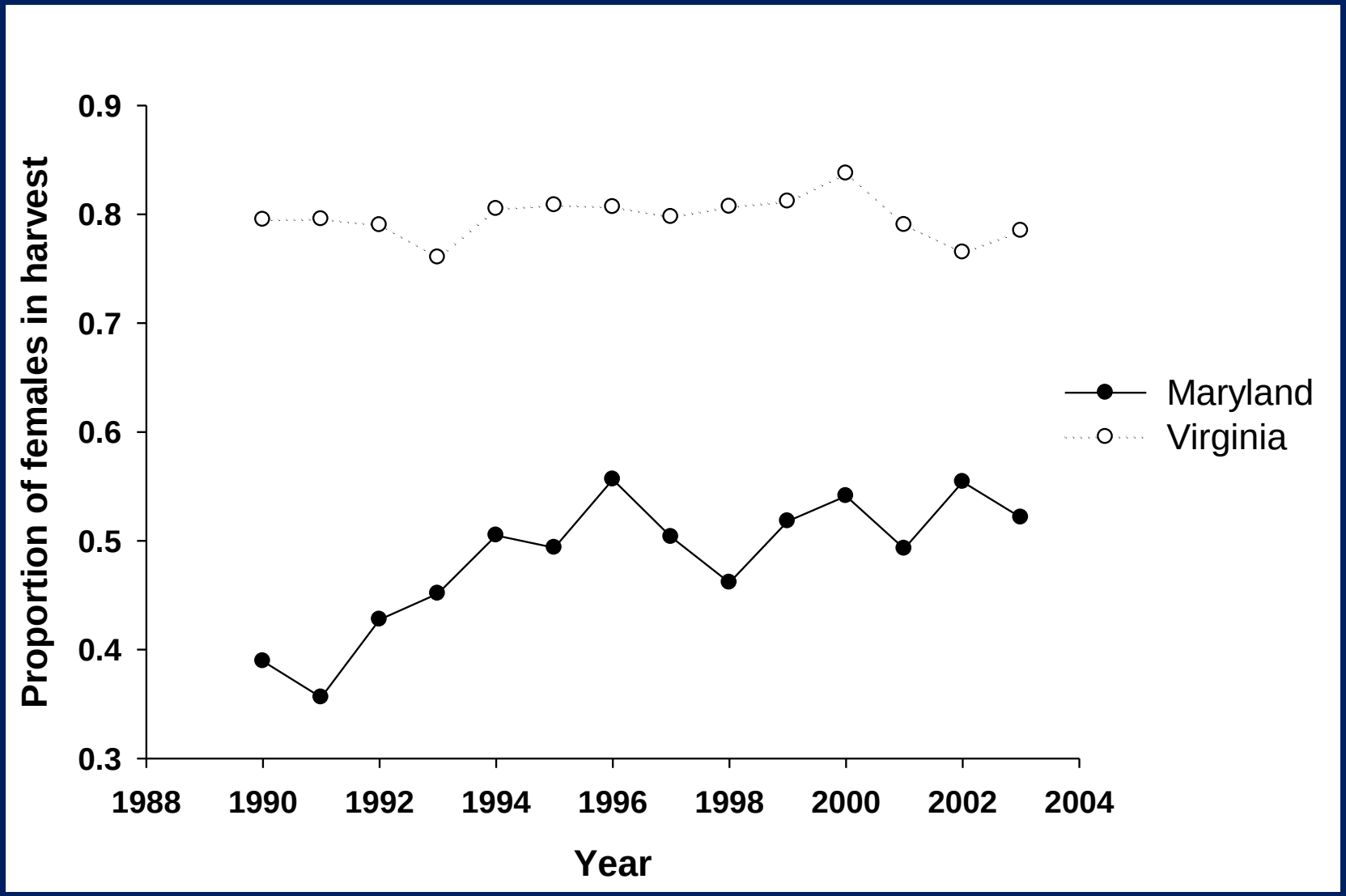
Year

0
100
200
300
400
500

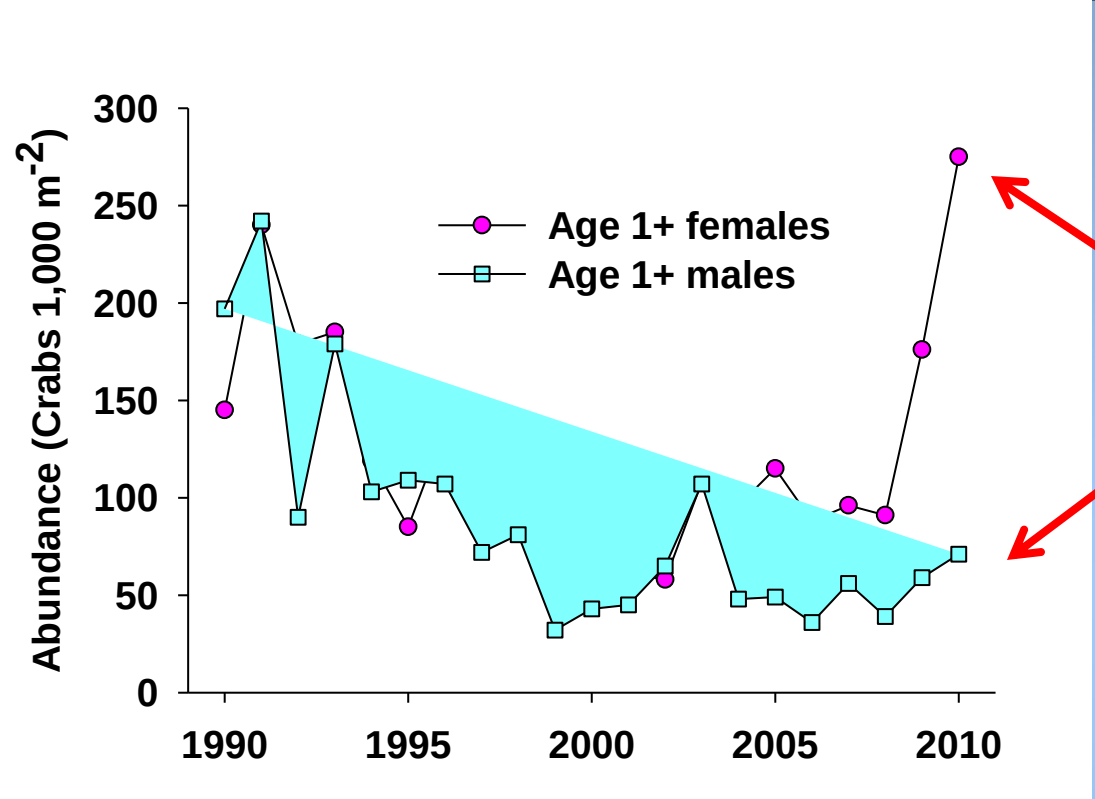
0
2
4
6
8
10

1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010

Proportion females in harvest



2008-2010 MANAGEMENT CHANGES



MARYLAND:

- NO RECREATIONAL FEMALES
- LIMITED FISHING ON MIGRATING FEMALES

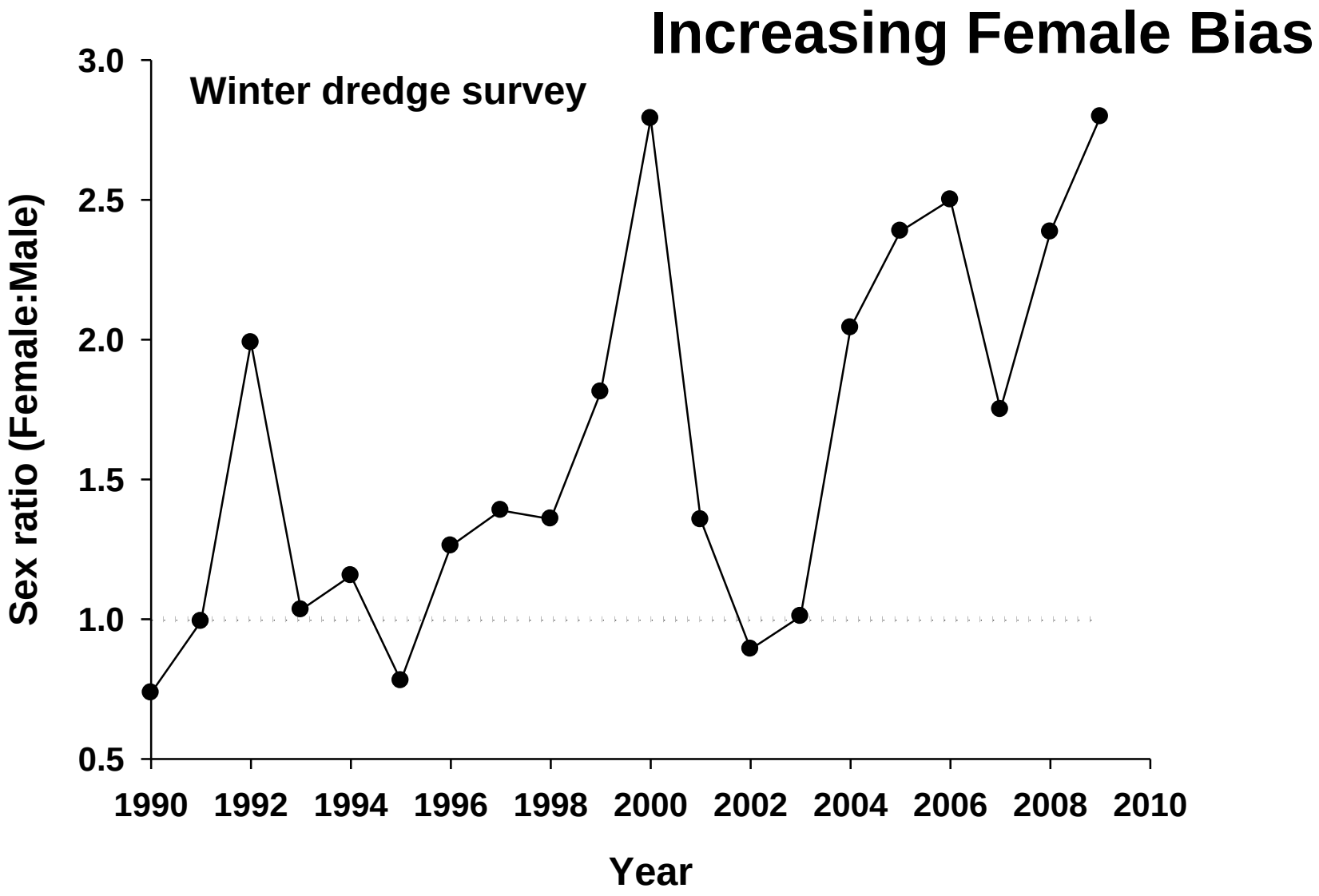
VIRGINIA:

- SUMMER SPAWNING SANCTUARY
- NO OVIGEROUS FEMALES
- PROHIBITED WINTER DREDGE

Bay-wide winter dredge survey

Source: Winter dredge survey (VIMS/MDNR)

SEX RATIO – Fishery Independent

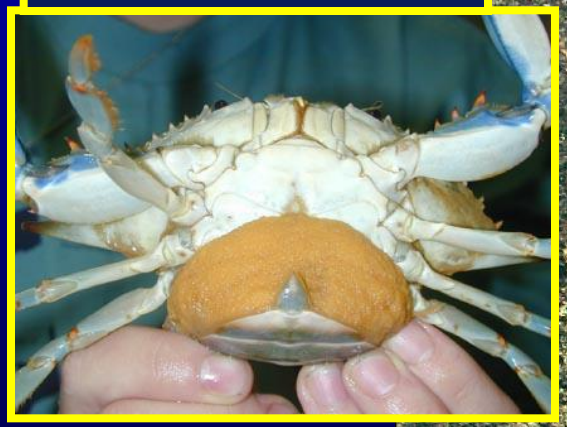


Life Cycle

Juvenile Nurseries

Juvenile, Female Migration

Spawning Stock



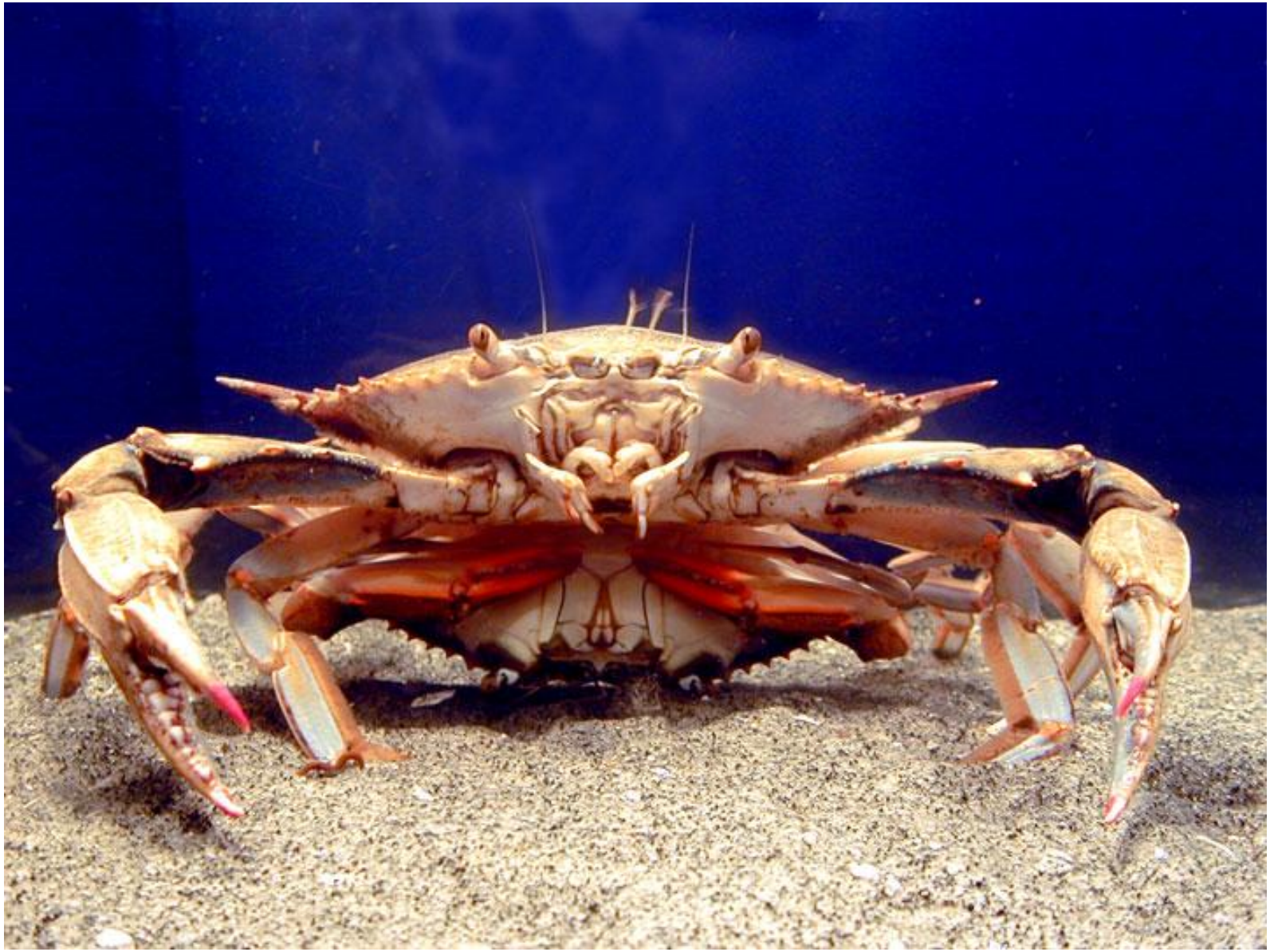
Larval Development

Rhode River subestuary

Nursery & Mating Habitat

Bay Population Abundance

Blue Crab Mating



Short Window: Female Final Molt and Mating

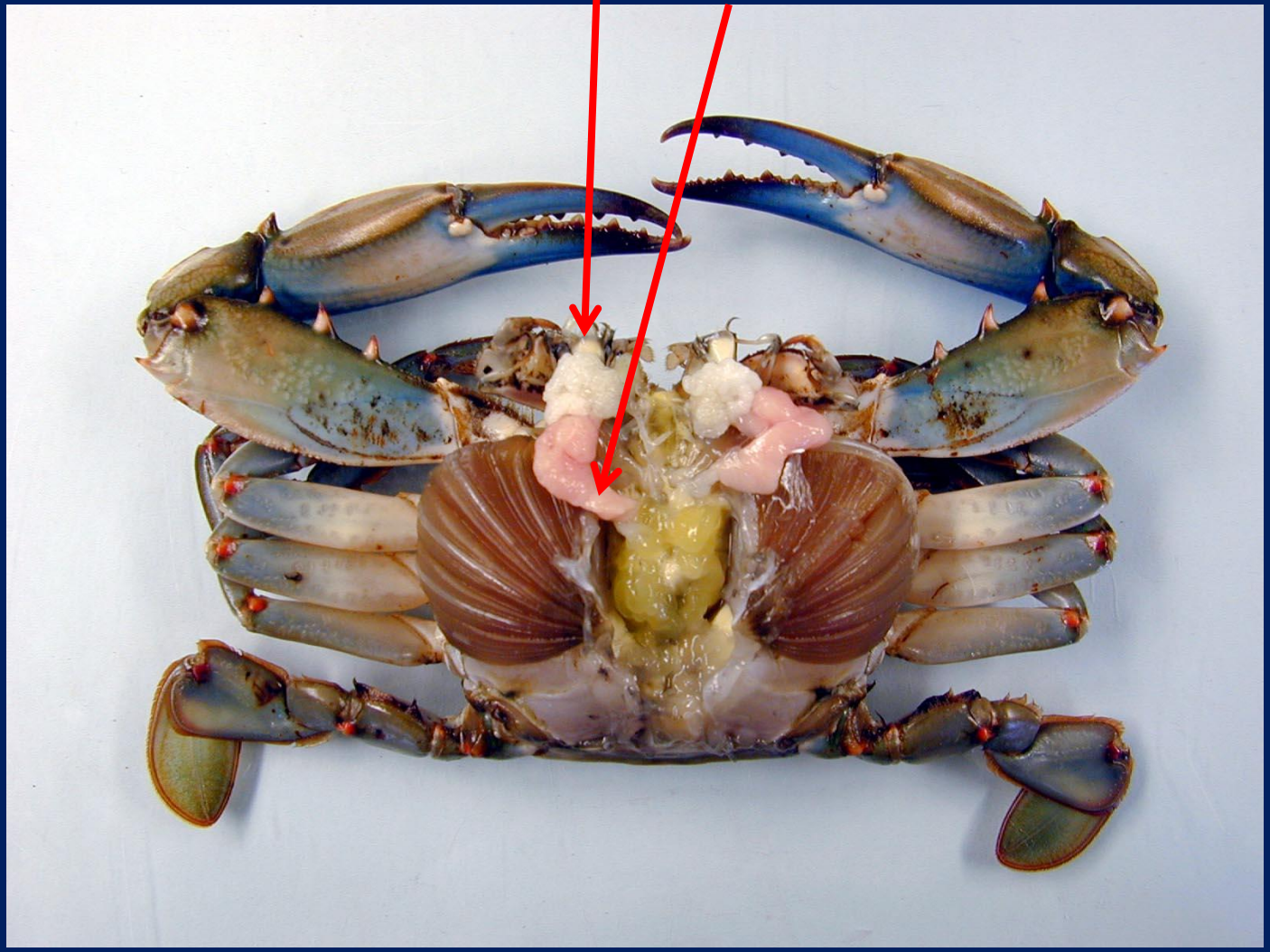
Females mate
1X in lifetime

Males mate
multiple times

Mate Guarding
Time = 2-4 days

Pre-mating Male

Testes & Vas defrens: White = Spermatophores
Pink = Seminal Fluid



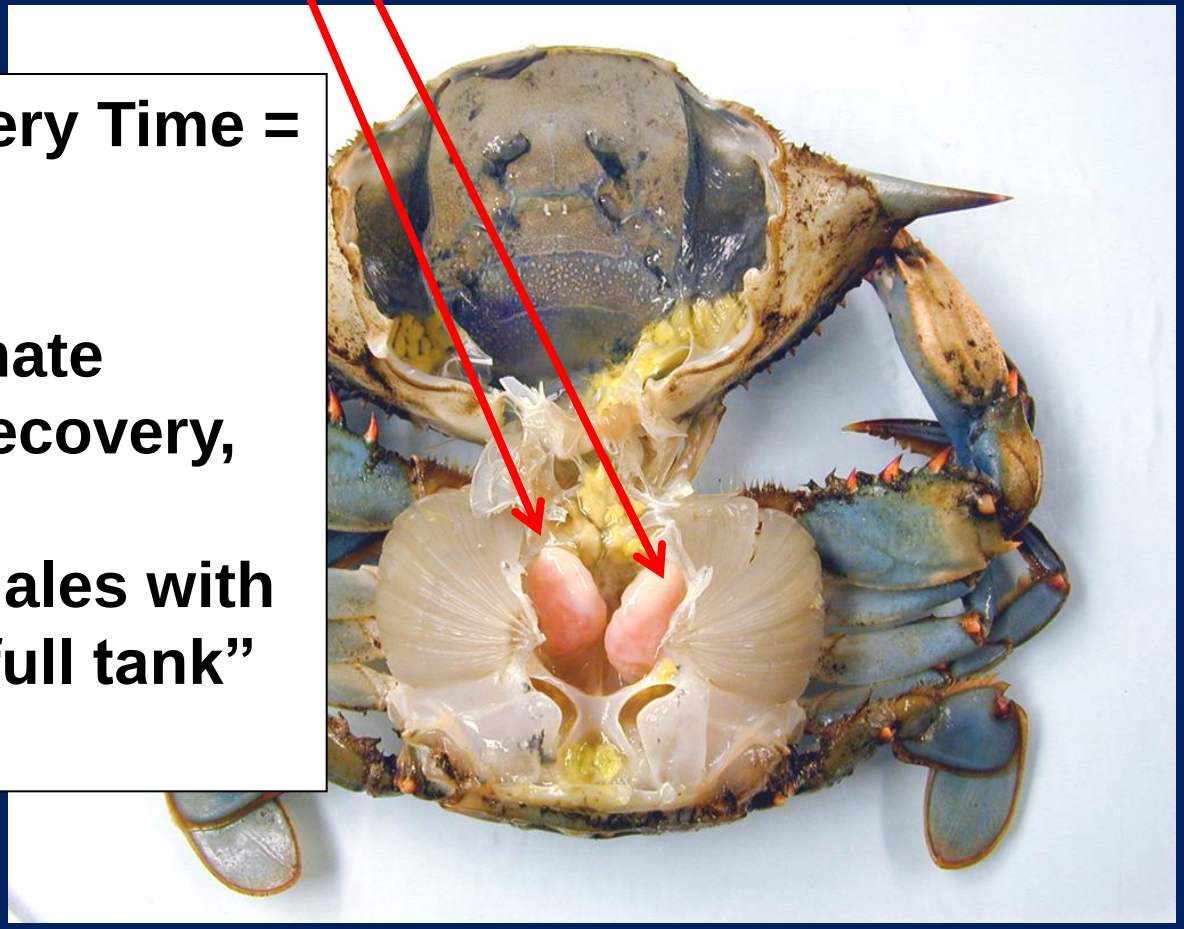
Newly Mated Female

Seminal Receptacles : white = spermatophores
pink = seminal fluid/ plug

Male Recovery Time = 10+ days

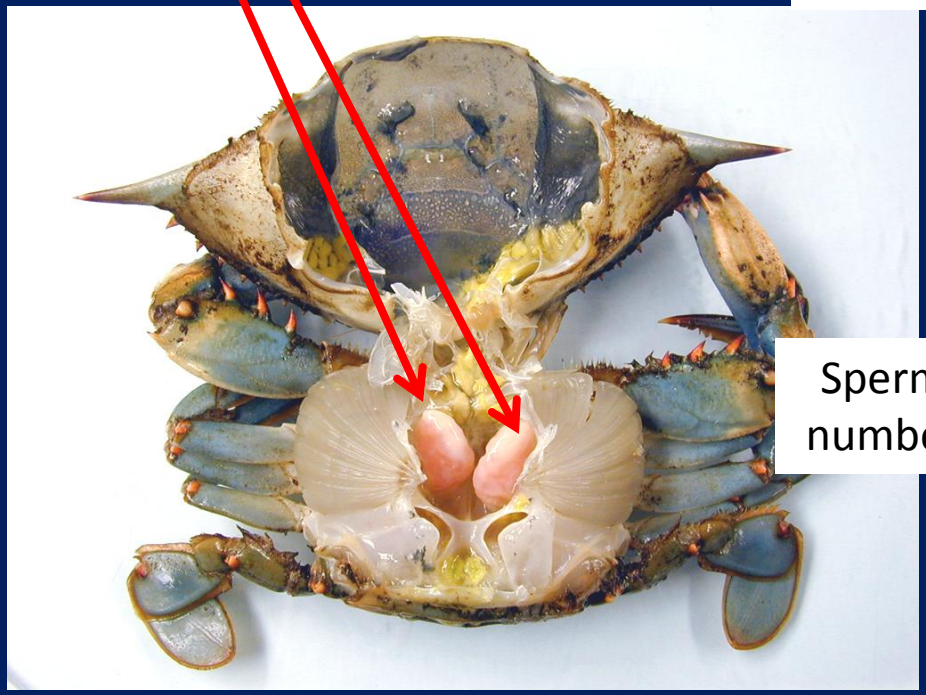
Males can mate before full recovery,

Leaving females with Less than “full tank”



Fishery Impacts: Potential Sperm Limitation

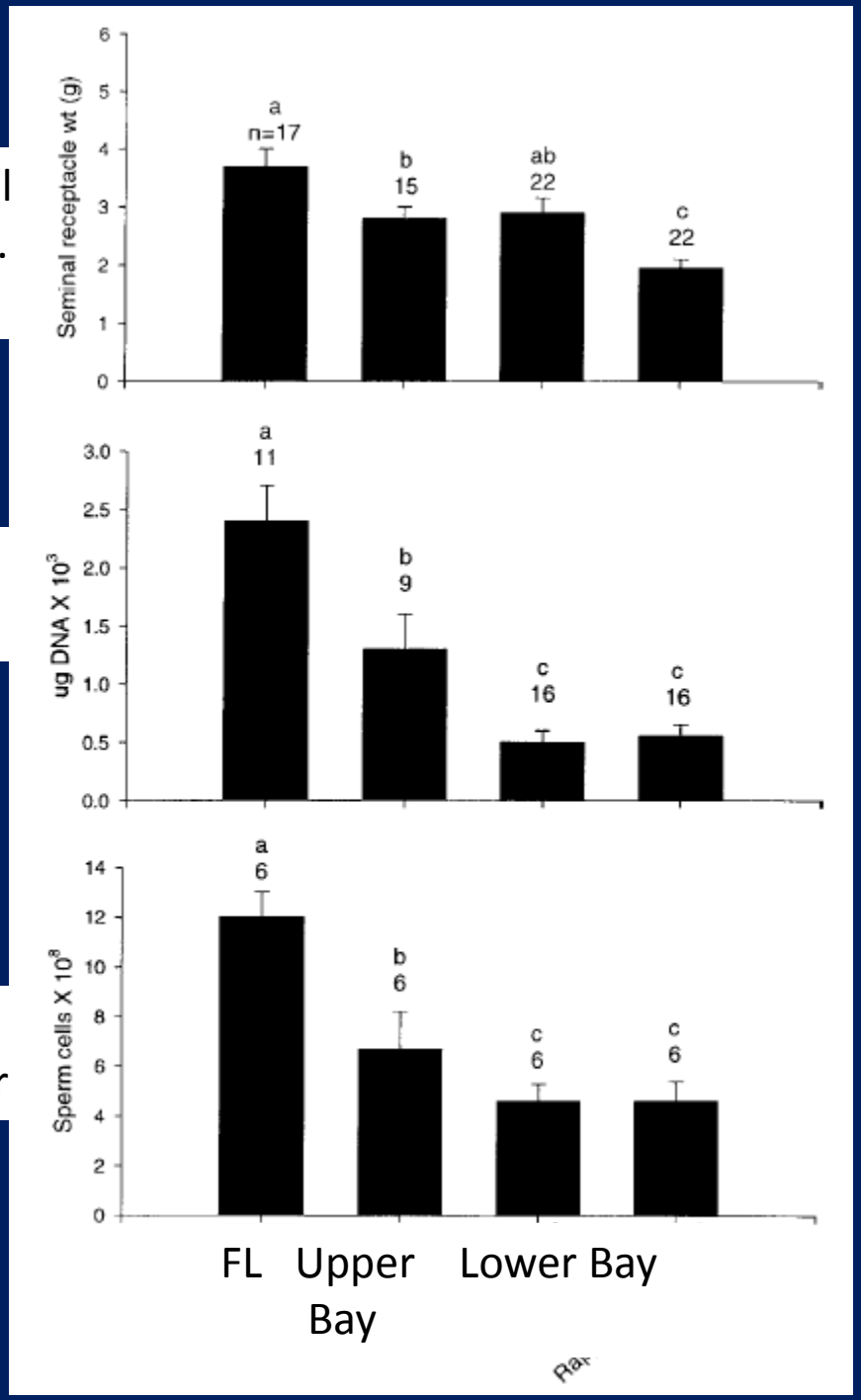
Seminal Receptacles



Seminal Recept. Wt.

Sperm DNA

Sperm number



Discussion: Sperm numbers

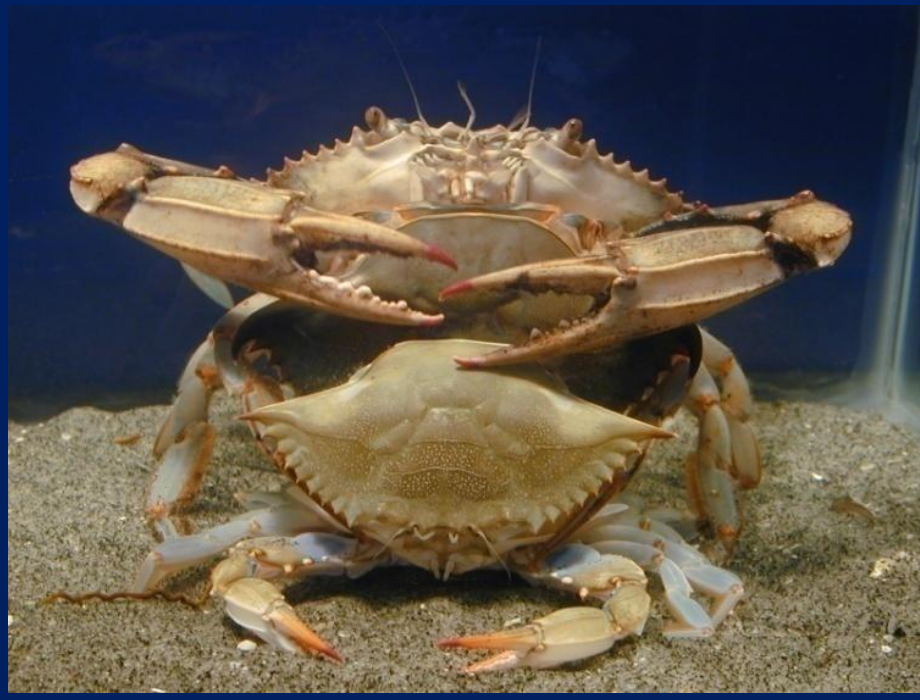
- Full ejaculate = 1 x 10^9 sperm cells (1,000 million)
  - 2-3 x 10^3 spermatophores
- Females can produce 6-10 broods in lifetime,

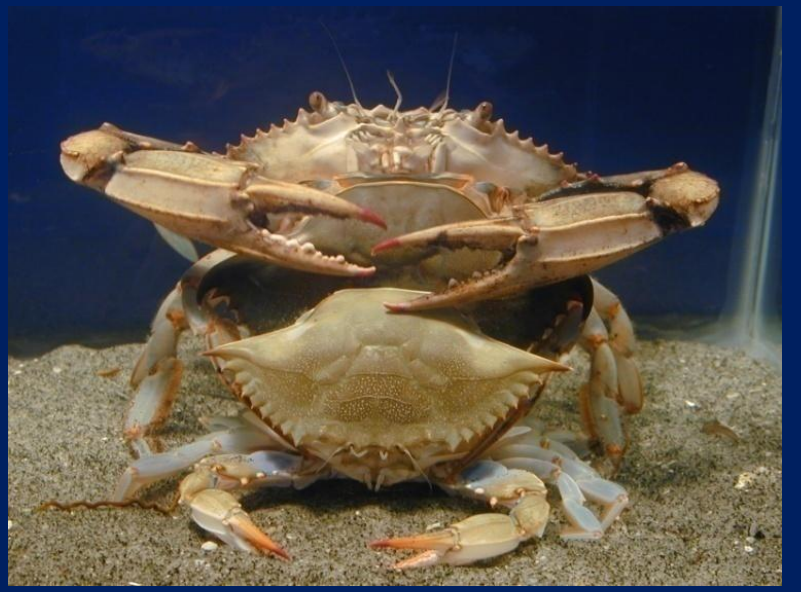
  typically 4-5 broods per year in Ches Bay
  - 3 x 10^6 eggs per brood
  - 20-30:1 sperm:egg ratio
  - 67 x 10^6 sperm per brood
- Females will use about 5 x 10^8 sperm in her lifetime of producing 7 broods

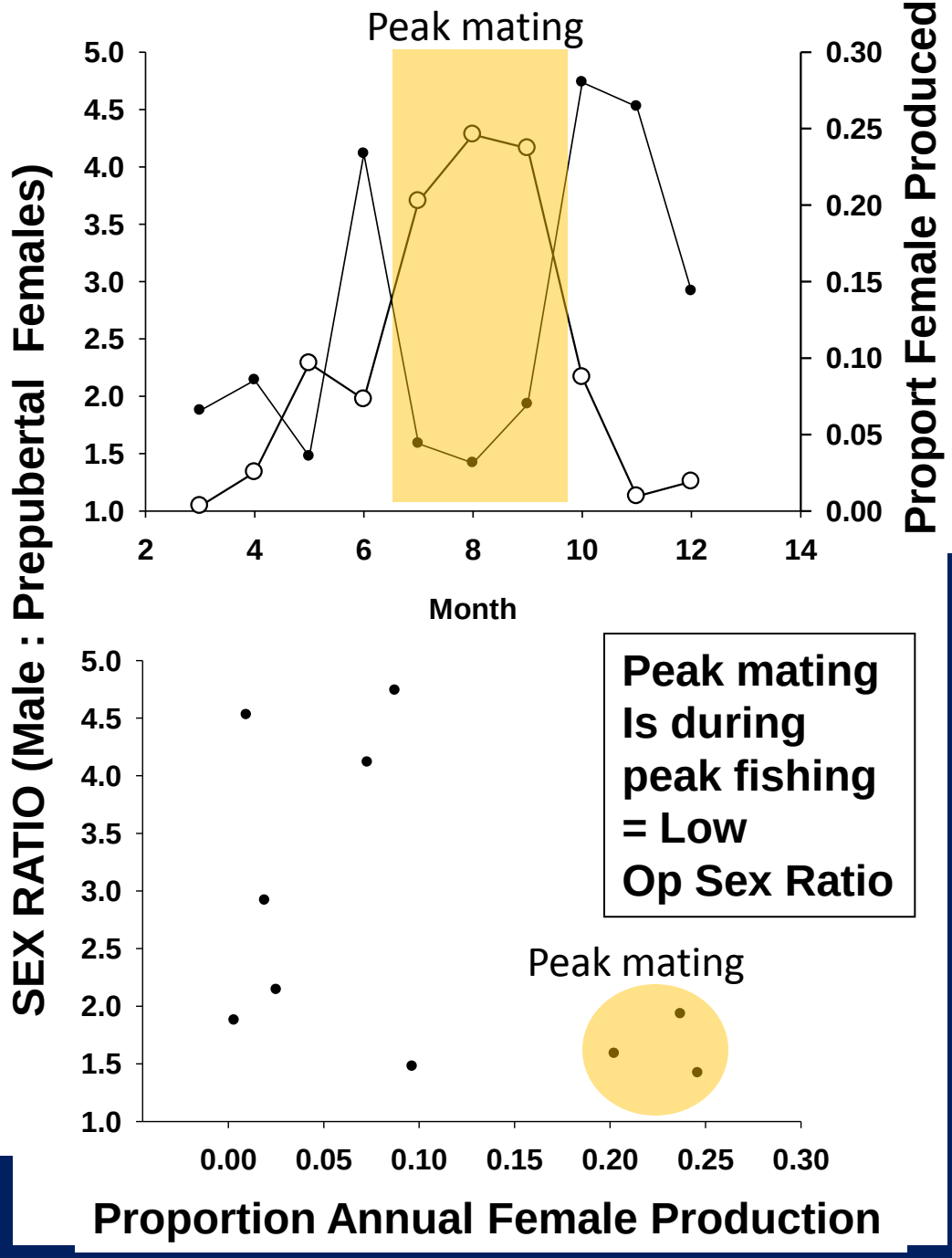
Fishery Impacts: Potential for Sperm Limitation

Pubertal Female Seasonal Production

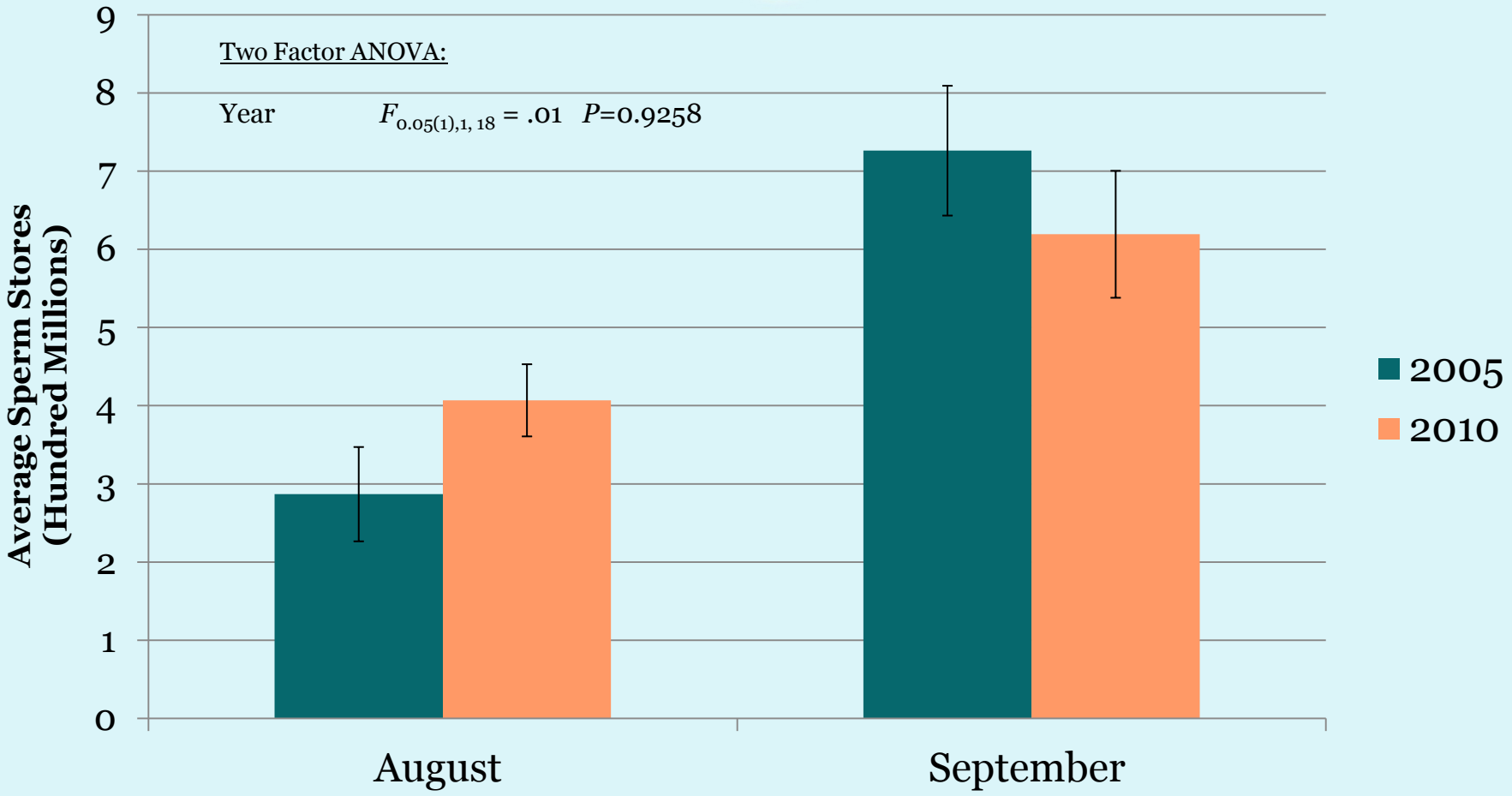
Operational Sex Ratio



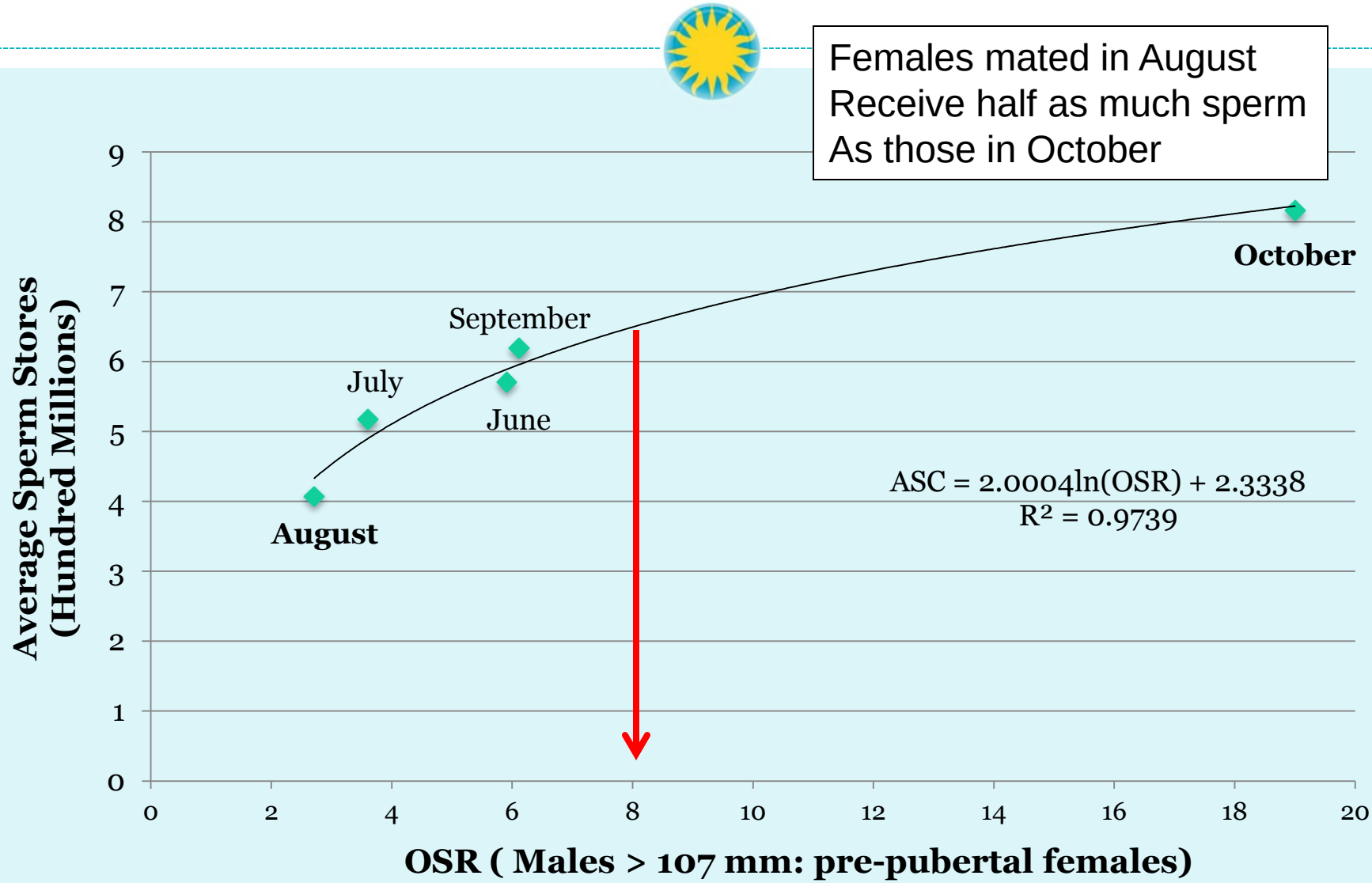



Peak mating
SEX RATIO (Male : Prepubertal Females)
Proport Female Produced
Month
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2
4
6
8
10
12
14
Peak mating
Is during
peak fishing
= Low
Op Sex Ratio
Peak mating
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Proportion Annual Female Production

Sperm Counts in the Rhode River 2005 & 2010

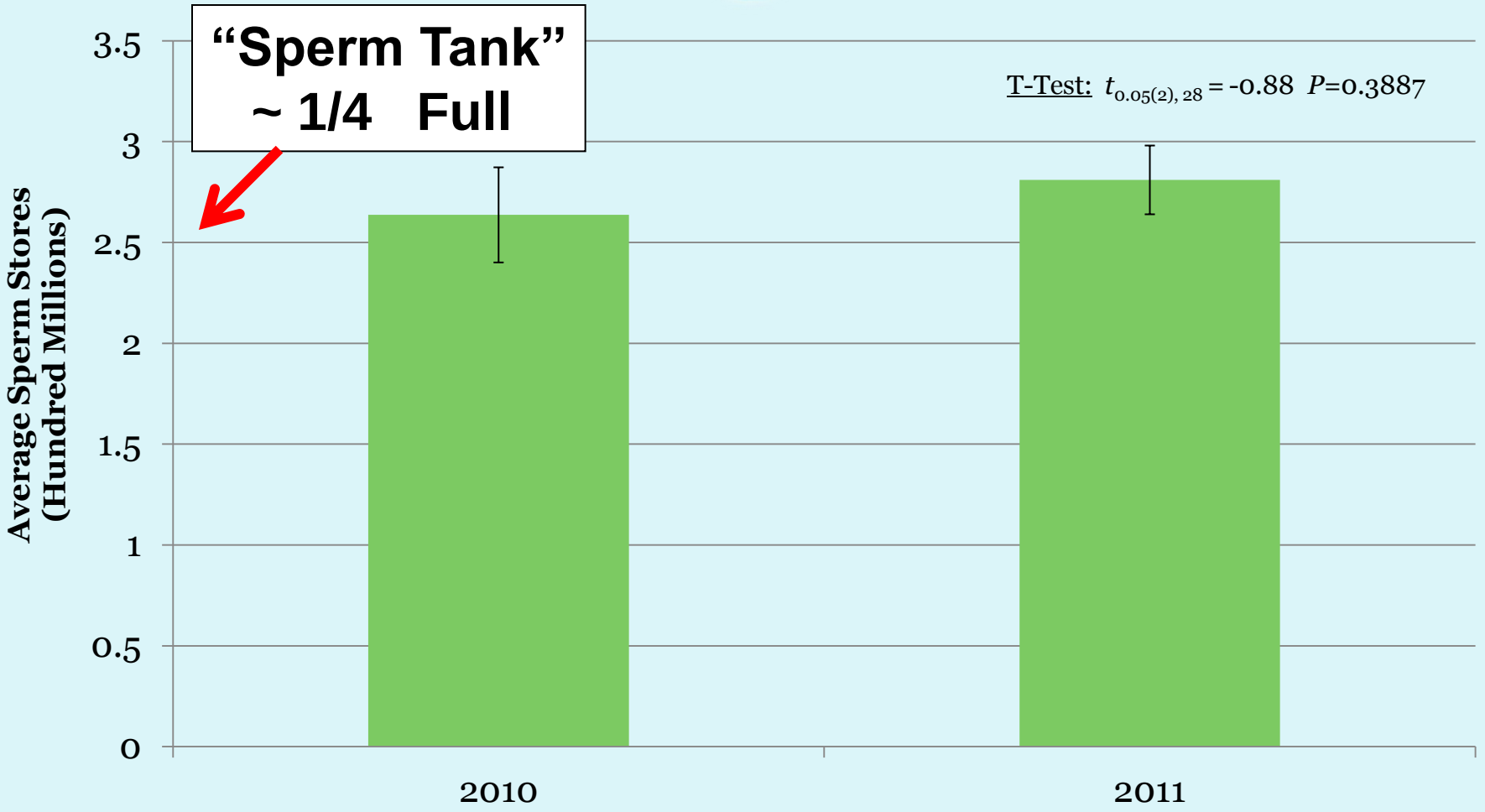


Operational Sex Ratio with Sperm Count Trend



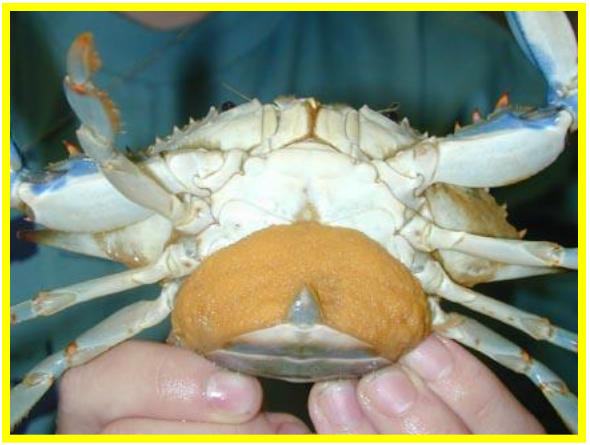
Spatial patterns of fishery exploitation

Sperm Counts in the Lower Bay 2010 & 2011

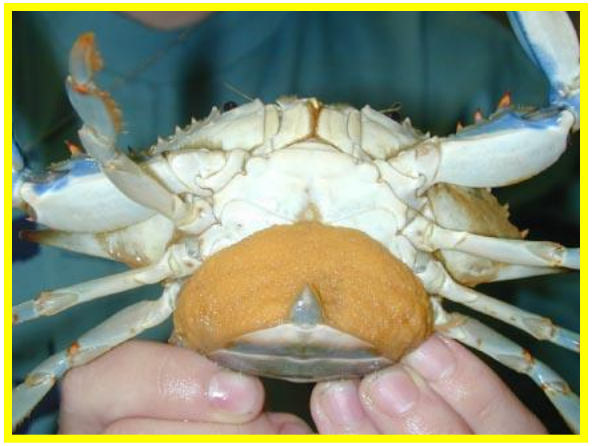


Goals:

- *Variation in sperm stores in spawning stock*
- *Brood production – how many eggs?*
- *Balanced population sex ratio*
- *Fishing impacts on mating dynamics*



Partners:



- *NOAA Chesapeake Bay Office*
- *MD DNR, VA VMRC*
- *VIMS, Univ North Florida*
- *MD & VA Watermen's Associations*
- *Commercial Watermen &*
- *Recreational Fishers*