The History of Commercial Exploitation of the Diamondback Terrapin (*Malaclemys terrapin*): Lessons for Turtle Conservation

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Outline

1) The history of the terrapin fishery in Maryland
2) The role of science in regulatory change
3) Factors that contributed to harvest closure
4) Have we solved the problem?

Thomas Hariot 1588 – *Briefe and True Report of the New Found Land of Virginia*

"tortoyses ….. they are very good meate, as also their egges"

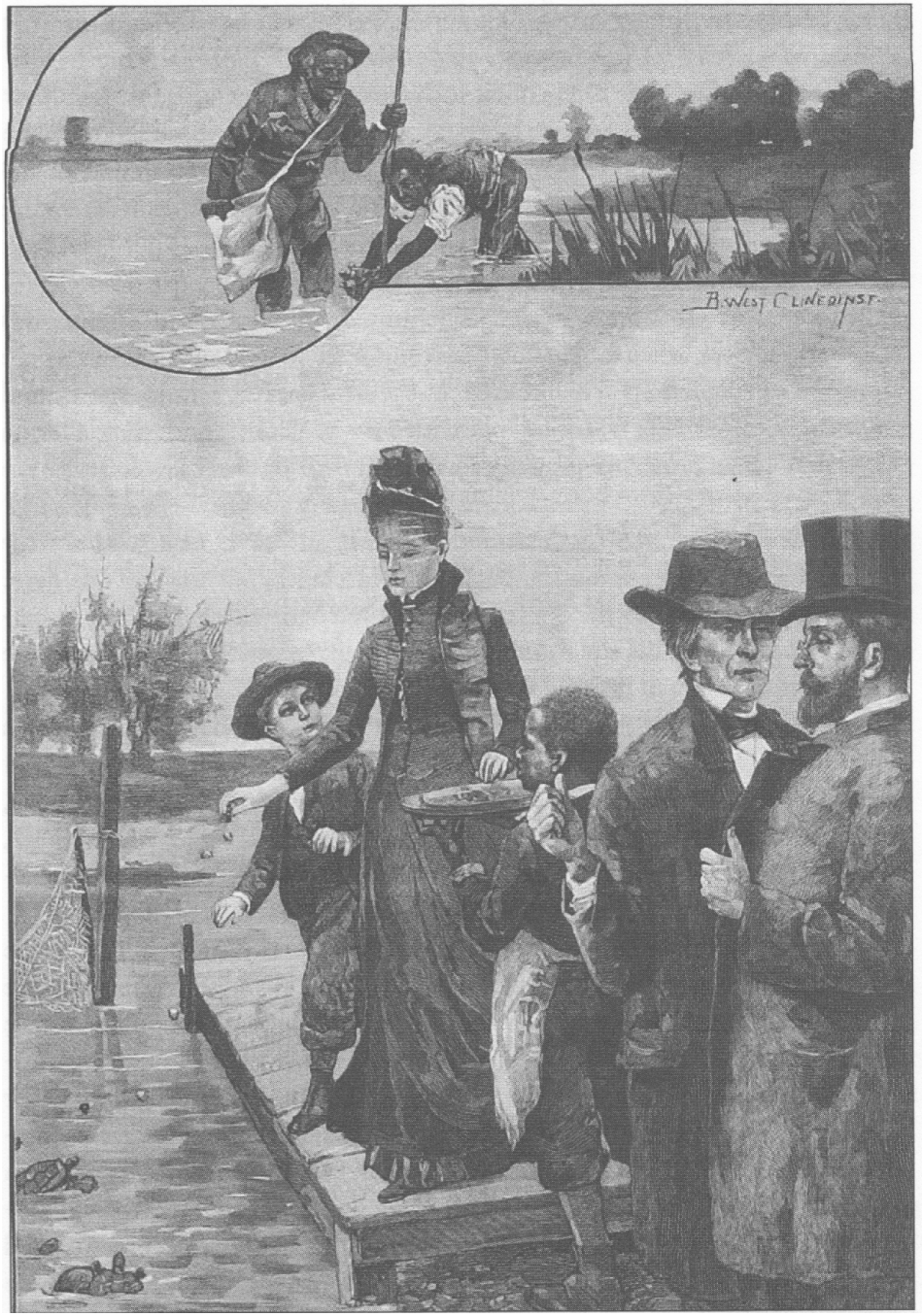
Economic Importance

"tidewater slaves once struck for relief from a diet to heavy in terrapin"

1797 MD statute restricted the use of terrapin as food for slaves

In colonial times a wagon load of terrapins could be purchased for a dollar

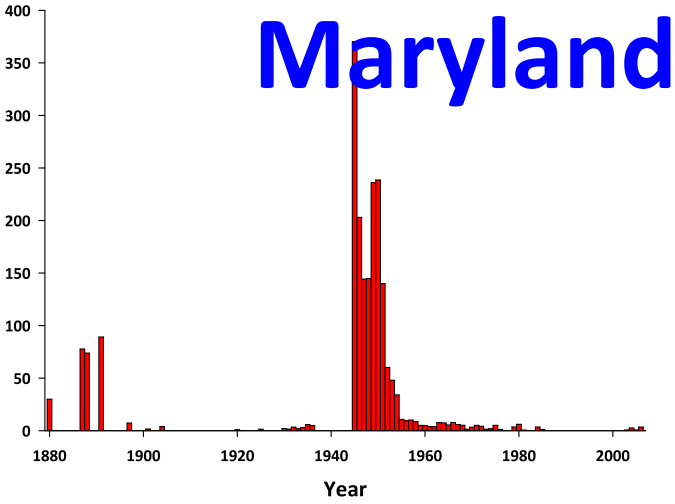
1850s – $96- $125 /dozen for "counts" > 8 inches in plastron length



Fishery Decline

- 1903 U.S Bureau of Fisheries established terrapins farms in Lloyds, MD (Oxford), Charleston, SC and Beaufort, NC
  - "a terrapin for every household"
- 1920 – 823 lbs harvested in MD and the terrapin fell from favor
  - Prohibition
  - Decline in terrapin populations throughout their range could not meet demand

Maryland's Terrapin Harvest



Maryland's Regulatory History and the Role of Science in Regulation

1929-1976 – 5" minimum; season closed April-October

1977-1981 – 6" minimum; season closed February-April

1982-1991 - 6" minimum; no closed season

1991-2005 – 6" minimum; season closed May – July

- **nesting beach philopatry and focused effort could dramatically reduce local nesting populations**
- **close fishery during nesting season**

Maryland's Regulatory History and the Role of Science in Regulation

2000 – 1 3/4"x 5" BRD required on recreational crab pots

- **BRD reduced terrapin catch without affecting crab catch**
- **require BRD in recreational fishery**

2006 - 4"-7" slot limit; season closed November – July

- **winter dredging take in hibernacula**
- **concern for maintaining brood stock**
- **invoke slot limit and season**

2007 – commercial fishery closed

- **increase in commercial harvest, declining populations**
- **modeling demonstrates harvest is unsustainable**
- **fishery closed**

Modeling Turtle Populations

Feasible Demography

- Snapping turtles – Congdon et., 1994
- Blandings Turtles – Congdon et al., 1993
- Leatherback sea turtle – Spotila et al., 1996
- Diamondback terrapins – Roosenburg unpublished data

Elasticity or Matrix Analyses

- Common mud turtle, slider, yellow mud turtle, snapping turtle, painted turtle, desert tortoise, loggerhead sea turtle – Heppell 1998
- Loggerhead Sea turtle – Crouse et al., 1987
- Diamondback terrapin – Mitro 2003; Hart 1999
- Spotted turtle - Enneson and Litzgus 2008
- Box turtles – Converse et al., 2005
- *Podocnemis expansa* – Mogollones et al 2010

Only subsistence harvest by indigenous people

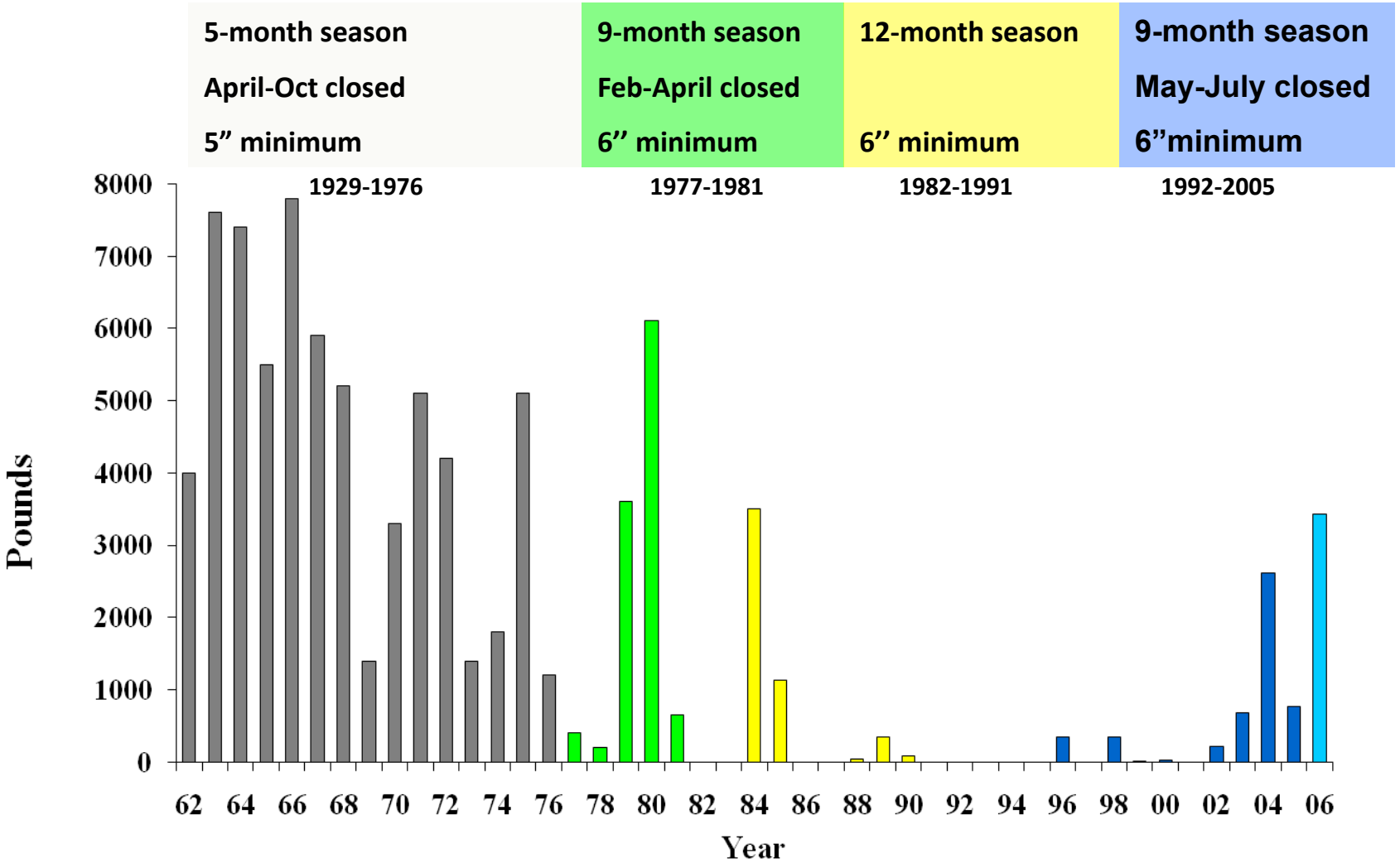
- Northern snake-necked turtle - Fordham et al., 2008
- Hawaiian Green Turtle – Chaloupka and Balazs 2007

Modeling Outcome

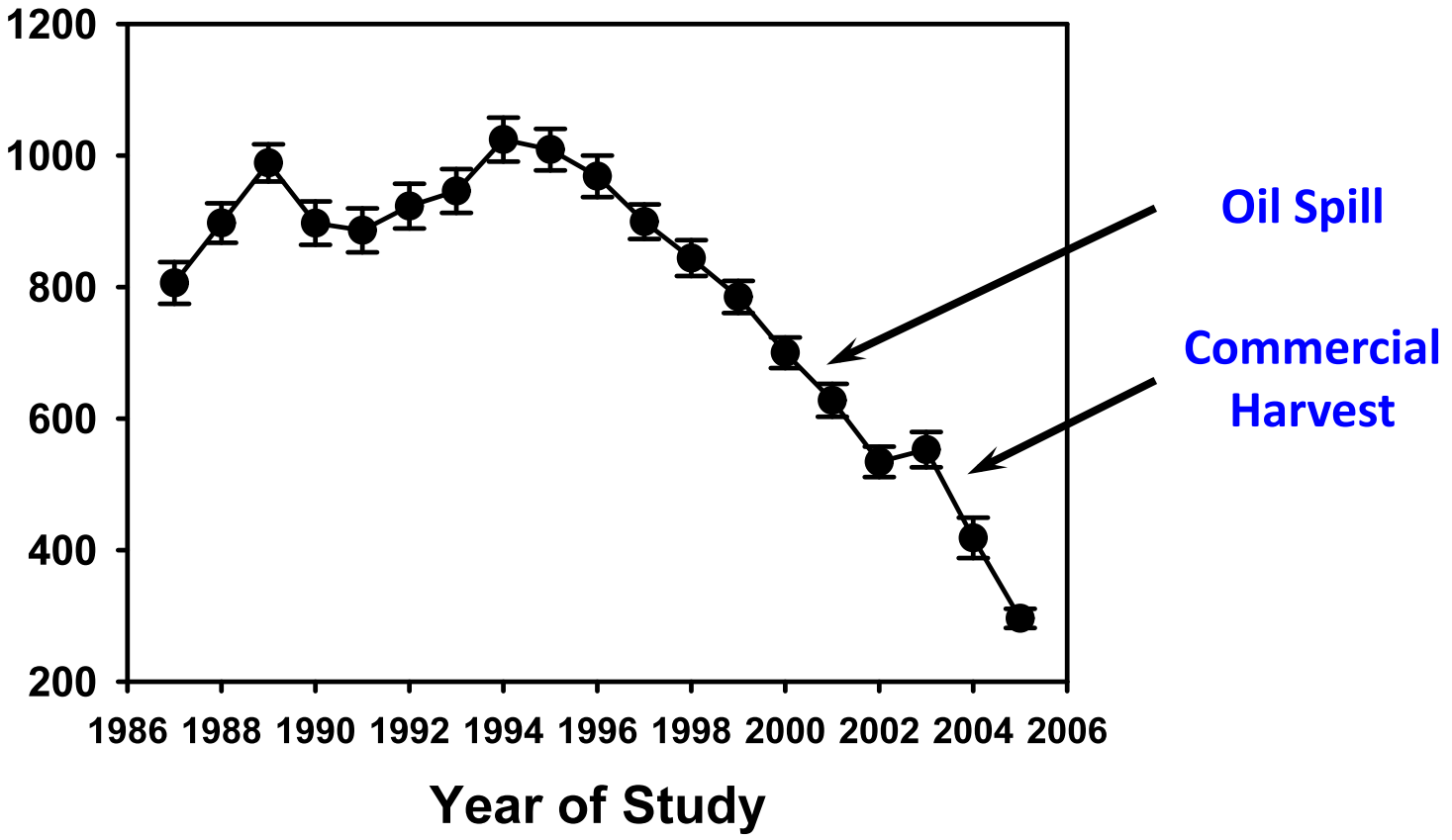
- Species with delayed maturity, low reproductive rates, and high adult survivorship are most sensitive to changes in adult and juvenile survivorship.
- Increasing reproductive output and increasing hatchling survivorship have minimal effects on population growth rate.
- The scenario that fits most turtle populations studied to date.

Confusing to most

Factors that closed the Harvest:
1962-2006 Terrapin Harvest

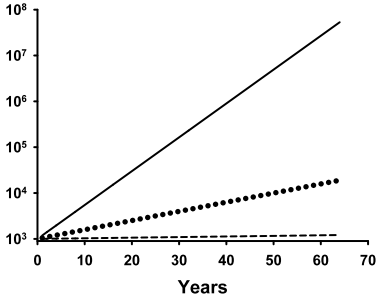


Factors that closed the Harvest: Population Decline



Factors that closed the Harvest:

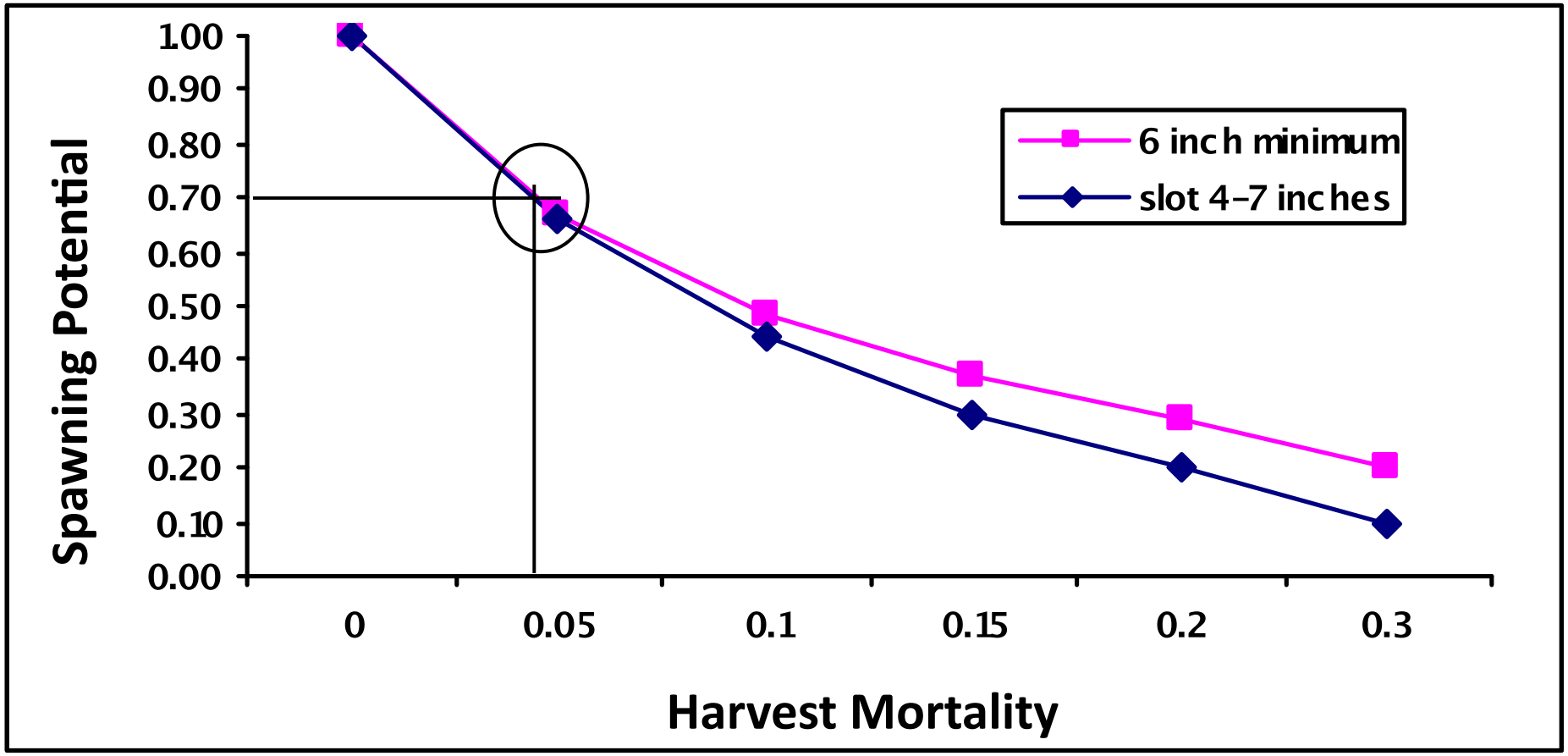
Compare to local resources



Used examples that the audience recognized

Used economic analogies - capital vs. interest

Ricker Spawner-Recruit Simulation



Traditional fishery models demonstrated unsustainability

Factors that closed the harvest: Economic and Political Costs

The economic value of the catch was small, affected few watermen

The economic and political cost to state agencies and officials was minimal

Affected harvesters can redirect their skills for habitat restoration, environmental cleanup, and ecotourism or be compensated through a buyout program

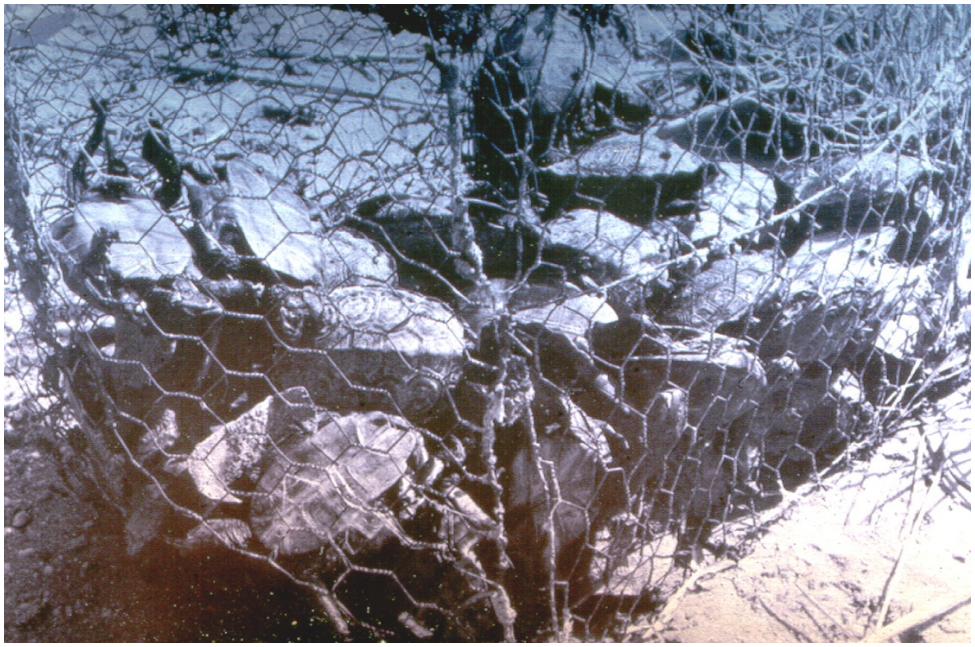
Factors that closed the harvest: Develop Local and Regional Advocacy

- **Inform the public of the practice and the problem**
  - **Education programs**
  - **Petitions**
- **Enlist reputable entities "NGOs" to help**
- **Get the press on board**
- **Eliminating harvesting is only the first step in a comprehensive conservation strategy**

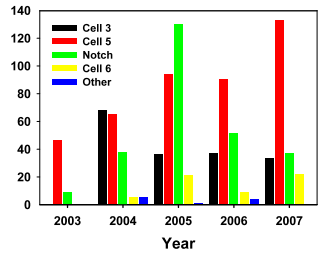
What are the next steps?

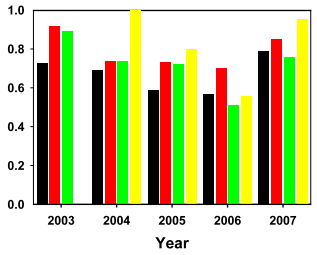
Eliminating terrapin by-catch mortality

1) **Science**
2) **Advocacy and Education**
3) **Solutions and Implementation**



Poplar Island





Population growth models

Stage-structured Leftkovich matrix (Leftkovich 1965)

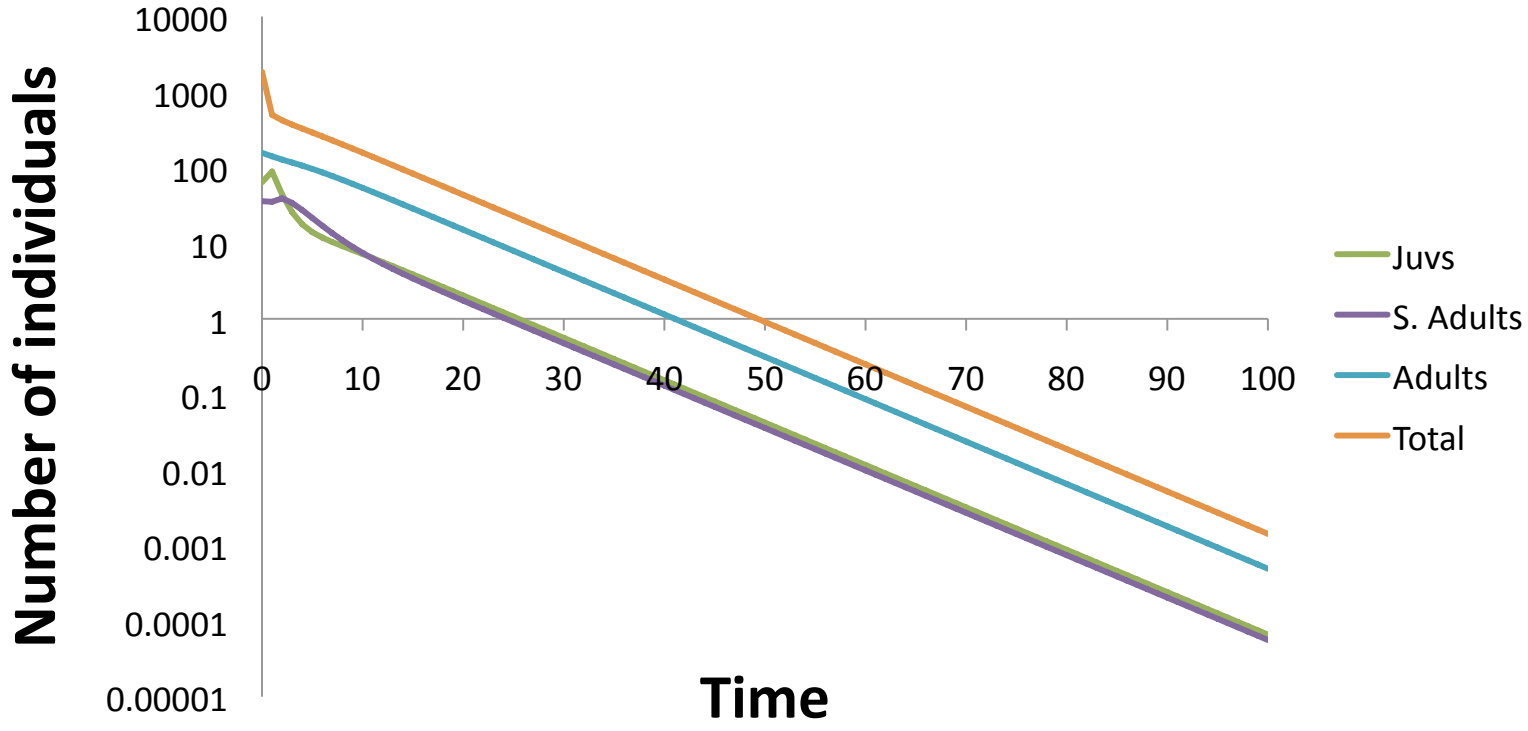
Four female stages based on size:

1. **Hatchling (h) – young of the year**
2. **Juvenile (j) – PL < 123 mm**
3. **Subadult (sa) – 123 mm ≤ PL < 163 mm** (Roosenburg et al. 1997)
4. **Adult (a) – PL ≥ 163 mm**

$$\begin{vmatrix} P_{h,h} & F_j & F_{sa} & F_a \\ P_{h,j} & P_{j,j} & 0 & 0 \\ 0 & P_{j,sa} & P_{sa,sa} & 0 \\ 0 & 0 & P_{sa,a} & P_{a,a} \end{vmatrix}$$

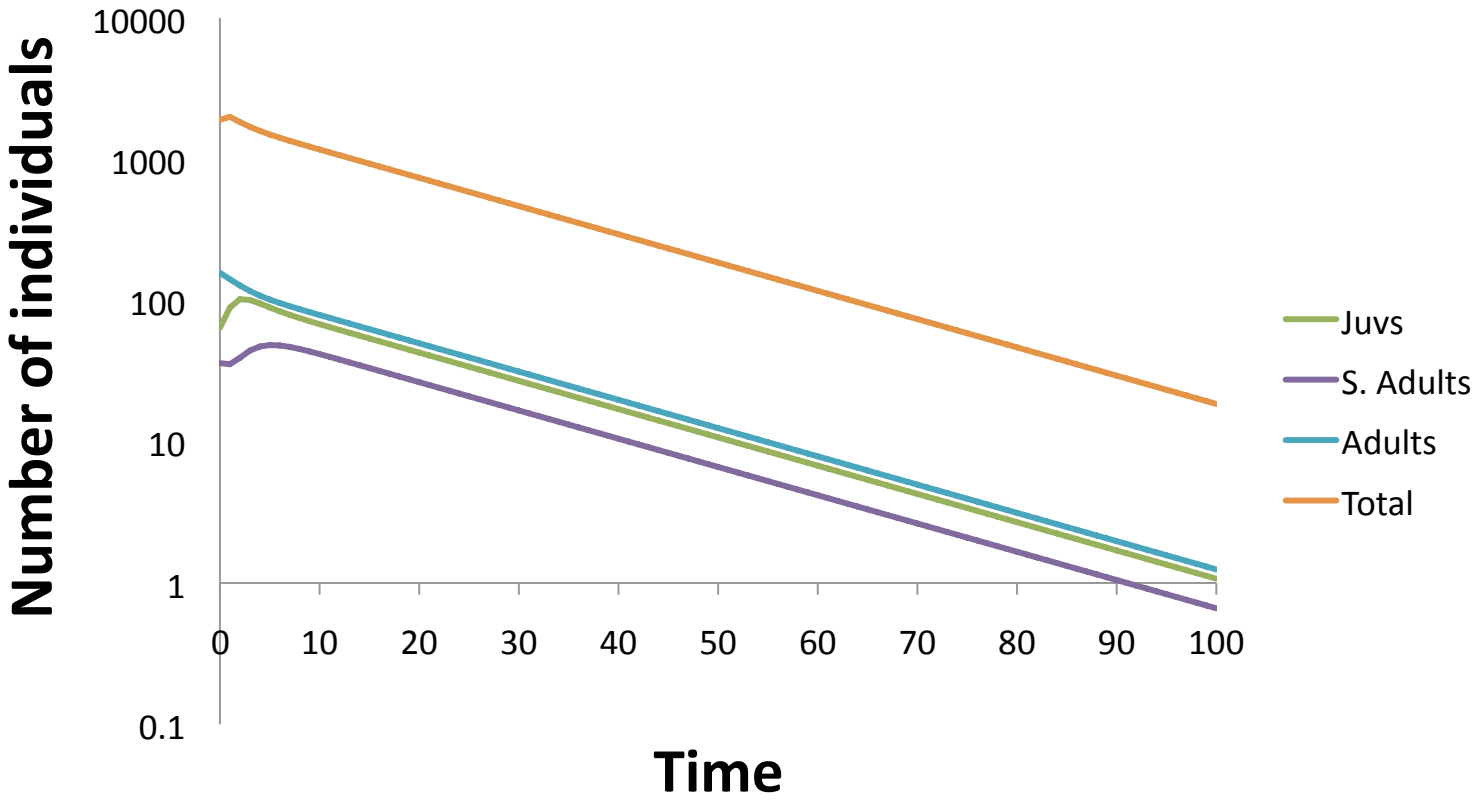
No Protective Measure (λ = 0.879)

$$\begin{vmatrix} P_{h,h} & F_j & F_{sa} & F_a \\ P_{h,j} & P_{j,j} & 0 & 0 \\ 0 & P_{j,sa} & P_{sa,sa} & 0 \\ 0 & 0 & P_{sa,a} & P_{a,a} \end{vmatrix} = \begin{vmatrix} 0 & 0 & 0.4 & 1.4 \\ 0.038999 & 0.38981 & 0 & 0 \\ 0 & 0.1726 & 0.675246 & 0 \\ 0 & 0 & 0.182754 & 0.858 \end{vmatrix}$$



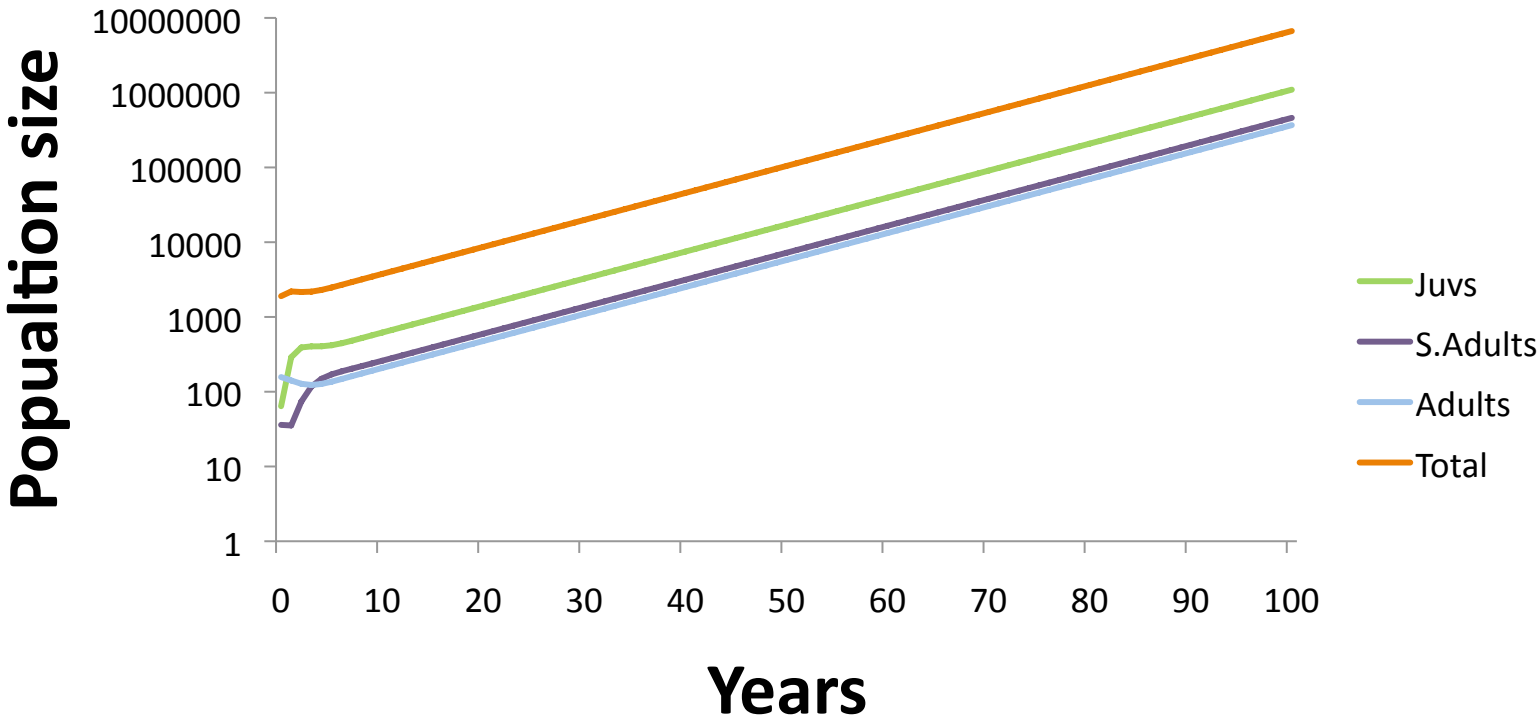
Protecting Nests (λ = 0.940)

$$\begin{vmatrix} P_{h,h} & F_j & F_{sa} & F_a \\ P_{h,j} & P_{j,j} & 0 & 0 \\ 0 & P_{j,sa} & P_{sa,sa} & 0 \\ 0 & 0 & P_{sa,a} & P_{a,a} \end{vmatrix} = \begin{vmatrix} 0 & 0 & 2.951111 & 10.32889 \\ 0.038999 & 0.38981 & 0 & 0 \\ 0 & 0.172688 & 0.675246 & 0 \\ 0 & 0 & 0.182754 & 0.858 \end{vmatrix}$$



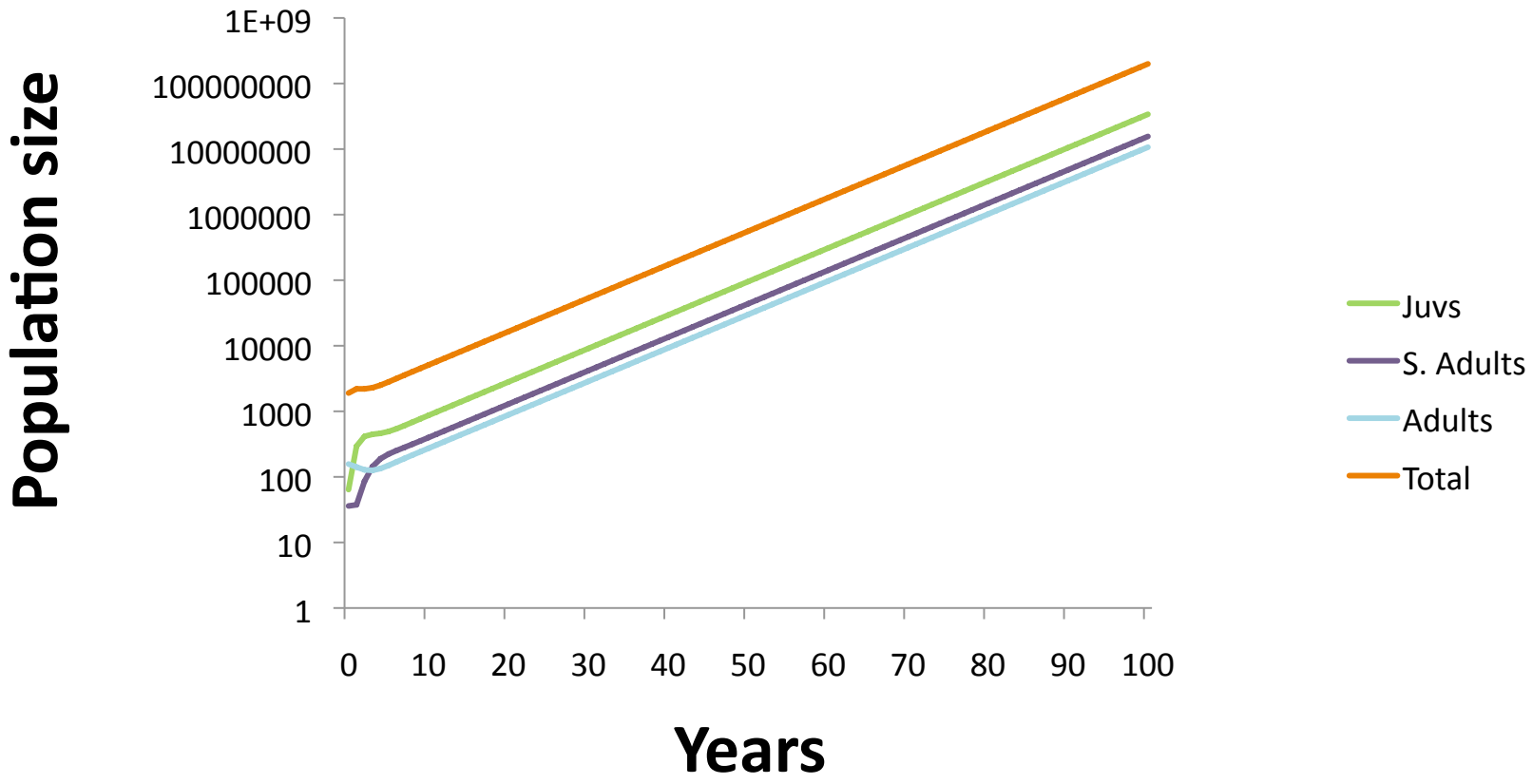
What Head-starting Should Accomplish (λ = 1.07)

$$\begin{vmatrix} P_{h,h} & F_j & F_{sa} & F_a \\ P_{h,j} & P_{j,j} & 0 & 0 \\ 0 & P_{j,sa} & P_{sa,sa} & 0 \\ 0 & 0 & P_{sa,a} & P_{a,a} \end{vmatrix} = \begin{vmatrix} 0 & 0 & 2.951111 & 10.32889 \\ 0.160999 & 0.38981 & 0 & 0 \\ 0 & 0.172688 & 0.675246 & 0 \\ 0 & 0 & 0.182754 & 0.858 \end{vmatrix}$$



Further Increase in Juvenile Survivorship ($\lambda = 1.12$)

$$\begin{vmatrix} P_{h,h} & F_j & F_{sa} & F_a \\ P_{h,j} & P_{j,j} & 0 & 0 \\ 0 & P_{j,sa} & P_{sa,sa} & 0 \\ 0 & 0 & P_{sa,a} & P_{a,a} \end{vmatrix} = \begin{vmatrix} 0 & 0 & 2.951111 & 10.32889 \\ 0.160999 & 0.465696 & 0 & 0 \\ 0 & 0.206304 & 0.675246 & 0 \\ 0 & 0 & 0.182754 & 0.858 \end{vmatrix}$$



Lessons Learned from Terrapins

1. Harvesting adult turtles cannot maintain an economically viable or sustainable fishery
2. Science is important and essential to effective management but can rarely accomplish it alone
3. Environmental conditions have deteriorated such that most turtle populations are threatened by some anthropogenic increase in mortality
4. Eliminating the commercial exploitation of adults is just the beginning of a comprehensive management program

“Shall the diamondback not meet in a changing world, and even go forth from cloistered epicurean walls to win and hold a broad esteem. The diamondback forever!”

Coker 1920