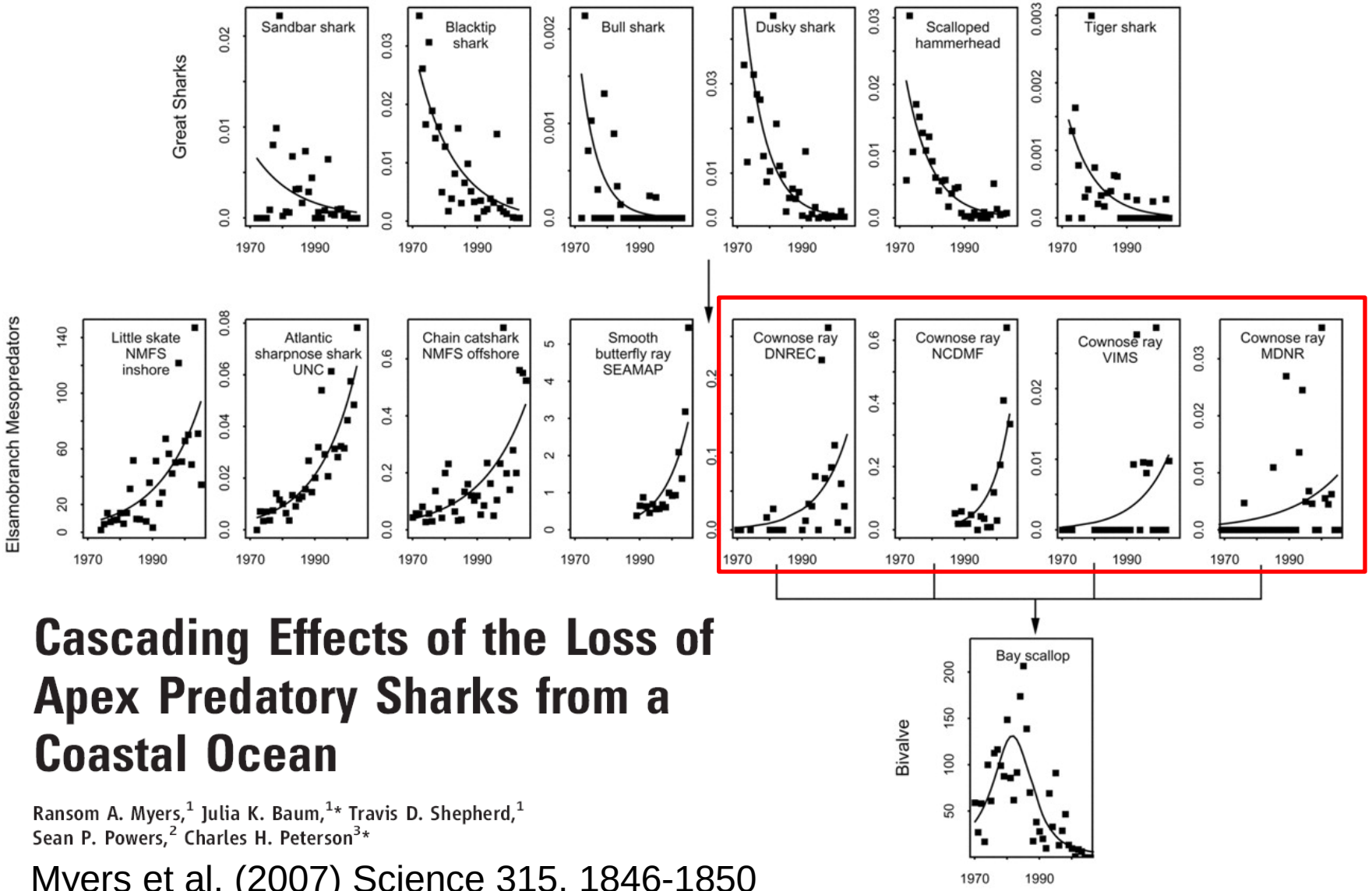
Cownose ray population changes:
Do the reports match the biology?

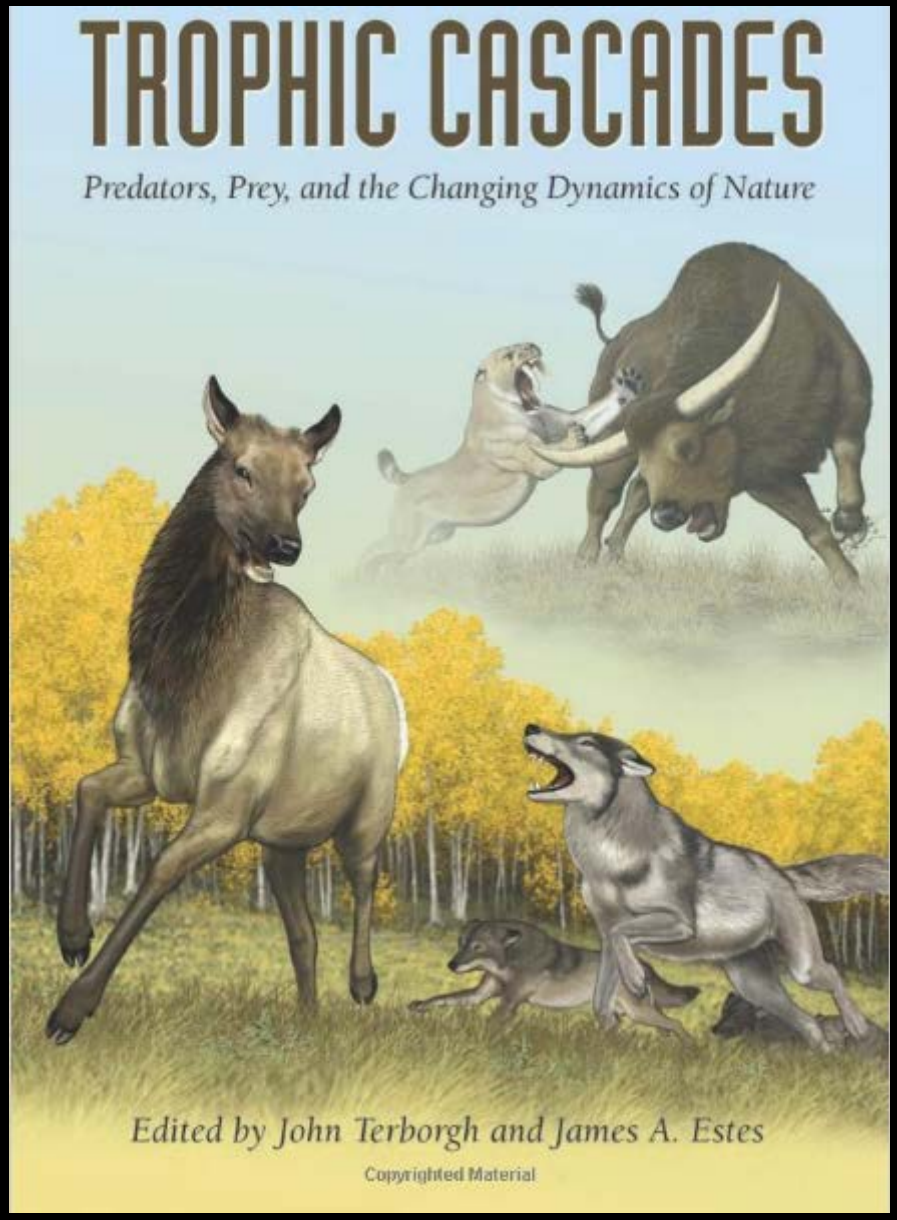
Dean Grubbs, Ph.D
Associate Research Professor
Associate Director of Research
Florida State University Coastal and Marine Lab



Cascading Effects of the Loss of Apex Predatory Sharks from a Coastal Ocean

Ransom A. Myers,[1] Julia K. Baum,[1]* Travis D. Shepherd,[1]
Sean P. Powers,[2] Charles H. Peterson[3]*

Myers et al. (2007) Science 315, 1846-1850



CHAPTER 3

Some Effects of Apex Predators in Higher-Latitude Coastal Oceans

James A. Estes, Charles H. Peterson, and Robert S. Steneck

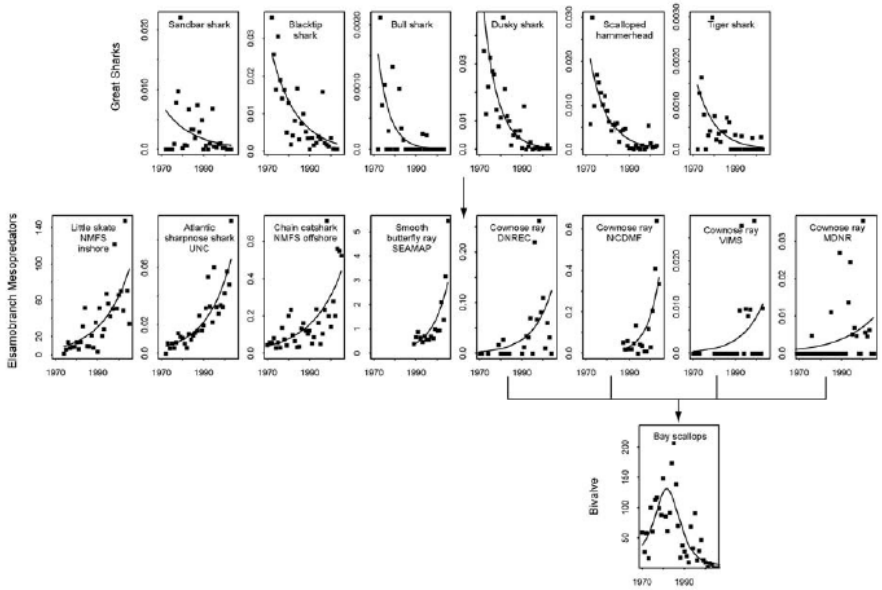
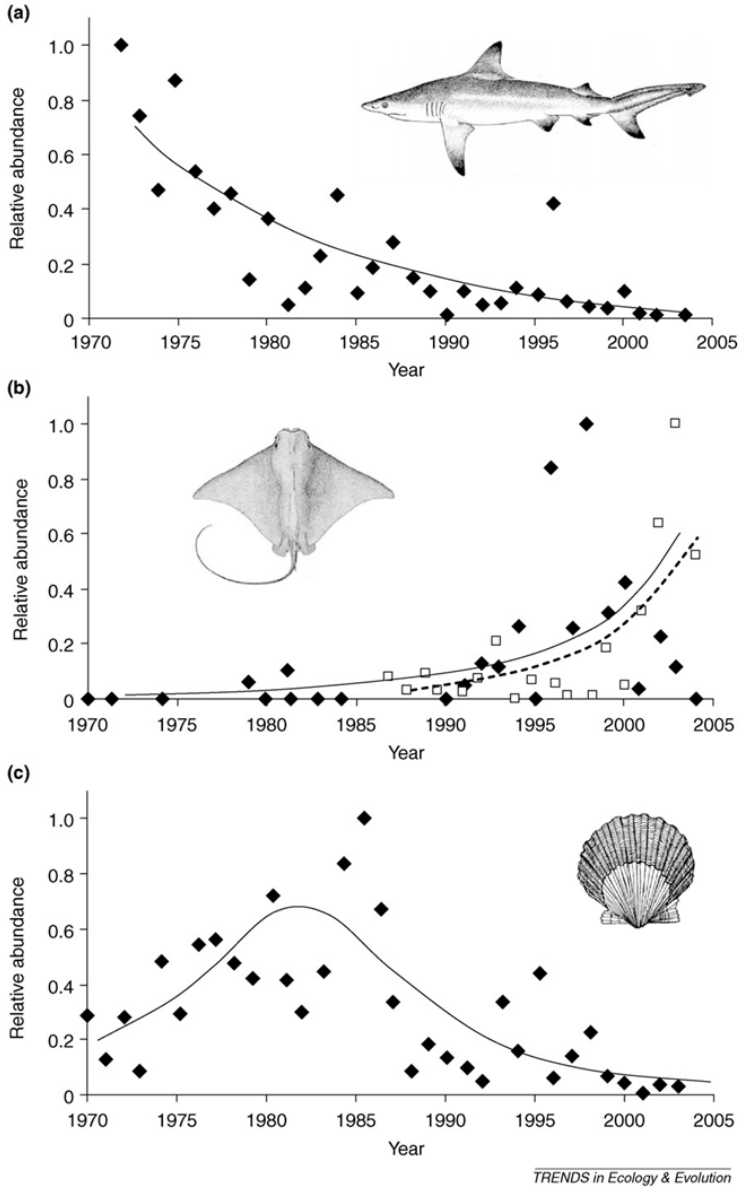


Figure 3.2. Patterns of temporal covariation among the declines of great sharks, the rise of small elasmobranchs, and the declines of bay scallops in East Coast estuaries and coastal oceans (from Myers et al. 2007). DNREC = Delaware Department of Natural Resources and Environmental Control, Division of Fish & Wildlife; MDNR = Maryland Department of Natural Resources, Fisheries Service; NCDMF = North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries; NMFS = National Marine Fisheries Service; SEAMAP = Southeast Area Monitoring and Assessment Program, South Atlantic; UNC = University of North Carolina Institute of Marine Sciences longline shark monitoring survey; VIMS = Virginia Institute of Marine Science.

Predicting ecological consequences of marine top predator declines

Michael R. Heithaus[1], Alejandro Frid[2], Aaron J. Wirsing[1] and Boris Worm[2]

[1]Department of Biological Sciences, Florida International University, 3000 NE 151st Street, North Miami, FL 33181, USA
[2]Department of Biology, Dalhousie University, Halifax, NS B3H 4J1, Canada



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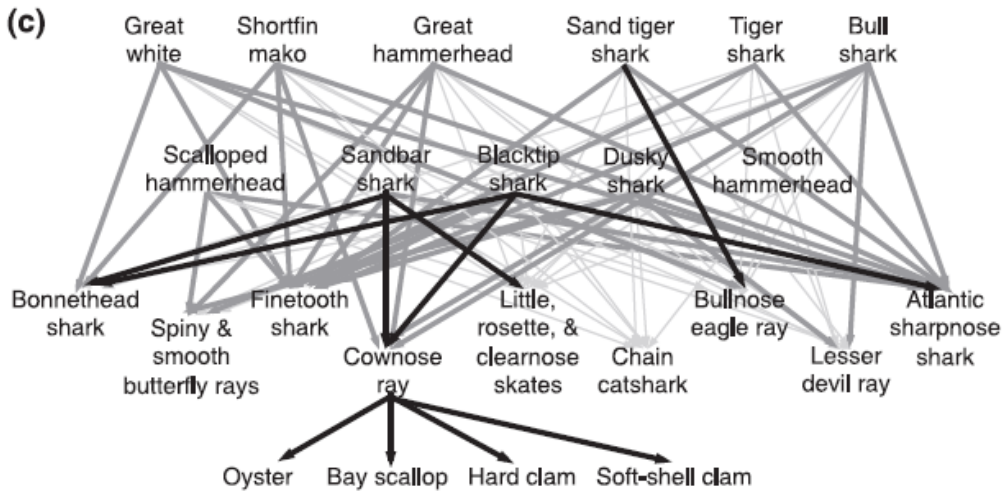
doi: 10.1111/j.1365-2656.2009.01531.x

REVIEW

Cascading top-down effects of changing oceanic predator abundances

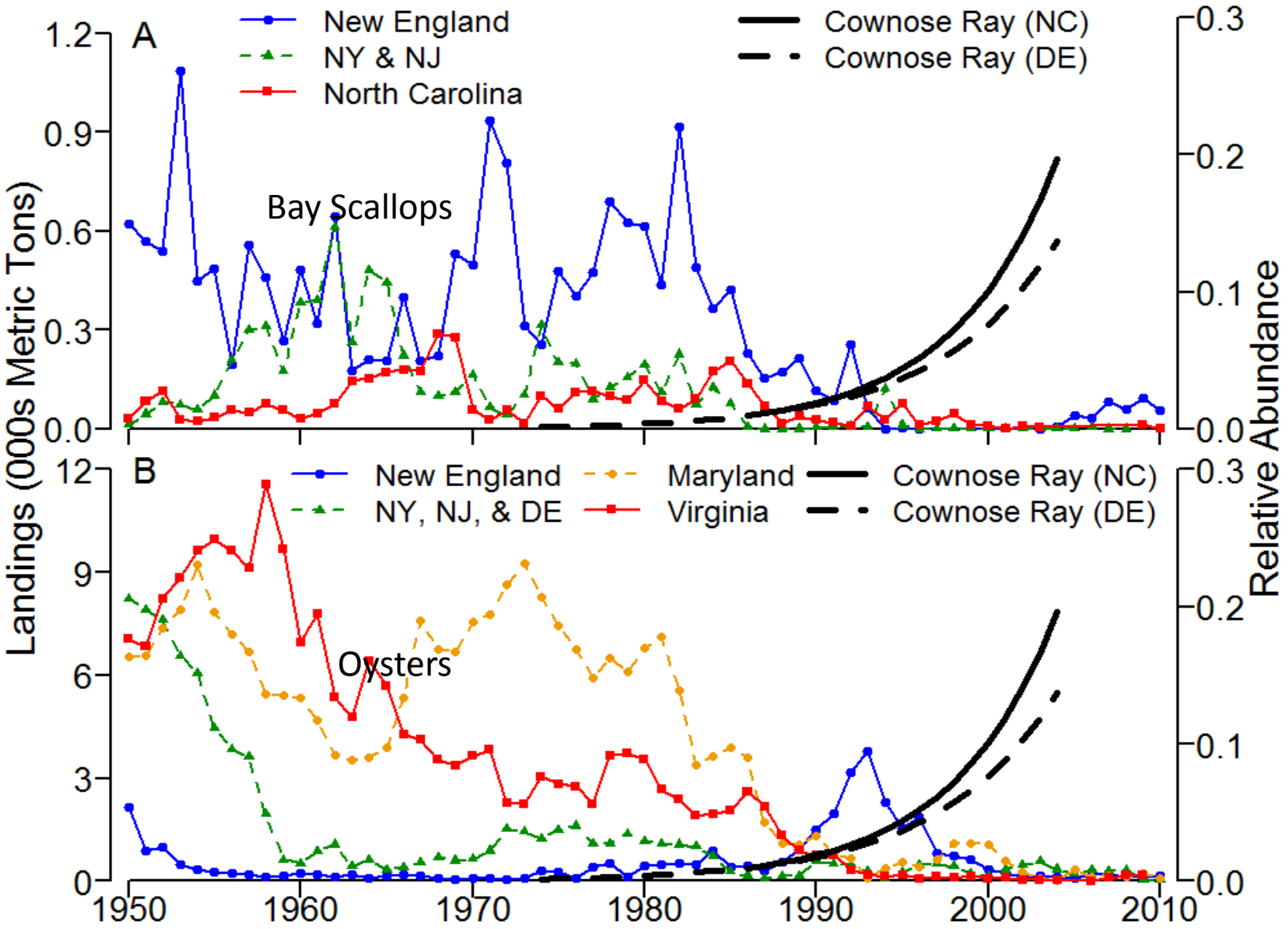
Julia K. Baum[1,2*] and Boris Worm[1]

[1]Department of Biology, Dalhousie University, Halifax, NS, Canada B3H 4J1; and [2]Scripps Institution of Oceanography, University of California, San Diego, 9500 Gilman Dr., La Jolla, CA 92093-0202, USA



Baum and Worm (2009)

Heithaus et al. (2008)

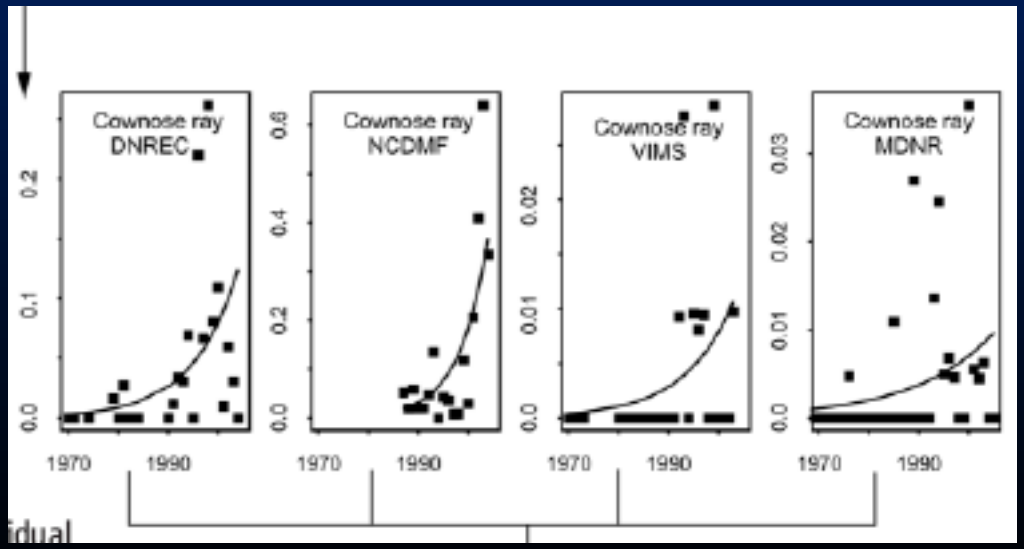


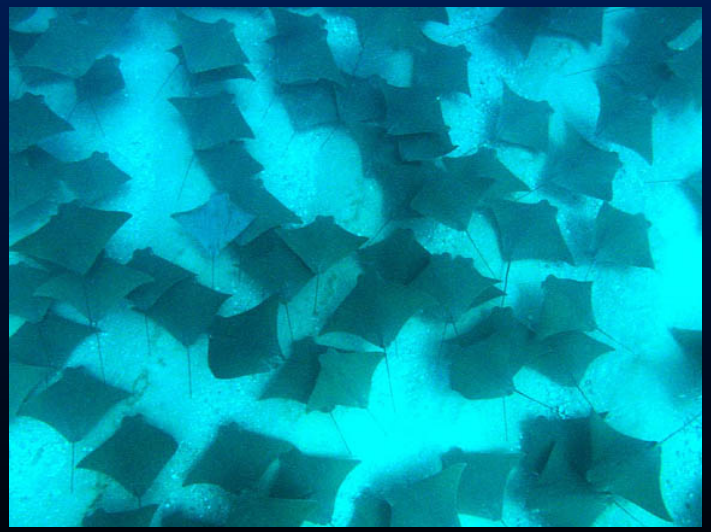
Analysis from Tobey Curtis in Grubbs et al. (In review): Collapse of shellfish stocks occurred prior to the purported increases in the cownose ray population and occurred in regions where cownose rays are absent..

The cownose ray population explosion?

Survey	Gear	Years	No. Caught	Inst. Rate
DNREC	Trawl	24	76	0.117****
NCDMF	Trawl	17	230	0.175****
VIMS	Seine	35	11	0.104*
MDNR	Seine	45	26	0.063**
NMFS-Off	Trawl	5	23	-0.265
NMFS-In	Trawl	31	544	0.044*
SEAMAP	Trawl	17	4817	0.059**

Most dramatic increases illustrated; very small sample sizes.



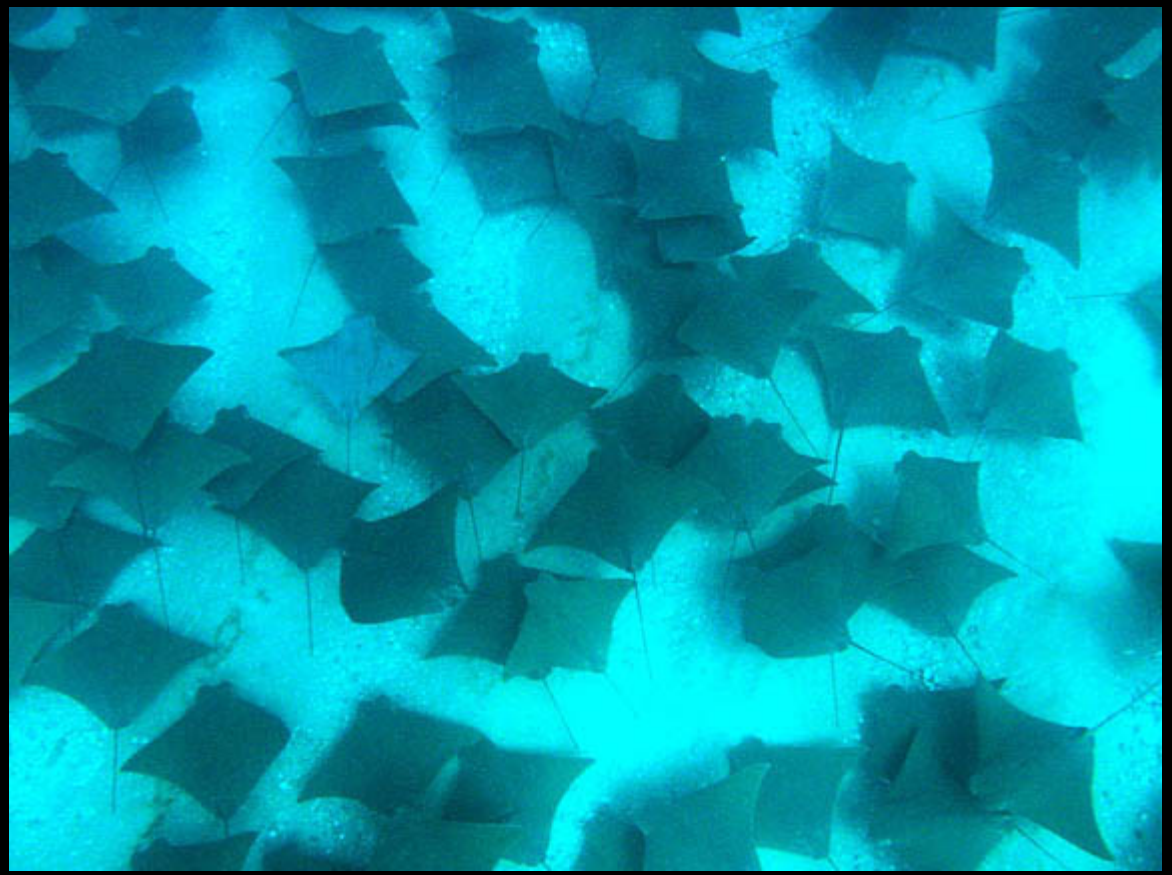


Data from Myers et al. (2007)

Blaylock 1993

Three Aerial Surveys in Chesapeake Bay (off Cape Charles)
25 July 1988, 02 August 1988, 09 August 1988

457 ha school (1,129 acres)
1.1 rays per square meter
School Size ~5,000,000 rays



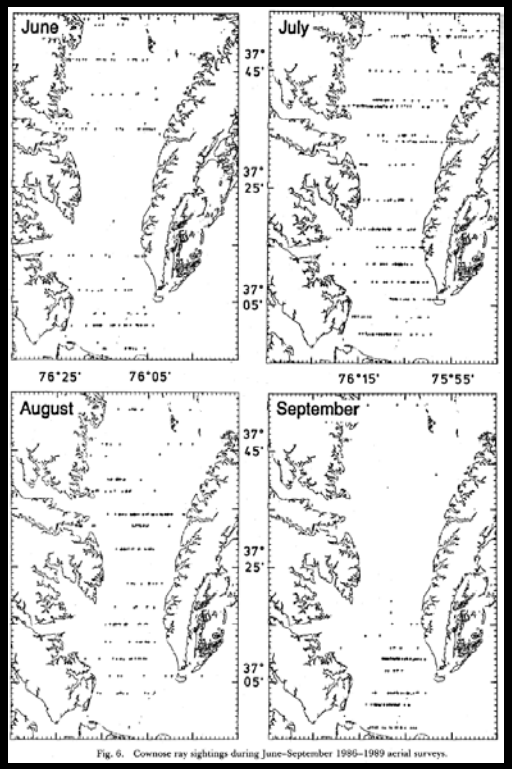


Fig. 6. Cownose ray sightings during June–September 1986–1989 aerial surveys.

The cownose ray population explosion?

Survey	Gear	Years	No. Caught	Inst. Rate
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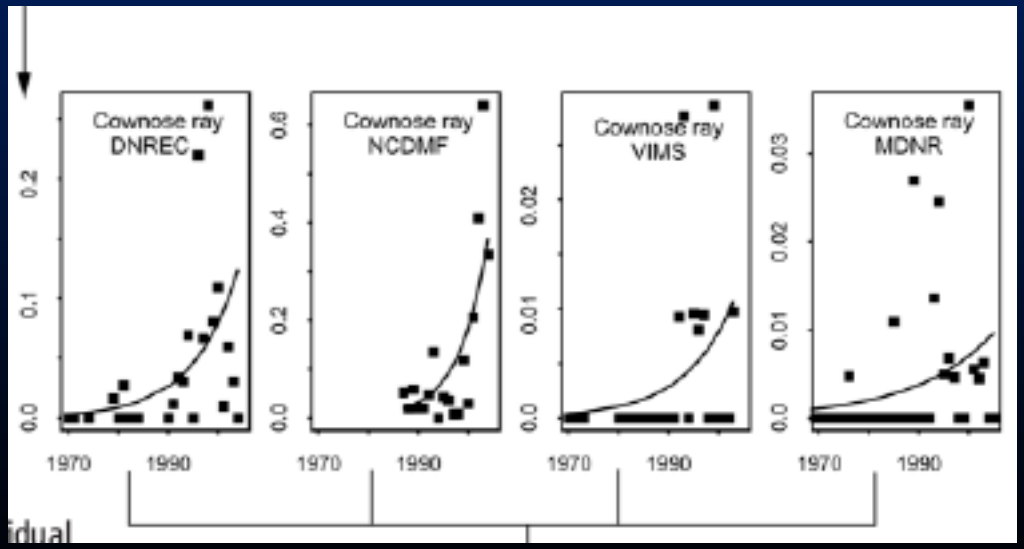
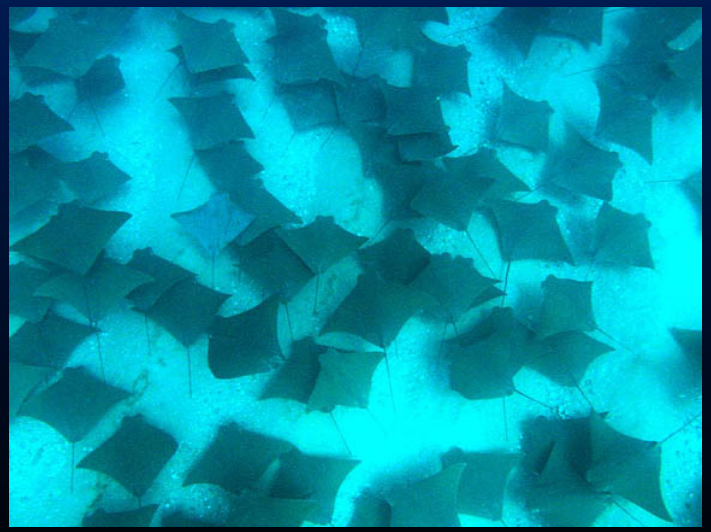




Data from Myers et al. (2007)

C. Cownose ray life history, demographics, and resilience

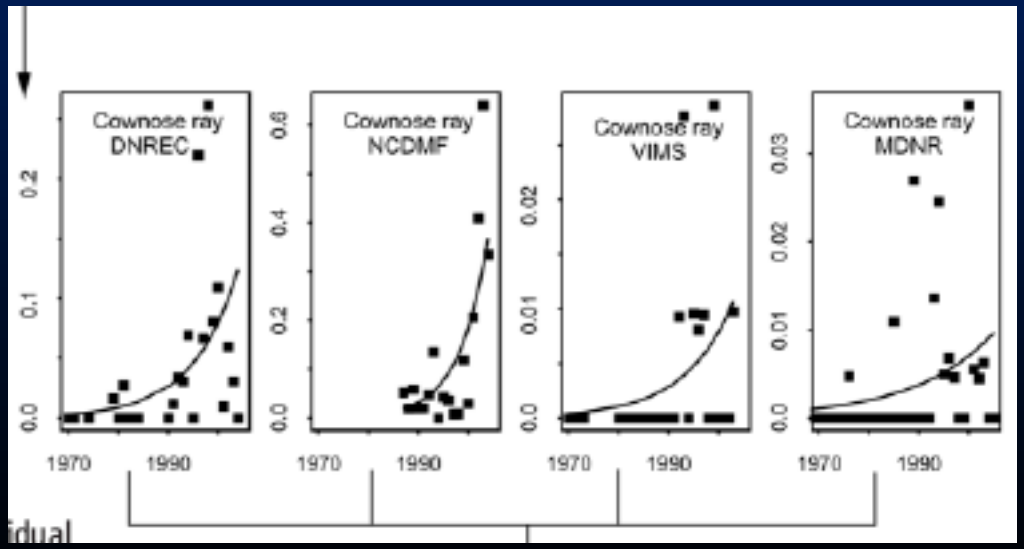
Myers et al. (2007)

Meta-analytical mean r = 8.7%

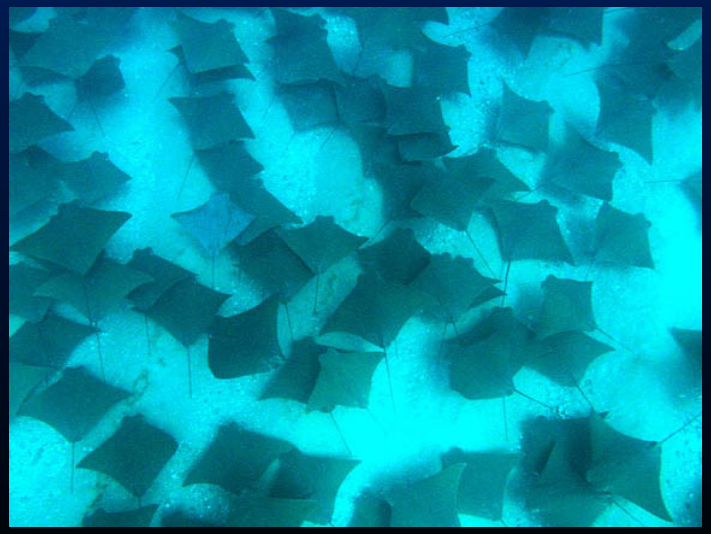
Annual Survival = 92.3%

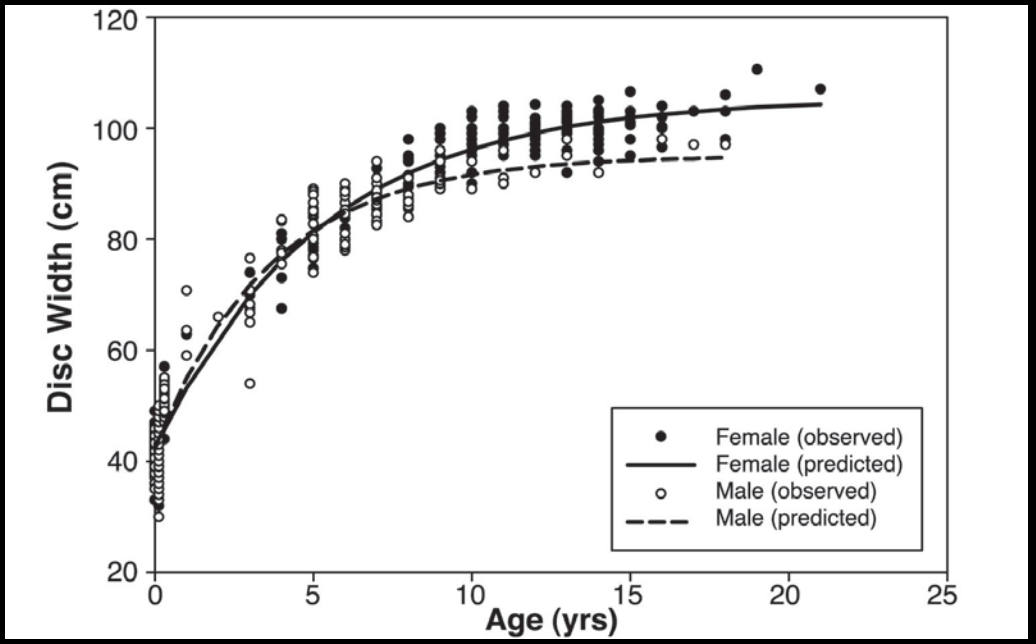
Are these values even possible demographically?

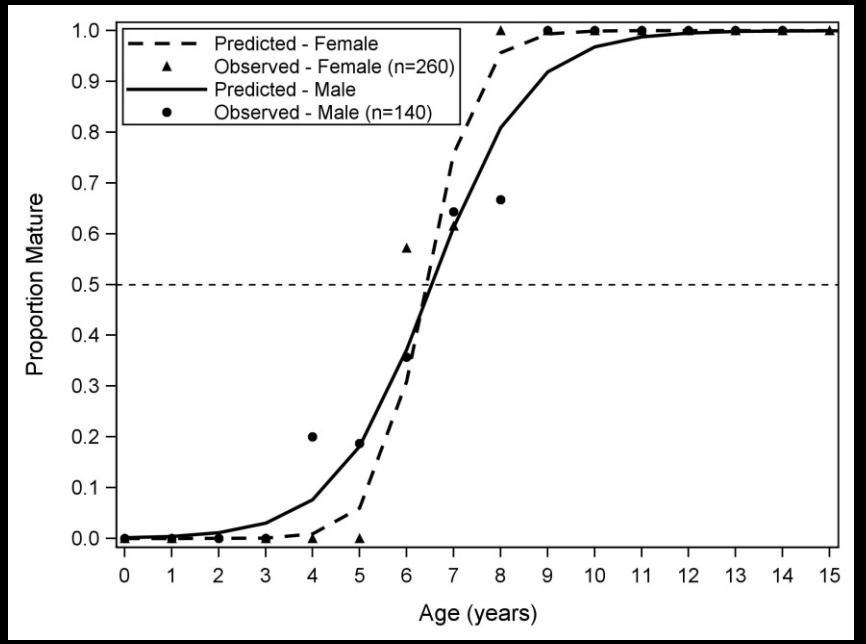
Alternative explanations? Shift in the population distribution rather than a population increase (Frisk et al. 2008, Frisk 2010)?



Data from Myers et al. (2007)

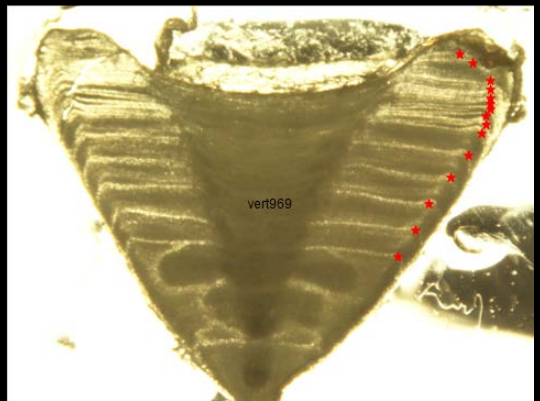






Reference	N (♂)	50% Mat.	K	N (♀)	50% Mat.	K	T_{max}	Region
Fisher, Call & Grubbs (2013)	**217**	**6-7 years**	**0.262**	**319**	**6-7 years**	**0.191**	**21**	**Chesapeake Bay**
Smith & Merriner (1986)	61	5-6 years	0.126	54	7-8 years	0.119	13	Chesapeake Bay

536 vertebral samples
Five growth models applied (modified VBGF best fit)
6-7 years to mature, Max. age ~21 years

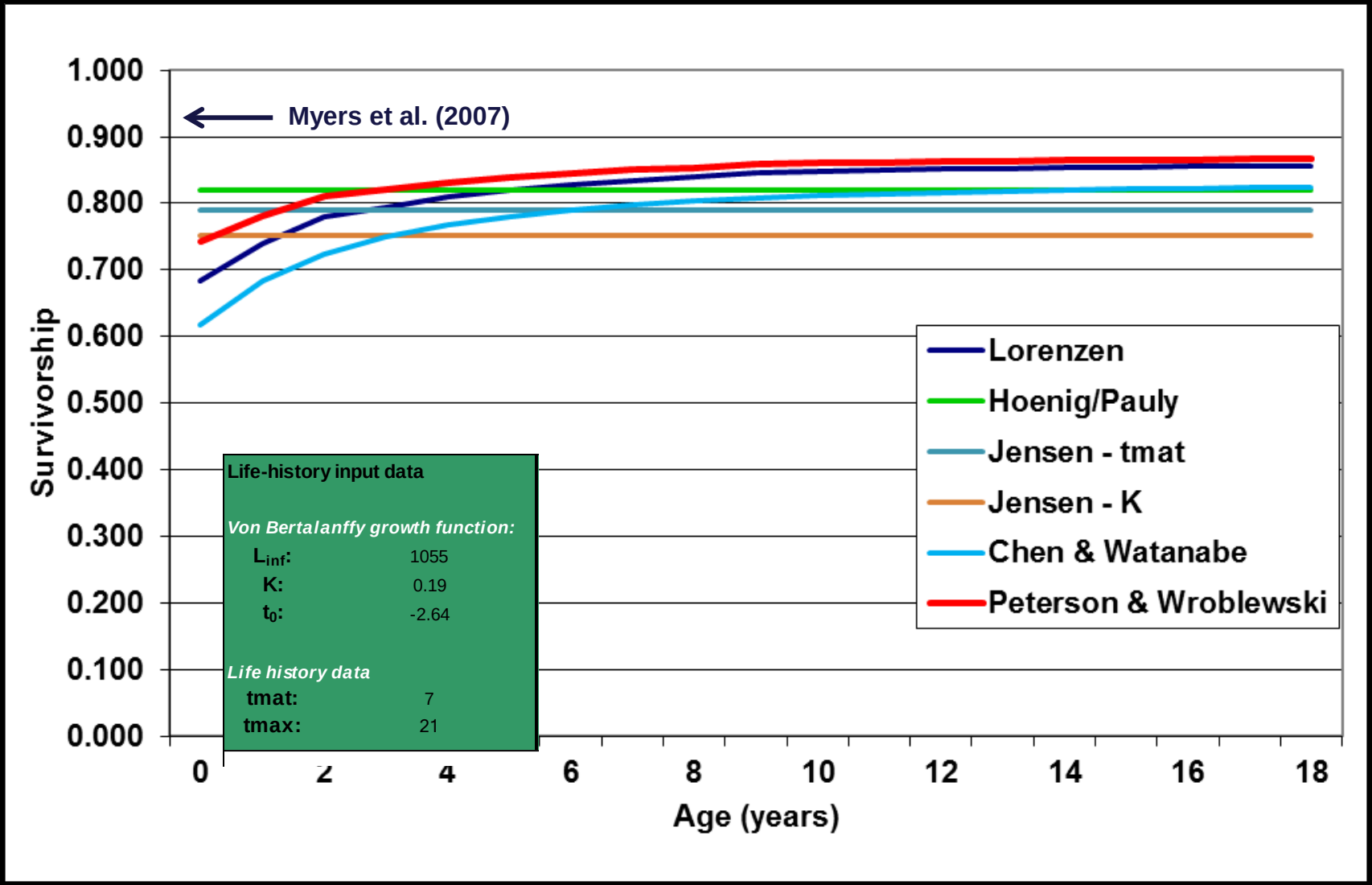


Ovoviviparous
Trophonemata
(lecithotrophy to lipid histotrophy)

Fisher (2010) Examined ~400 term pregnant females. 97.7% single pups, 2.3% produced twins.

Lifetime fecundity:
Cownose rays <15;
Large sharks >100

Estimated Age-specific Cownose Ray Survival



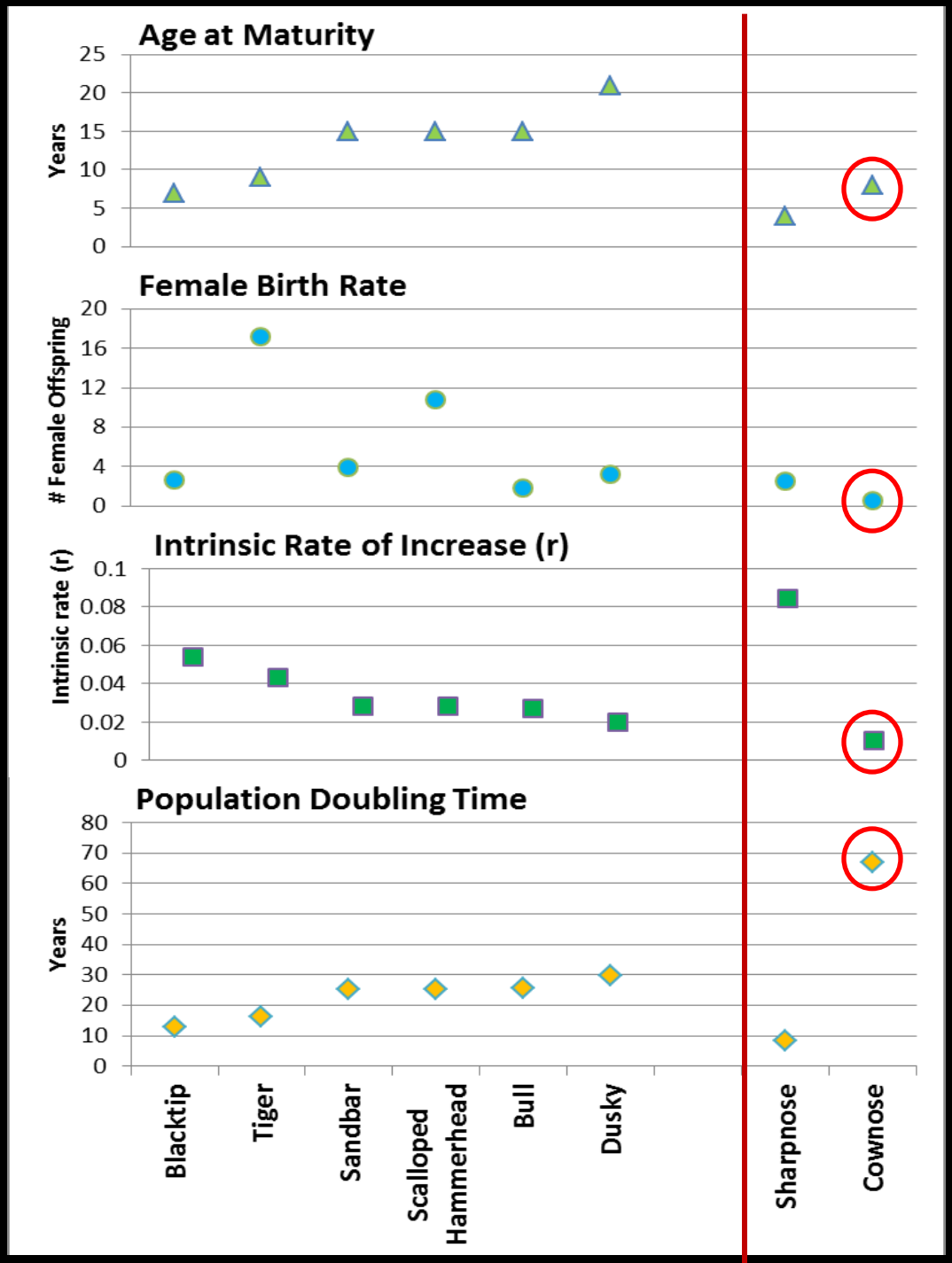
Analysis from John Carlson: All estimates of age-specific survival are well below those required for the purported cownose ray population explosion as suggested by Myers et al. (2007)

Parameter	Value	Standard deviation	Range	Distribution
Age-at-maturity:	a = -12.473 b = 1.945			
Maximum age:	21 years	4.04		Lognormal
Litter size:	1		0.9-1.1	Uniform
Reproductive periodicity	Annual			
Sex ratio	1:1			
Theoretical maximum size (L_∞)	105.34 cm disc width	0.76		
Growth coefficient (k)	0.1931 yr^{-1}	0.008		
Theoretical time at zero length (t_0)	-2.64 yr			
Survivorship:				
Age 0-4	0.83 yr^{-1}		0.62-0.83	Uniform
Age 5	0.84 yr^{-1}		0.78-0.84	Uniform
Age 6-8	0.85 yr^{-1}		0.79-0.85	Uniform
Age 9-15	0.86 yr^{-1}		0.80-0.86	Uniform
Age 16-21	0.87 yr^{-1}		0.82-0.87	Uniform

Analysis by John Carlson in Grubbs et al. (in review)

Grubbs et al. (in review):

Cownose rays Intrinsic rate of increase (r)
Range: -0.018 yr^{-1} to 0.032 yr^{-1}
(median r = 0.008)



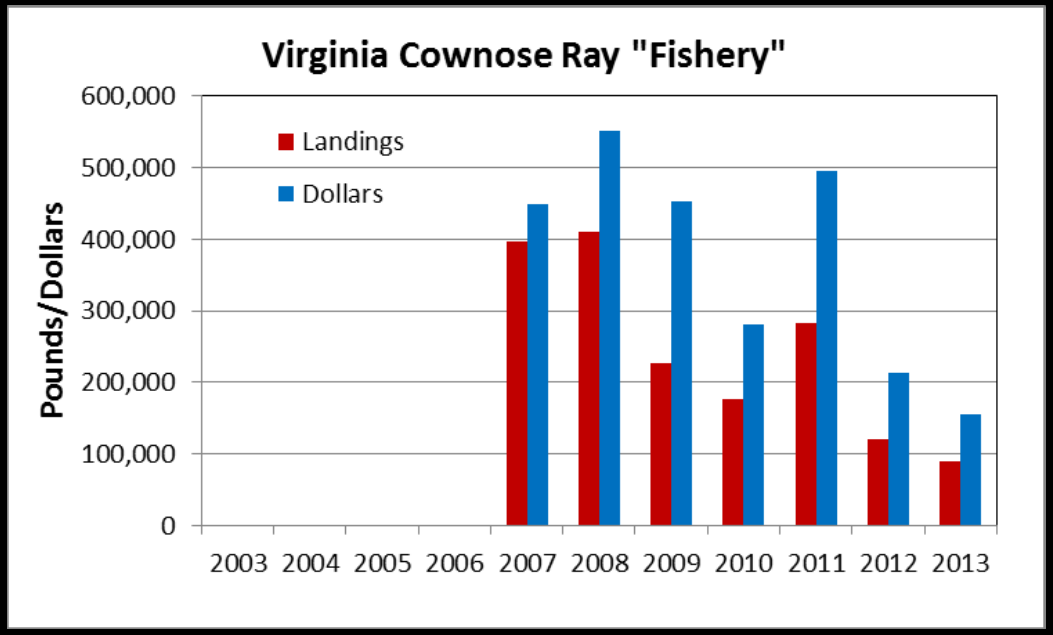
Shark data from Smith et al. (1998)

Grubbs et al. (In review) conducted a meta-analysis of population growth rates (λ) for 38 species of sharks (including sandbar, dusky, and blacktip sharks) and 5 species of skates compared to cownose rays. Cownose rays had the lowest λ values of any chondricthyan species analyzed.

Fishing Mortality recommendations for three large coastal sharks from Federal Stock Assessments

- SEDAR 21 (NOAA)
  - Sandbar shark: $F_{MSY} = 0.021$, $F_{OY} = 0.016$
  - Dusky shark: $F_{MSY} = 0.035$, $F_{OY} = 0.026$
- SEDAR 29 (NOAA)
  - Blacktip shark: $F_{MSY} = 0.084$

Given the low levels of fishing mortality that can be sustained by the large coastal sharks and that the life history of cownose rays likely renders them more susceptible to over-fishing than those sharks, the sustainable fishing mortality for cownose rays is likely very low.



Does not include commercial discards or recreational mortality (e.g. ray derbies)

2008 = 186 MT

Perspective: 168.9 MT = Current Federal quota for all aggregated large coastal sharks (excluding sandbar sharks) harvested in U.S. Atlantic waters combined

Data from Virginia Marine Resources Commission's commercial landings bulletins
http://www.mrc.state.va.us/landings_bulletins.shtm

Wild. Available.
Day boat harvested.

Chesapeake Ray (Rhinoptera bonasus) is a delicious, mild tasting fish caught in the United States along Virginia's Eastern Shore, the Chesapeake Bay and its many tributaries. Ray is a tender, red meat fish offering a "meaty bite".

Captain John Smith dined on ray in 1608. Today, chefs are excited about adding a new fish to the menu and their customers rave about the taste.

For more information contact:
Virginia Marine Products Board, 554 Denbigh Boulevard, Suite B, Newport News, Virginia 23608
Telephone: 757-874-3474, Fax: 757-886-0671, Website: www.virginiaseafood.org

Can Your

Menu

Use Something

Special?

Wild

Day Boat Harvested

Available

Chesapeake Ray

A delicious, mild tasting fish caught Along Virginia's Eastern Shore, The Chesapeake Bay, and its many tributaries
A fish for meat eaters.

A tender, red meat fish with a "meaty bite" and the dining excitement of Wild Game

Customers are raving about the taste!

Chefs are raving about the versatility!

This fish is recipe friendly.

Chesapeake Ray

adapts to most culinary applications.

Broil it, Sauté it

Grill or Pan Sear it,

Pan Fry, Braise, Stew,

or

Fry it

Wild. Available.
Day boat harvested.

Chesapeake Ray (Rhinoptera bonasus) is a delicious, mild tasting fish caught in the United States along Virginia's Eastern Shore, the Chesapeake Bay and its many tributaries. Ray is a tender, red meat fish offering a "meaty bite".

Captain John Smith dined on ray in 1608. Today, chefs are excited about adding a new fish to the menu and their customers rave about the taste.

Ray Fillet

- Resembles tuna with a rich red coloration like No. 1 tuna and has a beef or veal flavor.
- An average fillet is 2 lbs.
- Skinless fillets are packed fresh daily.
- Harvest season – late May until late September.

Fresh Fillet

- Packaged in poly bags in 10 pound increments, chilled to 32°F, surrounded by ice for a long shelf life.

IQF frozen Fillet

- Packed in 15 lb. seafood freezer boxes with each fillet separated by freezer paper, for easy access to individual fillets.
- Available year round

Harvesting

- Ray are harvested by day boats using pound or gill nets.

Preparation

- Chesapeake Ray can be sautéed, grilled, fried, pan seared, steamed or broiled.
- Ray fillet accepts all marinades and sauces.
- Ray should be cooked over high heat for a short duration of time, approximately three minutes on each side to medium well.
- To enhance the tenderness, ray fillets should be cut on a bias or against the grain.

Serving Suggestions

- Serve as you would veal or beef.
- Can be used as an appetizer or entree; or in a sandwich, wrap or soup.
- Delicious when marinated or served with sauces.
- Can also be grounded for stuffing or meat sauces.

For more information contact:
Virginia Marine Products Board, 554 Denbigh Boulevard, Suite B, Newport News, Virginia 23608
Telephone: 757-874-3474, Fax: 757-886-0671, Website: www.virginiaseafood.org

Product Image & Nutrition Facts

CHESAPEAKE RAY FILLET

Nutrition Facts

Serving size 4 oz (112 g)
Servings per container to be specified

Amount Per Serving	
Calories 100	Calories from fat 0
	%Daily Value*
Total Fat 0 g	0 %
Saturated Fat 0 g	0 %
Trans Fat 0 g	
Cholesterol 120 mg	40 %
Sodium 105 mg	4 %
Total Carbohydrate 2 g	1 %
Dietary Fiber 0 g	0 %
Sugars 0 g	
Protein 22 g	
Vitamin A 0 % • Vitamin C 0%	
Calcium 0 % • Iron 10%	

* Percent Daily Values are based on a 2,000 Calorie diet. Your daily values may be higher or lower depending on your Calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate	Less than	300g	375g
Dietary Fiber	Less than	25g	30g

Package Information

CHESAPEAKE RAY SHIPPING CARTON

CHESAPEAKE RAY FILLET, PACKAGED IN SHATTER PACK STYLE BOX FOR EASY FILLET ACCESS.

Product Image

CHESAPEAKE RAY WING

Package Information

CHESAPEAKE RAY SHIPPING CARTON

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Saturated Fat 0 g	0 %
Trans Fat 0 g	
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Sodium 105 mg	4 %
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Dietary Fiber 0 g	0 %
Sugars 0 g	
Protein 22 g	
Vitamin A 0 % • Vitamin C 0%	
Calcium 0 % • Iron 10%	

* Percent Daily Values are based on a 2,000 Calorie diet. Your daily values may be higher or lower depending on your Calorie needs.

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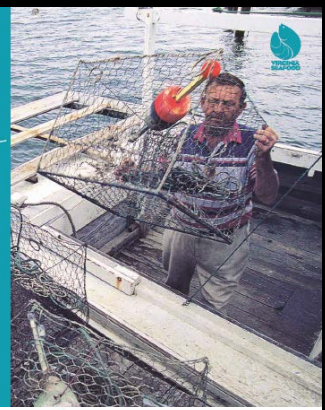

Chesapeake Ray
Bait & Chum

Fresh, frozen Chesapeake Ray (Rhinoptera bonasus) is available year-round from your top quality bait supplier.

Cheapeake Ray is harvested by day boats using pound and gill nets.

Ray is cut fresh then blast frozen, producing quality bait that holds up for a long period of time.

Product Information

CHESAPEAKE RAY BAIT IS CUSTOM CUT TO THE LBS NEEDED.

Package Information

CHESAPEAKE RAY BAIT SHIPPING CARTON

www.virginiaseafood.org/chesray/