

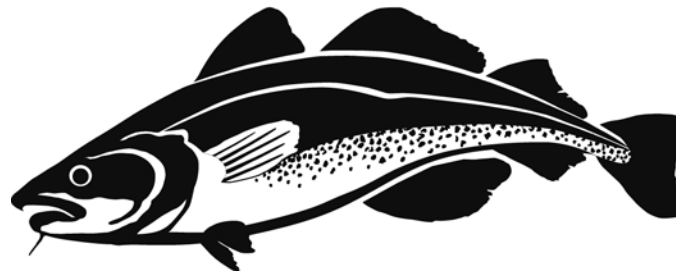
Channeled Whelk Fishery Update

MFAC Business Meeting – June 2018

Bob Glenn

Assessment and Survey Program

Marine Fisheries
Commonwealth of Massachusetts



Emerging Issues

- Status of Conch Fishery
- Channeled whelk stock assessment
- Gauge increase schedule
- Projected impact to fishery from gauge increase



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Fishery Profile

License Trends

Year	2010	2011	2012	2013	2014	2015	2016
Issued	151	147	145	144	143	141	139
Fished	78	84	87	90	83	83	82
Did Not Fish	69	57	54	53	58	56	54
Did Not Report	4	6	4	1	2	2	3

Catch and Value Trends

Year	Live Pounds	Est. Value	Price/lb.
2005	1,354,821	\$1,454,295	\$1.07
2006	2,420,481	\$3,104,430	\$1.28
2007	2,496,497	\$2,466,229	\$0.99
2008	2,701,409	\$3,212,108	\$1.19
2009	2,847,042	\$3,720,139	\$1.31
2010	2,505,855	\$3,961,252	\$1.58
2011	3,042,868	\$6,117,755	\$2.01
2012	3,649,270	\$6,274,224	\$1.72
2013	2,305,408	\$5,699,013	\$2.47
2014	1,921,067	\$4,866,462	\$2.53
2015	1,971,478	\$4,814,498	\$2.44
2016	1,971,153	\$4,876,260	\$2.47
2017	1,280,971**	\$3,683,232	\$2.88

SOURCE: SAFIS Dealer Reports **preliminary estimate

2013: introduced gauge (2 ¾) and dropped the 5% tolerance

2014: increased gauge to 2 7/8"

2015: increased gauge to 3"

2016: No changes

2017: adopted the "any orientation" method and enacted a 2 7/8" gauge (functional gauge increase)

2018: No changes



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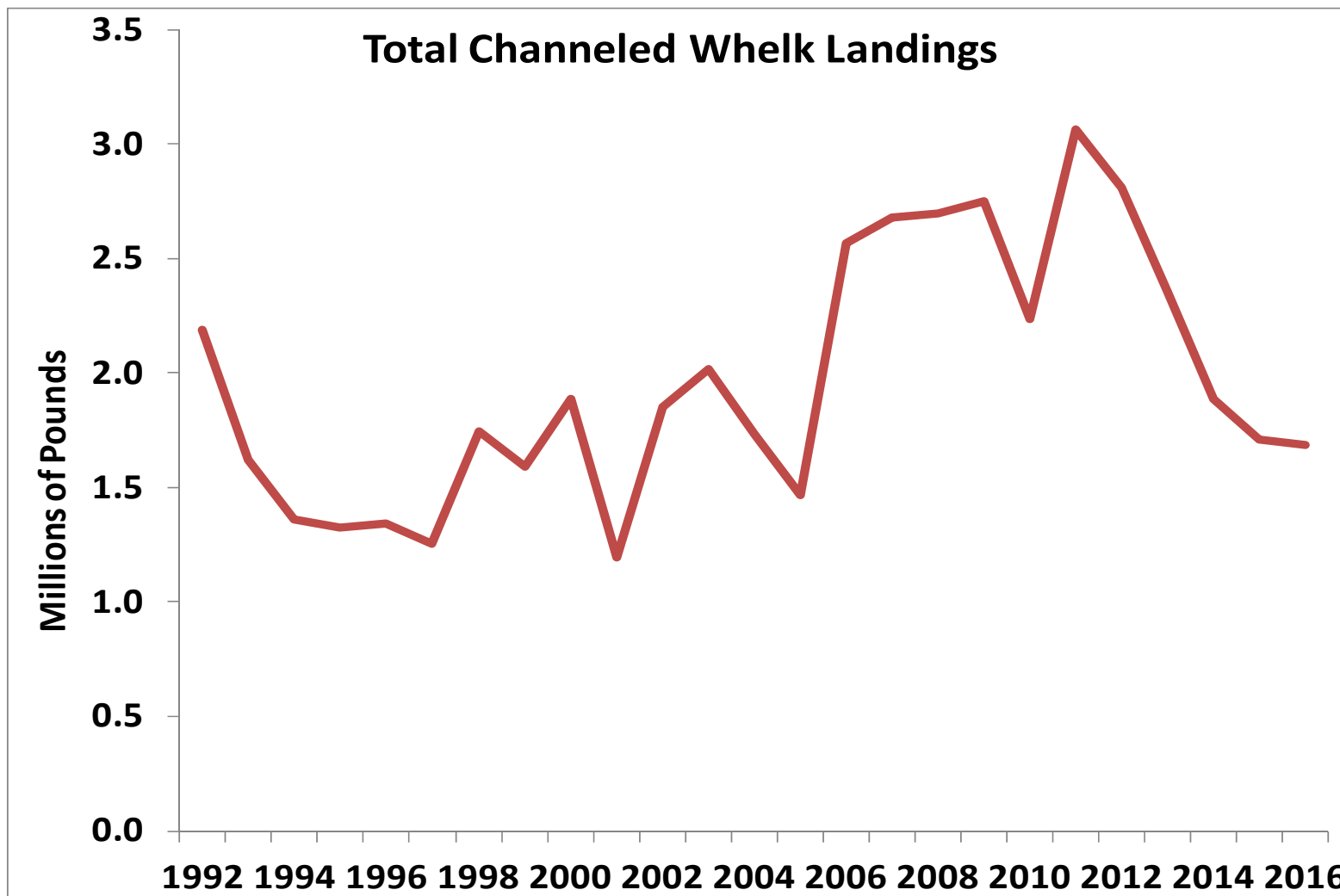
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Fishery Profile



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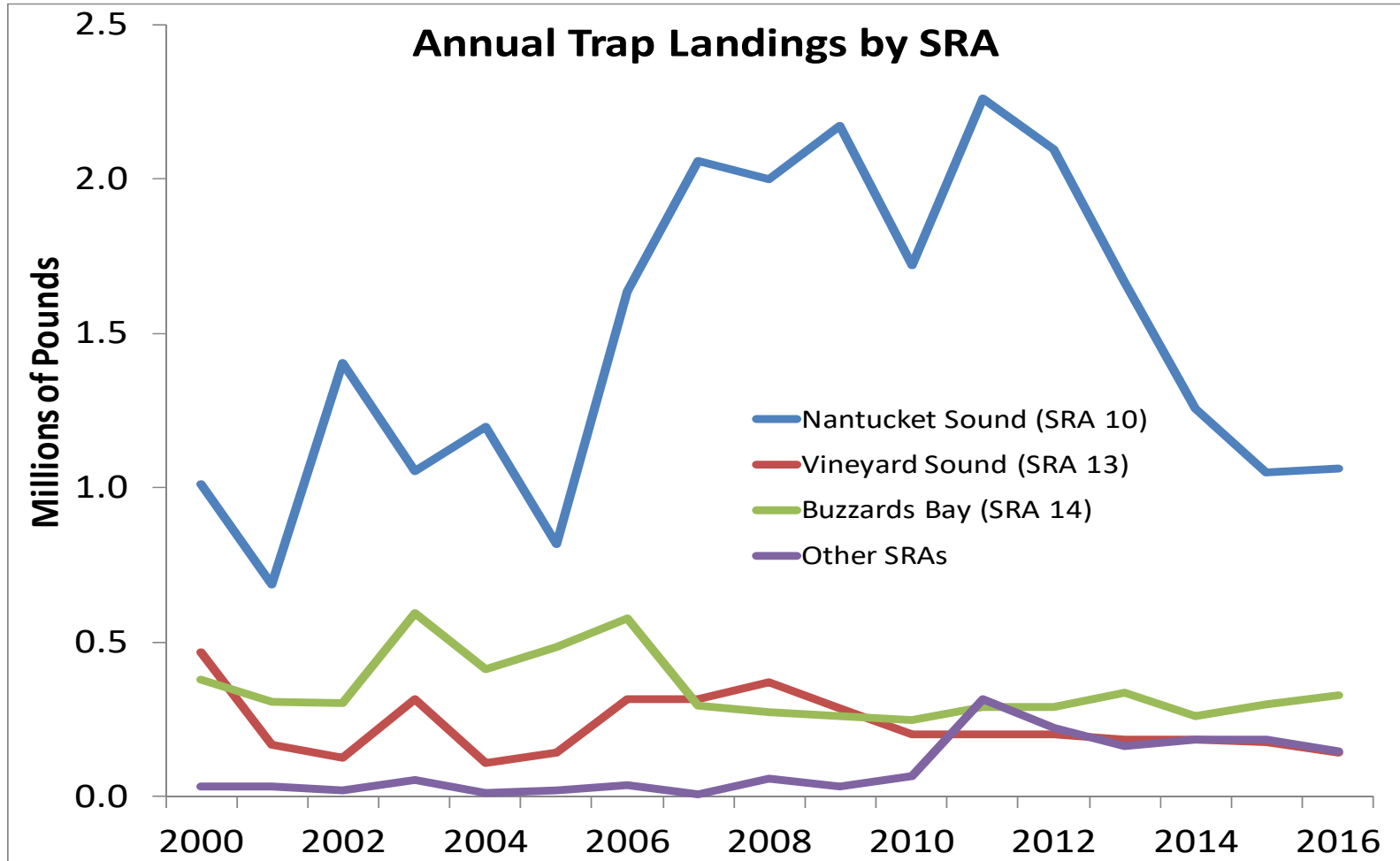
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Fishery Profile



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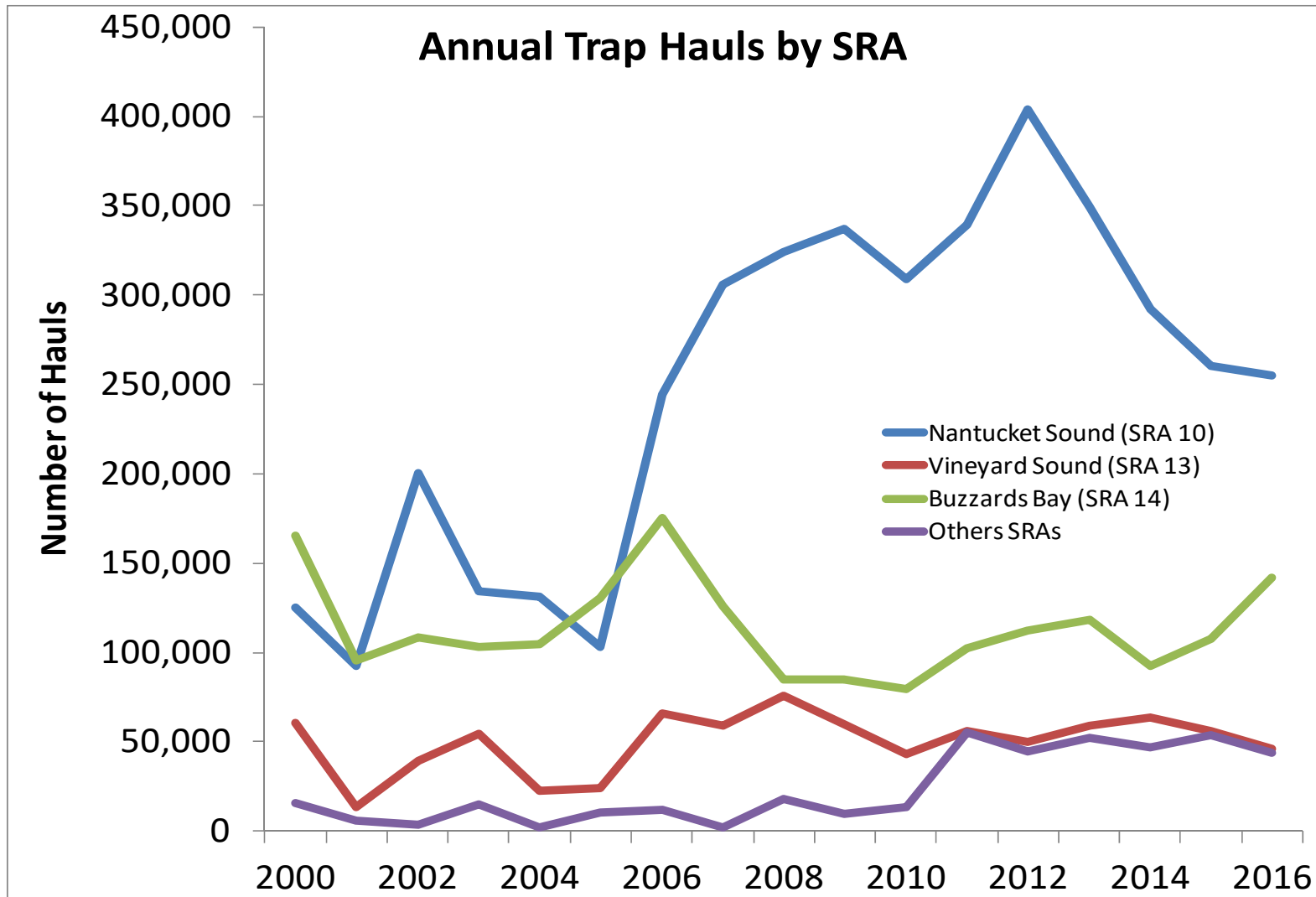
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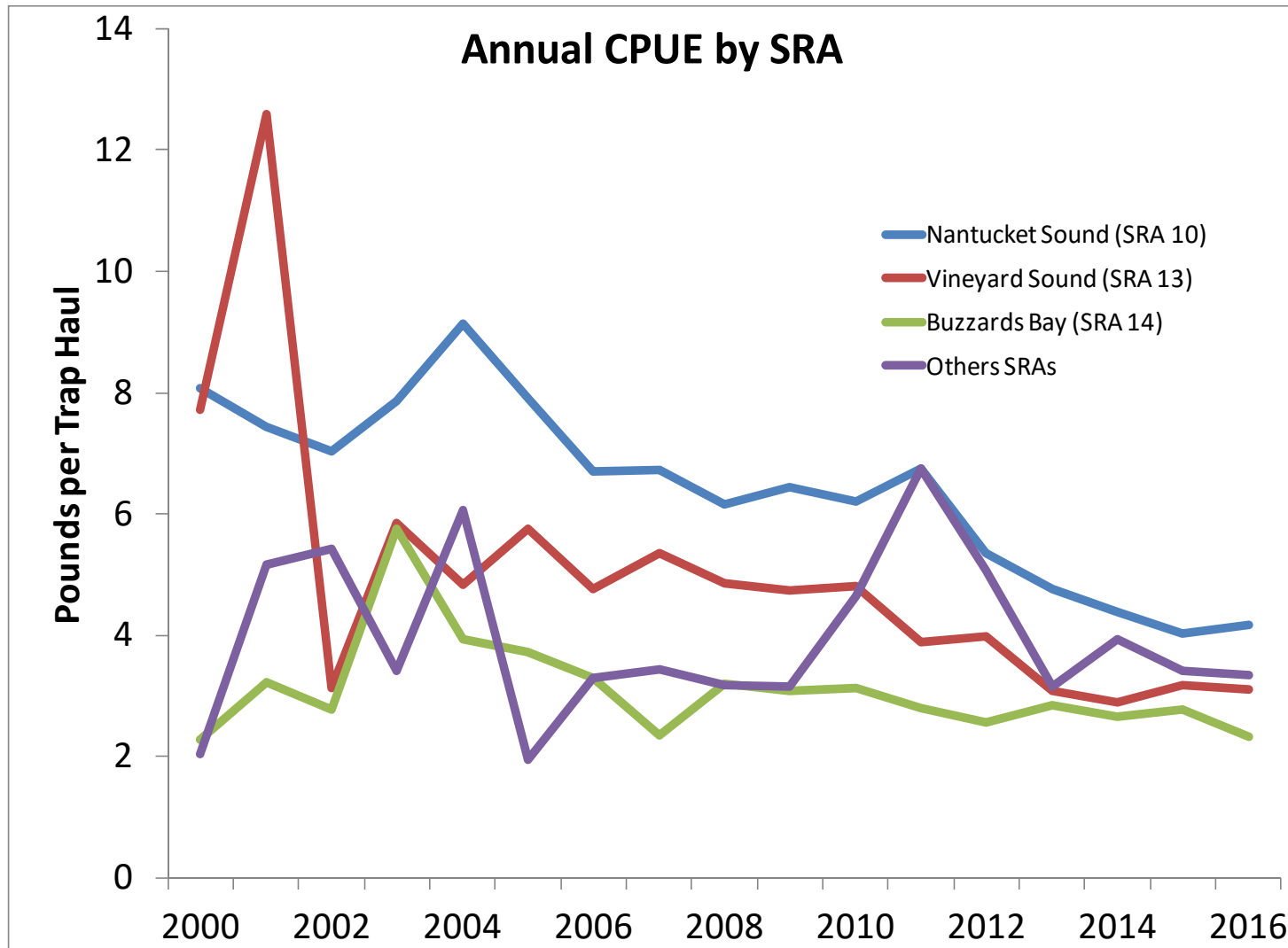
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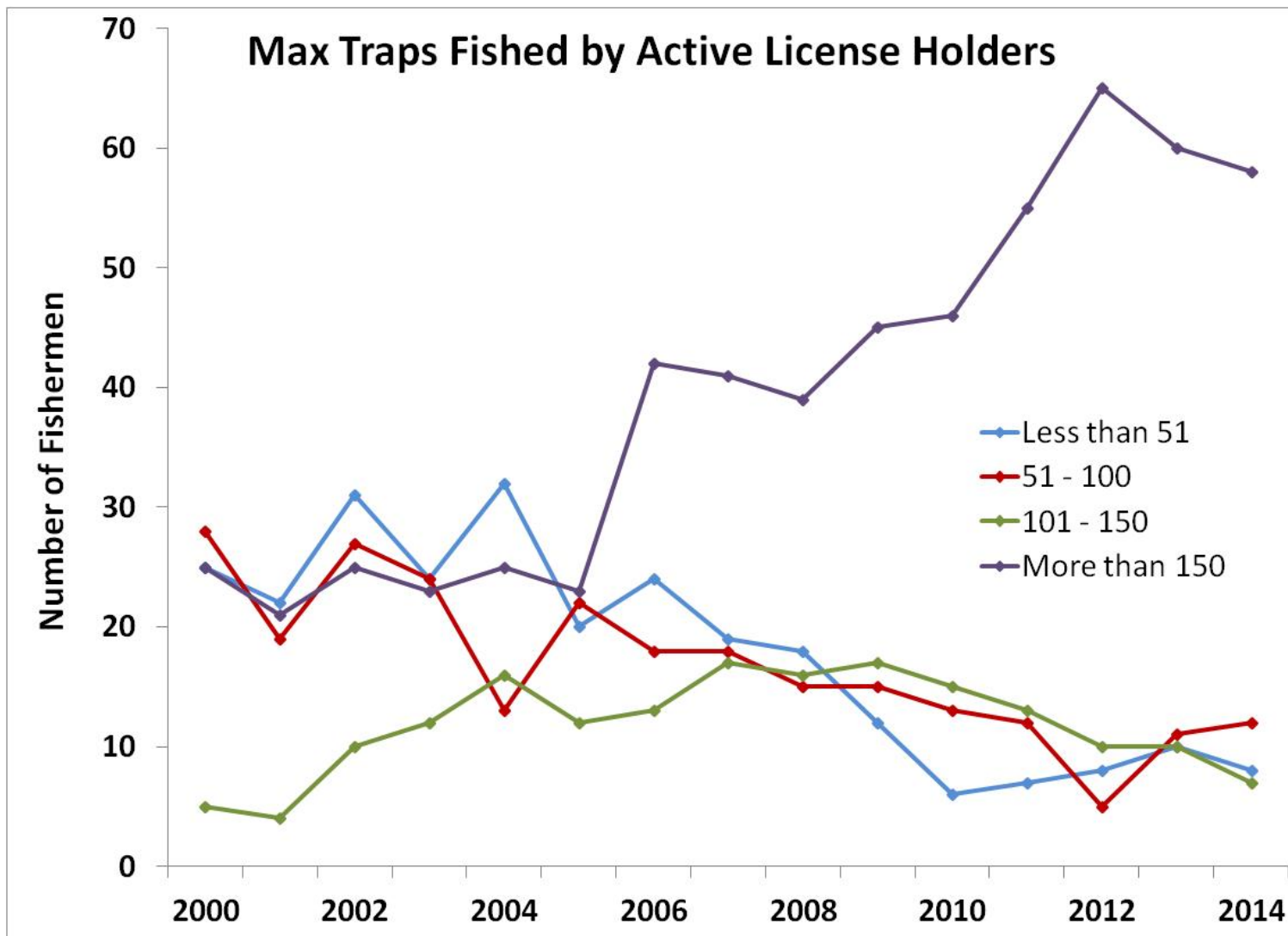
Fishery Profile



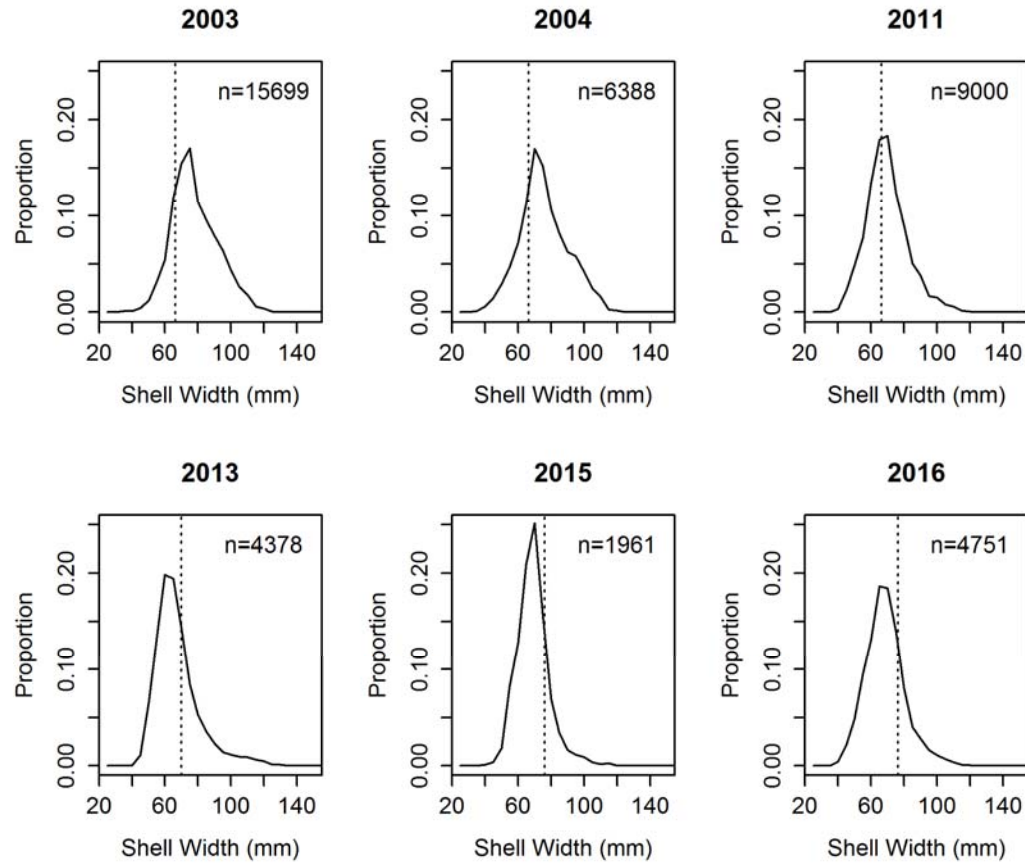
Fishery Profile



Fishery Profile

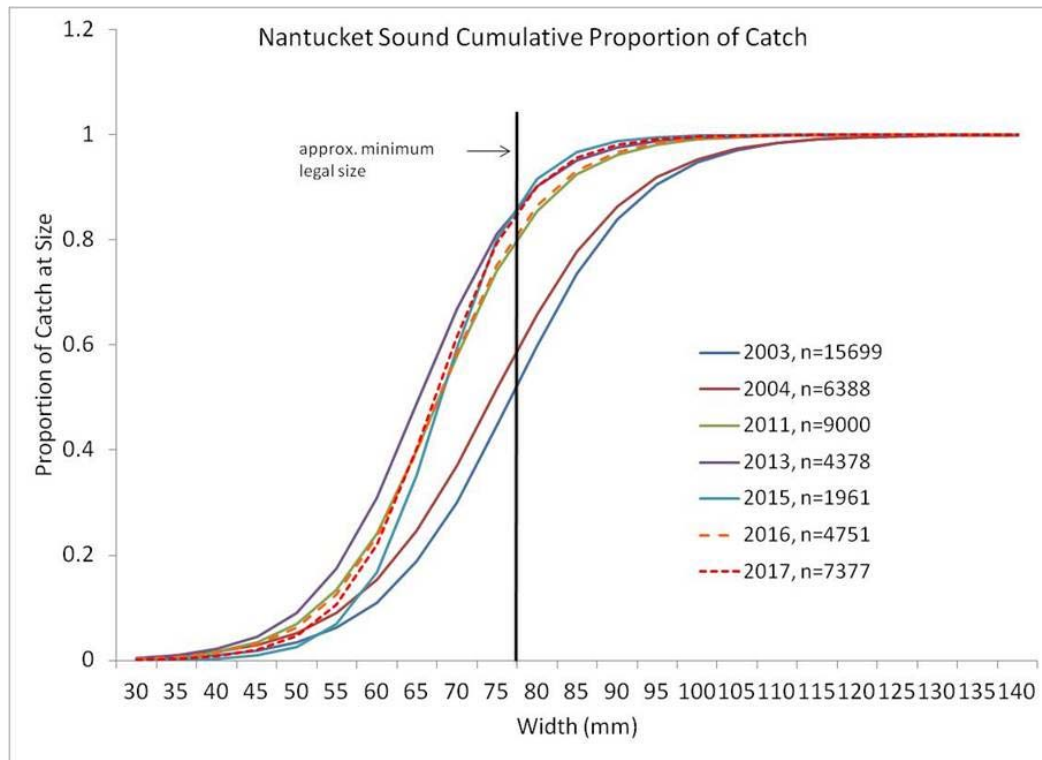


Fishery Profile



Fishery Profile

Sea Sampling Data



- Truncation in size of commercial channelled whelk catch observed in sea sampling data
- Less larger whelk
- In 2017 only 2% of the whelk observed in commercial sea-sampling were above the size at 50% maturity



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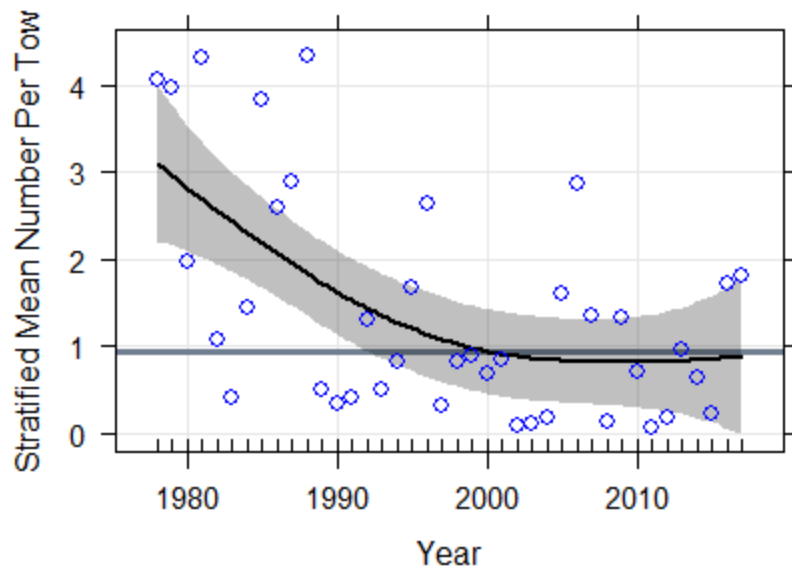
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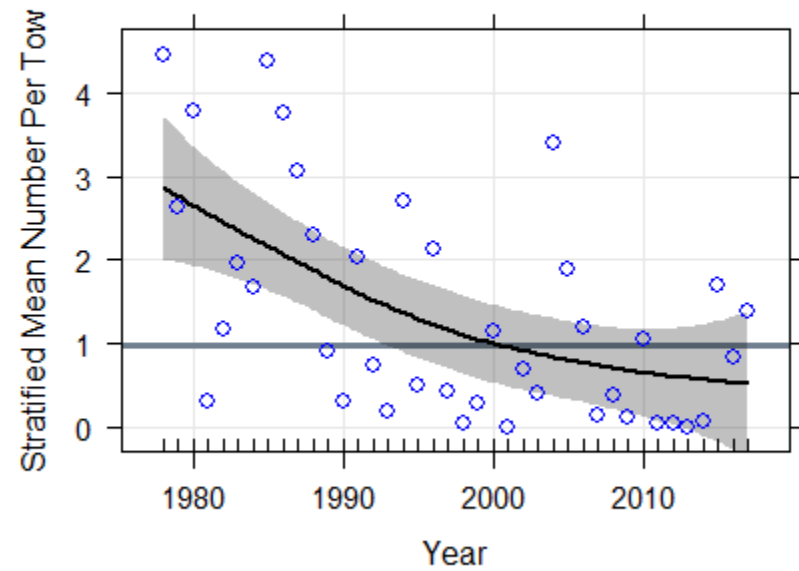
Fishery Independent Data

Channeled Whelk Abundance
MDMF Spring Survey, Regions 1-2
B. Bay/V. Sound/N. Sound/South of MV



Black line: GAM fit.
Grey line: timeseries median.

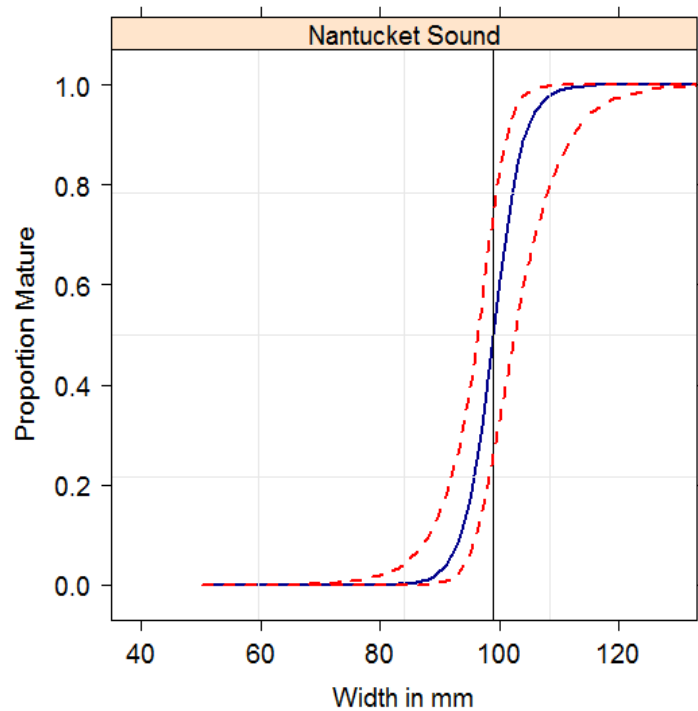
Channeled Whelk Abundance
MDMF Fall Survey, Regions 1-2
B. Bay/V. Sound/N. Sound/South of MV



Black line: GAM fit.
Grey line: timeseries median.



Size at Maturity



- 2010-2011 Nantucket Sound females reach 50% maturity at 3 7/8"
- 2015 preliminary results show no significant changes
- Still no female mature at minimum legal size



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DMF Whelk Stock Assessment

- Whelk are the only species we manage unilaterally
- Historically we have relied on empirical data to manage the fishery
 - Biological data –size at maturity
 - Fishery independent data – trawl survey trends
 - Fishery dependent data – catch, effort, size distribution
- Given the increasing importance of the fishery and the warning signs we have been observing in our data we decided to develop a formal stock assessment
- With help from Dr. Gary Nelson we developed stock assessment for Channeled Whelk



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DMF Whelk Stock Assessment

- Channeled whelk are challenging to assess
 - Somewhat data limited compared to other higher profile species like lobster, scallops, and groundfish
 - Many of the biological parameters like maturity and growth are just being worked out
 - Not many examples of stock assessments of marine snails available in the literature
- Adopted a “shotgun” approach
 - Use multiple methods and compare results to look for agreement
 - Agreement among methods suggests results are robust
 - Disagreement among methods suggest uncertainty in stock status



DMF Whelk Stock Assessment

- Goal
 - Develop estimates of fishing mortality (F)
 - Develop estimates of stock biomass (B)
 - Develop a suite of commonly used reference points to assess stock status



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Stock Assessment Methods

Biomass Based Methods

- Catch MSY
 - Biomass dynamics based model
 - Relies on catch data only
 - Produces MSY estimate
- Depletion-based stock reduction model
 - Biomass dynamics based model (delayed-difference reparameterized Pella-Thompson)
 - Estimates the carrying capacity (K) necessary to have sustained an observed time series of catch resulting in recent stock biomass levels
 - Produces MSY, B_{MSY} , and F_{MSY} estimate
- Non-equilibrium biomass dynamics model
 - Standard biomass dynamics model
 - Uses catch and catch per unit effort data
 - Estimates MSY, F , B , F_{MSY} , and B_{MSY}



Stock Assessment Methods

Abundance-based Methods

- **Catch Curve Analysis**
 - Uses glm to fit a slope of catch at size data to estimate total mortality (z)
 - Natural mortality M is assumed to be 0.16
 - Simple but instructive
- **Delury Model**
 - Depletion model
 - estimates the recruitment and population sizes that must have occurred to produce the observed pattern in catch at size
 - Generates estimates of fishing mortality (F), abundance (A), and Recruitment (R)
- **Statistical catch-at-age model**
 - Age-based and projects the population numbers-at-age forward through time given model estimates of recruitment and age-specific total mortality.
 - Uses catch data and trawl survey data
 - Provides estimates of F , SSB and R



Stock Assessment Methods

Reference Points

- Yield per Recruit Analysis (YPR)
 - Used to estimate F_{\max} and $F_{0.10}$
 - Uses growth and average weight at age parameters
- Spawner per Recruit Analysis (SPR)
 - Used to estimate $F_{40\%}$ (often used as a proxy for F_{MSY})
 - Uses growth, average weight at age, and size at maturity parameters

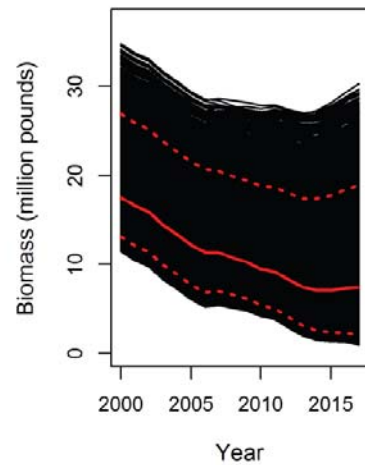


Stock Assessment Results

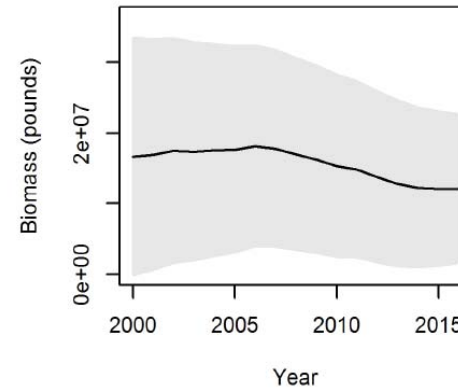
Trends in Biomass and Abundance

DBSRA

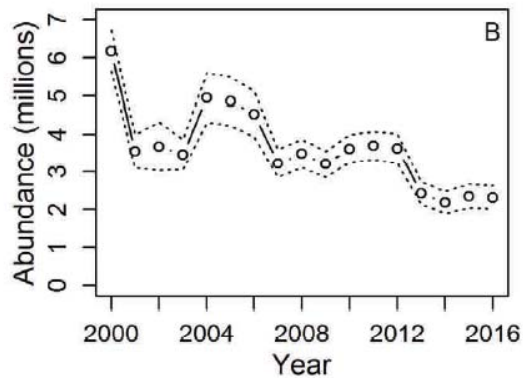
Accepted



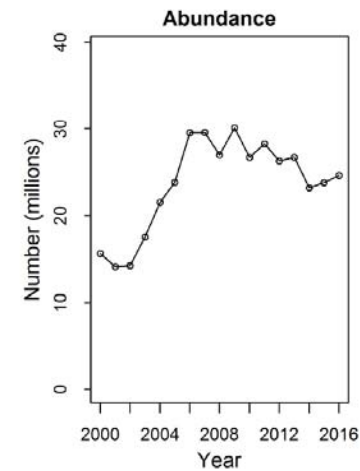
BDM



Delury



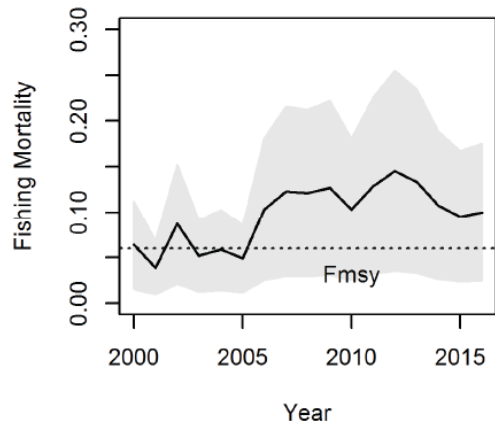
SCA



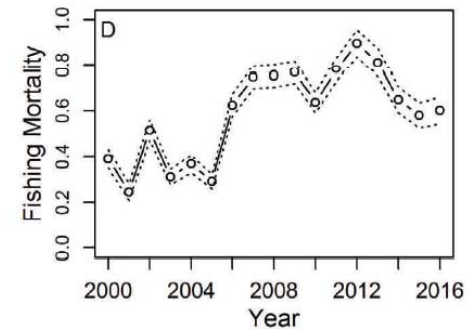
Stock Assessment Results

Trends in Fishing Mortality

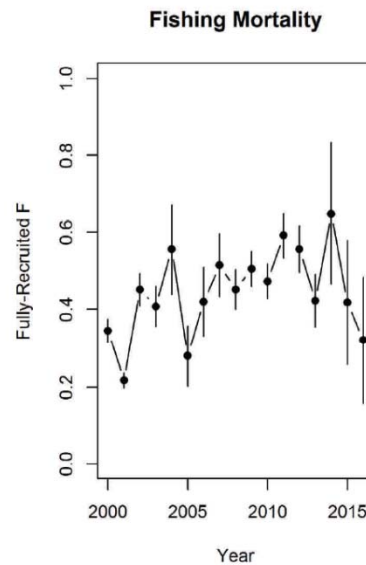
BDM



Delury



SCA



Stock Status

Biomass-Based Management Metrics

Method	Parameter	Value	2016 Estimate	Overfishing Occuring	Stock Overfished
Catch MSY	MSY	1,200,000	1,971,153	Y	
	B _{MSY}	21,900,000	5,726,235		Y
	F _{MSY}	0.07	0.19	Y	
Depletion-Based Stock Reduction Analysis	MSY	1,600,000	1,971,153	Y	
	B _{MSY}	20,800,000	6,178,509		Y
	F _{MSY}	0.09	0.17	Y	
Biomass Dynamics	MSY	1,300,000	1,971,153	Y	
	B _{MSY}	21,400,000	12,157,546		Y
	F _{MSY}	0.06	0.10	Y	



Stock Status

Number-Based (F) Management Metrics

Method	Reference Point	Value
YPR	F_{\max}	0.23
	$F_{0.10}$	0.14
SPR	$F_{40\%}$ (FMSY proxy)	0.09

Method	F_{Terminal}	$>F_{\max}$	$>F_{0.10}$	$>F_{40\%}$ (FMSY proxy)
Catch Curve	0.58	Y	Y	Y
Delury	0.60	Y	Y	Y
SCA	0.32	Y	Y	Y



Summary

- At current minimum legal size no female whelk are mature
- Life history traits make them especially prone to depletion
- Trawl survey trends – declining
- Rapid escalation of catch and effort
- Truncation of size of commercial catch
- Biomass is declining and below B_{MSY} = Overfished
- Fishing mortality is increasing and above F_{MSY} = Overfishing
- Stock is in poor condition



Next Steps

- Gauge Increase Schedule
 - 2017 – method of measurement changed to “any-orientation” method using a $2\frac{7}{8}$ ” chute gauge
 - 2018 – no changes
 - 2019 – scheduled to increase chute gauge size to correspond with $1\frac{1}{8}$ ” minimum size increase



Estimate of percentage of keepers by weight for next three 1/16" gauge increases compared to current gauge size.

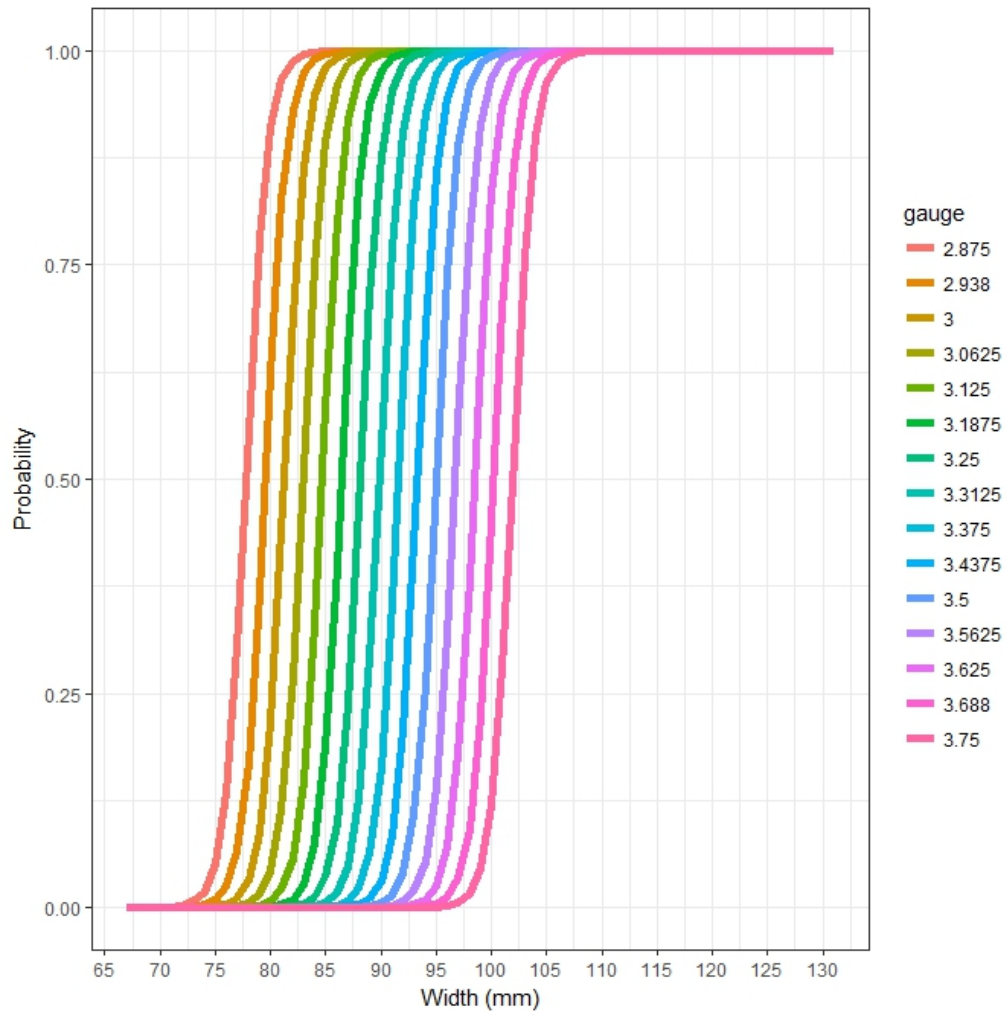
Gauge size	2 7/8"	2 15/16"	3"	3 1/16"
Percentage keepers by weight	100%	85%	73%	63%
Percentage lost by weight	0%	15%	27%	37%

- N= 1487 whelk measured using all gauges
- Used 2017 sea sample data from Nantucket and Vineyard Sound N= 7,377
- Weight used from weight at width curve generated from maturity data N= 789

Gauge sizes in 1/16" increments and the whelk size at which 50% are legal.													
Gauge Size (inches)	2 7/8	2 15/16	3	3 1/16	3 1/8	3 3/16	3 1/4	3 5/16	3 3/8	3 7/16	3 1/2	3 9/16	3 5/8
Size at 50% legal	3 1/16	3 1/8	3 3/16	3 1/4	3 5/16	3 3/8	3 7/16	3 1/2	3 5/8	3 11/16	3 3/4	3 13/16	3 7/8

- Based on measurement of 1487 channeled whelk this is the size at which 50% of whelk are legal at each 1/16" gauge increment.
- The size at which 50% will be legal is most similar to the size at which 50% of females will be mature at a gauge size of 3 5/8".





-proportion of keepers at size for 15 different gauges in 1/16" increments

- 99mm is the size at which 50% of females are sexually mature



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Questions?



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