

# **An Assessment of Sea Scallop Abundance and Distribution in the Mid-Atlantic Bight, Nantucket Lightship Closed Area and Closed Area II**

**David B. Rudders**

**Sally Roman**

**Hunter Tipton**

**Jennifer Anders**

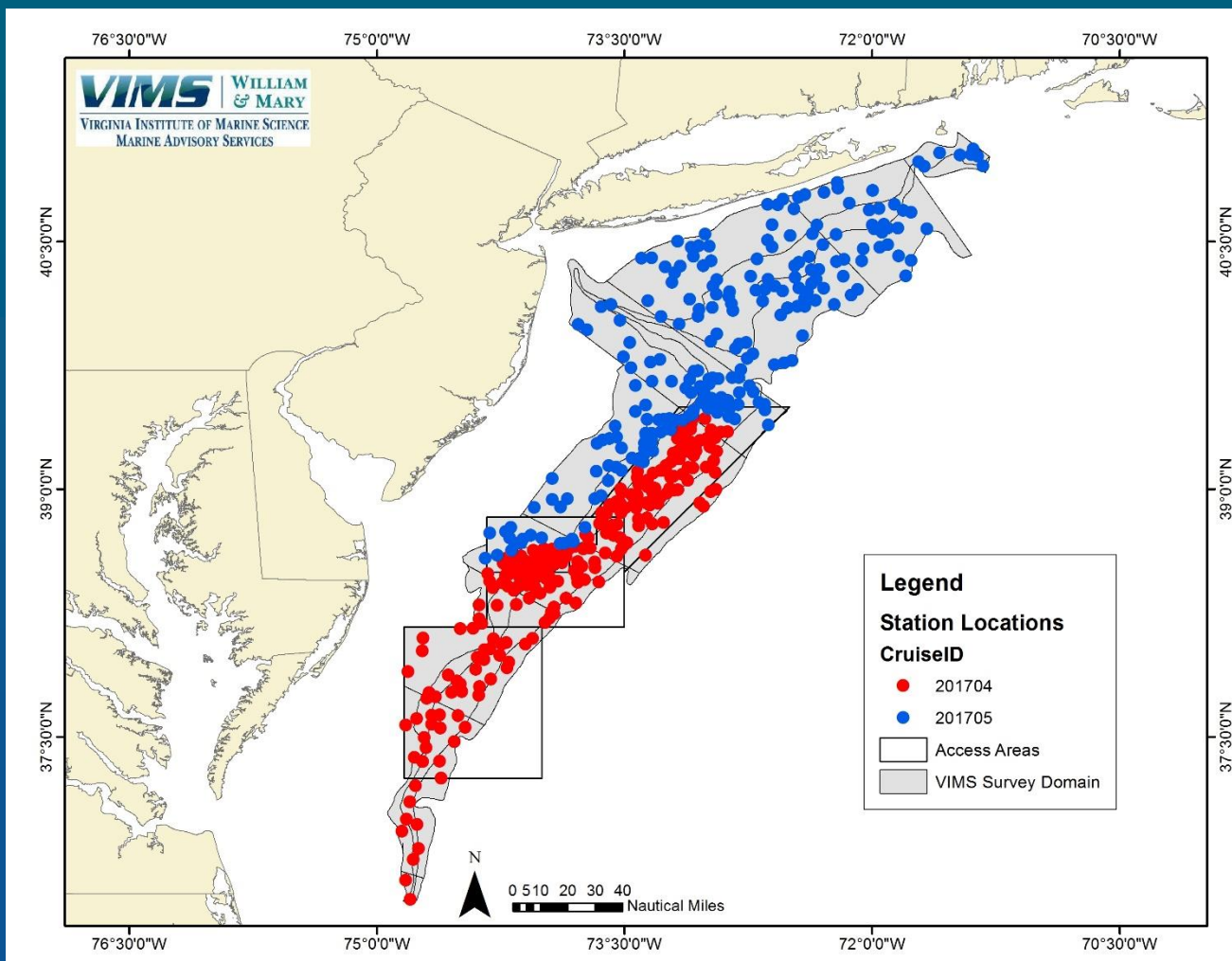
**Virginia Institute of Marine Science**

**Sea Scallop Plan Development Team**

**Falmouth, MA**

**August 29-30, 2017**

# 2017 VIMS-Industry Cooperative Surveys Mid-Atlantic Bight



## First Leg

- F/V Seahawk
- 5/8/17 - 5/18/17
- 219 Stations

## Second Leg

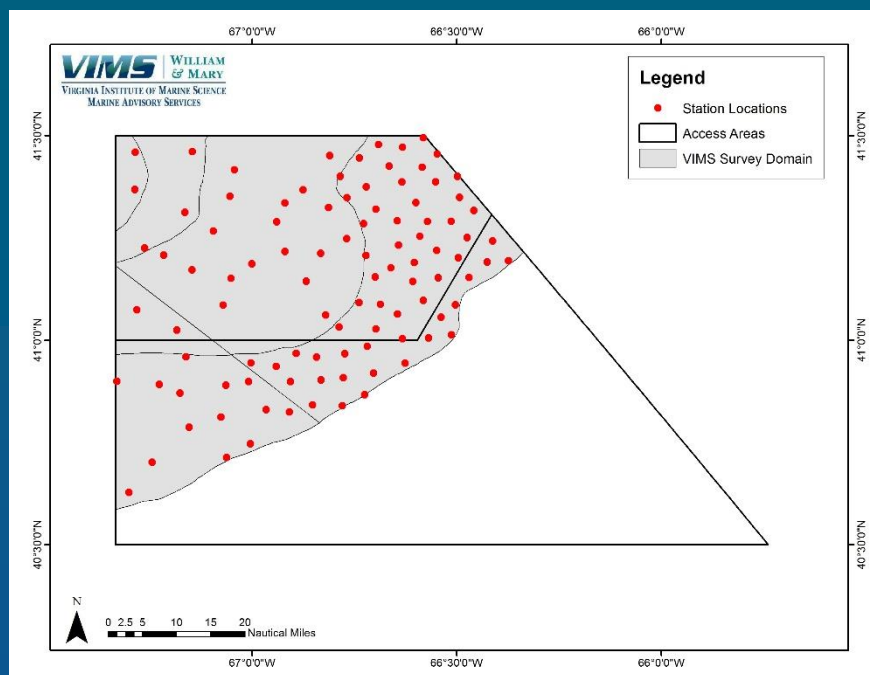
- F/V Carolina  
Capes II
- 5/22/17 - 6/1/17
- 221 Stations

## Total

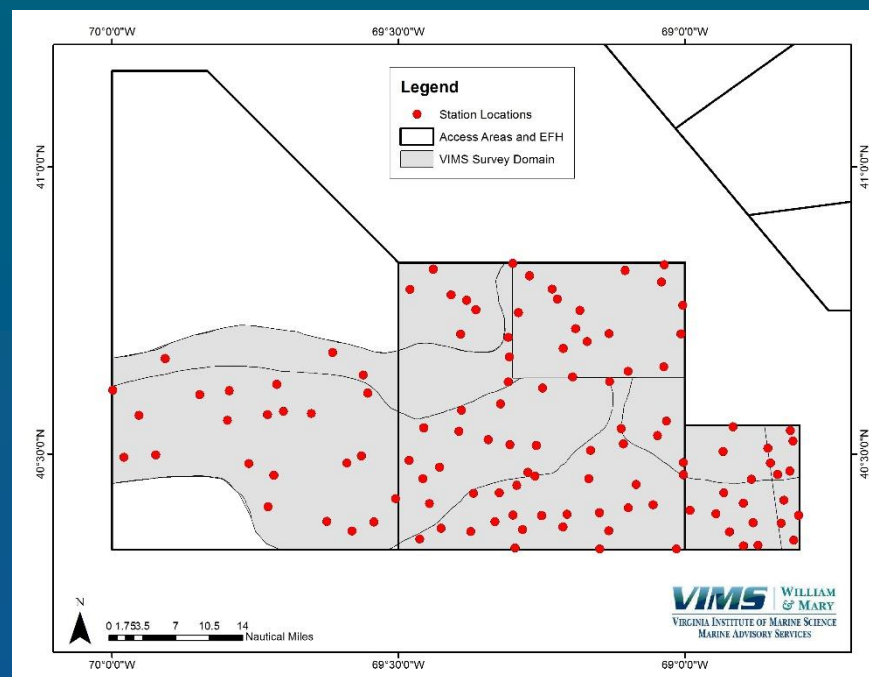
- 440 Stations

# 2017 VIMS-Industry Cooperative Surveys

## CA II and NLCA



- F/V Flavian S
- 6/16 - 6/24/17
- 100 Stations



- F/V Celtic
- 7/27 - 8/3/17
- 115 Stations

## 2017 VIMS-Industry Cooperative Surveys Project Objectives

### Primary Objectives

- Assess the abundance and distribution of scallops in the Mid-Atlantic Bight, NLCA and CAII by SAMS Area.
- Estimate exploitable biomass.
  - Biomass of scallops available for capture with 4 inch ring commercial dredge.

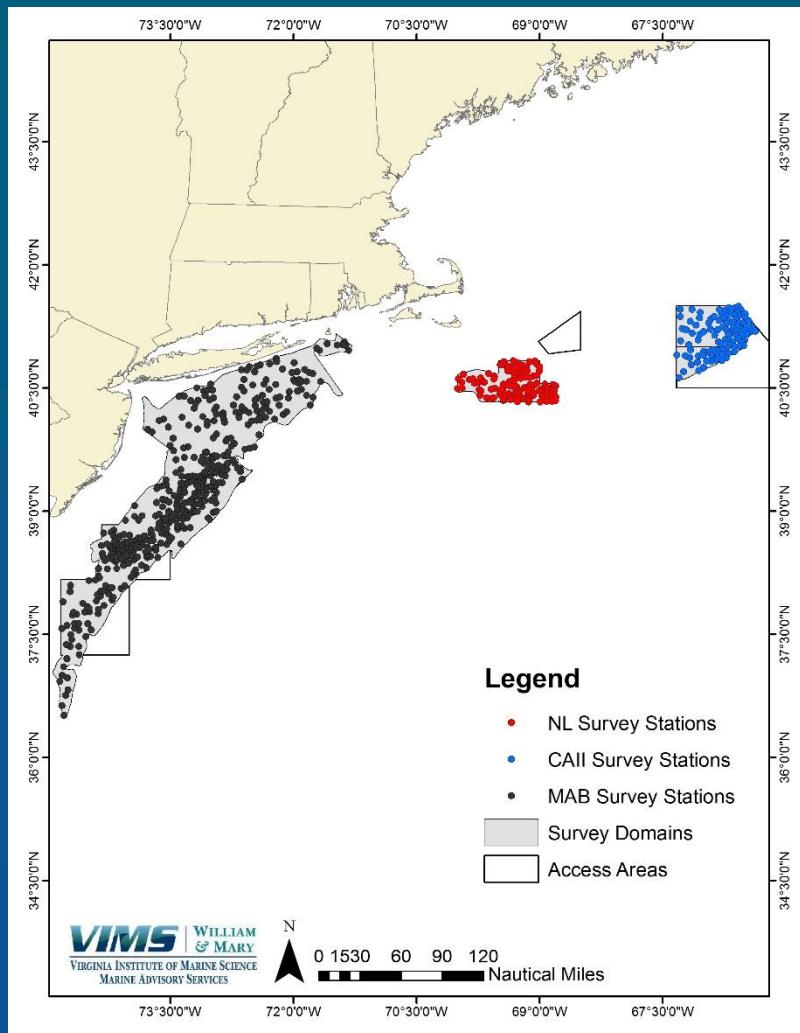


### Secondary Objectives

- Gear performance
- Scallop Biology & Product Quality
- Finfish Bycatch
- Scallop Predators



# 2017 VIMS-Industry Cooperative Surveys



- Sampling design
  - Stratified random design
  - NMFS shellfish strata plus
  - Allocation
    - Area, prior year catch data (biomass, number)
- Automated Data acquisition system
  - Electronic boards (1mm res.)
  - Custom front end to Access DB
  - Integrated with Marel scale
  - Automated recording of wheel house data
- All other protocols remained the same (see scallop survey peer review materials for details)

# 2017 VIMS-Industry Cooperative Surveys Analytical Framework

- **Area swept per tow**
  - Navigational info
  - Tilt sensor
- **Catch weight per tow (stratified means and variances)**
  - Length frequencies
  - Length-weight relationship (for this analysis regional SARC 59).
  - Selectivity (Yochum and DuPaul, 2008)

- **Efficiency (constant)**
  - Values from SARC 2014
    - 65% Commercial Dredge
    - 40% NMFS Survey Dredge

$$TotalBiomass = \sum_j \left( \frac{\left( \frac{CatchWtperTowinSubarea_j}{AreaSweptperTow} \right)}{Efficiency} \right) SubArea_j$$

- **Exploitable Biomass**
  - Selectivity curve applied to catch for both the survey and commercial dredges (Yochum and DuPaul, 2008)
- **SHMW**
  - SARC estimates for MAB and CA II
  - Area-specific VIMS 2016/17 combined estimates for NL\_S, NL\_ext and NL\_NA. SARC estimates for NL\_N.

# 2017 VIMS-Industry Cooperative Surveys

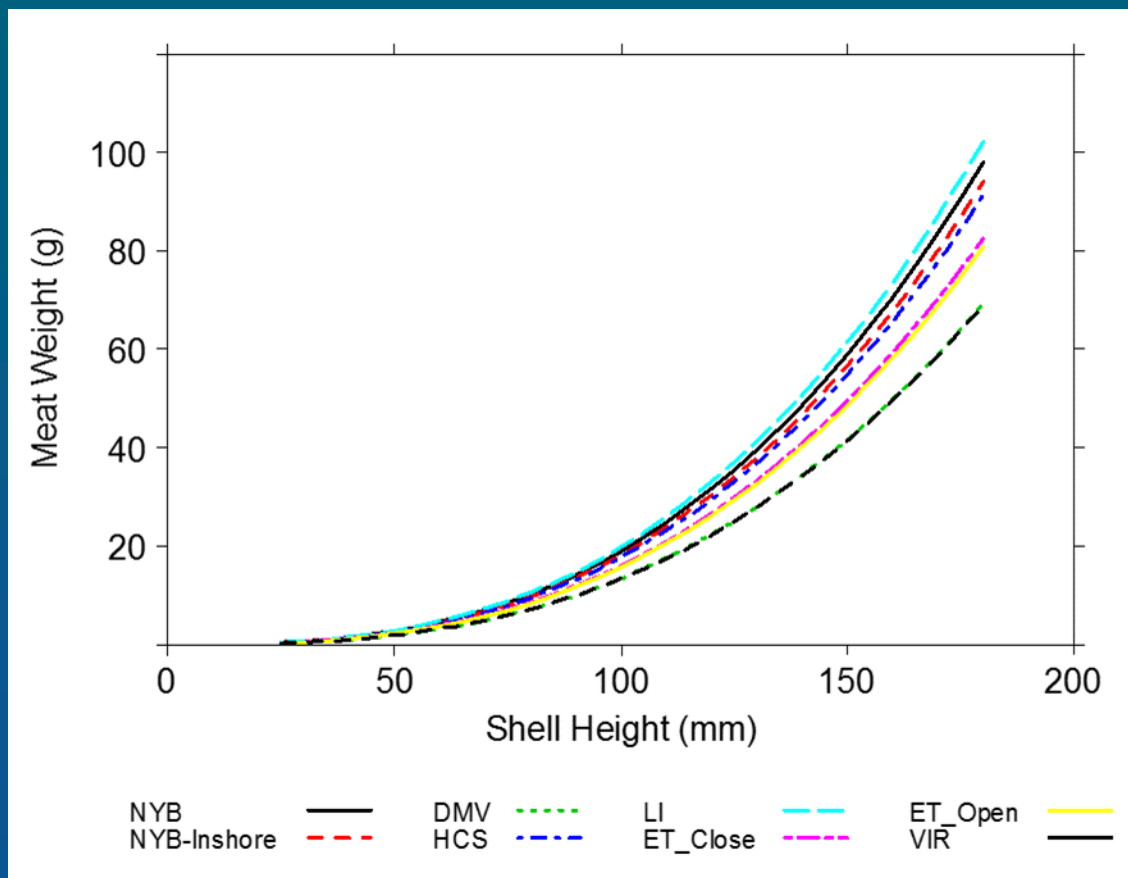
## SH:MW Relationship

- SH:MW samples were taken from all stations that had scallops (15/station):
  - MAB Survey: ~5,500
  - NLCA and CA II Surveys: ~1,000/survey
- The objective is to construct a model to predict meat weight based on a suite of potential covariates (i.e. shell height, depth, SAMS area, sex, disease...).
- Average depth was calculated for each tow from tilt sensor
- A GLMM was used to fit model (Gamma distribution, log link, random effect at the station level) with R v 3.3.1 Package lme4.



# 2017 VIMS-Industry Cooperative MAB Survey

## SH:MW Results



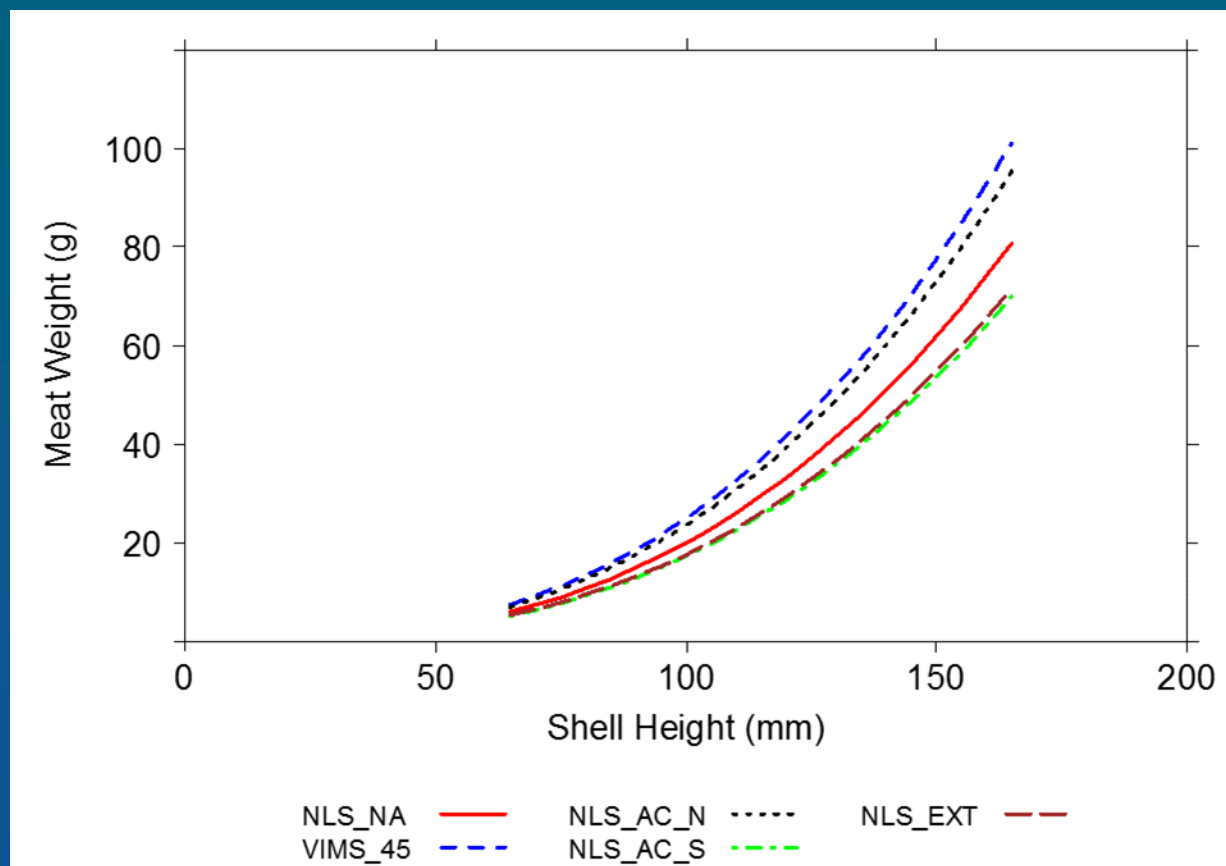
- Significantly different relationships between some SAMS Areas.

- Likely a function of average depths for each of subarea, as well as the temporal spread of the sampling



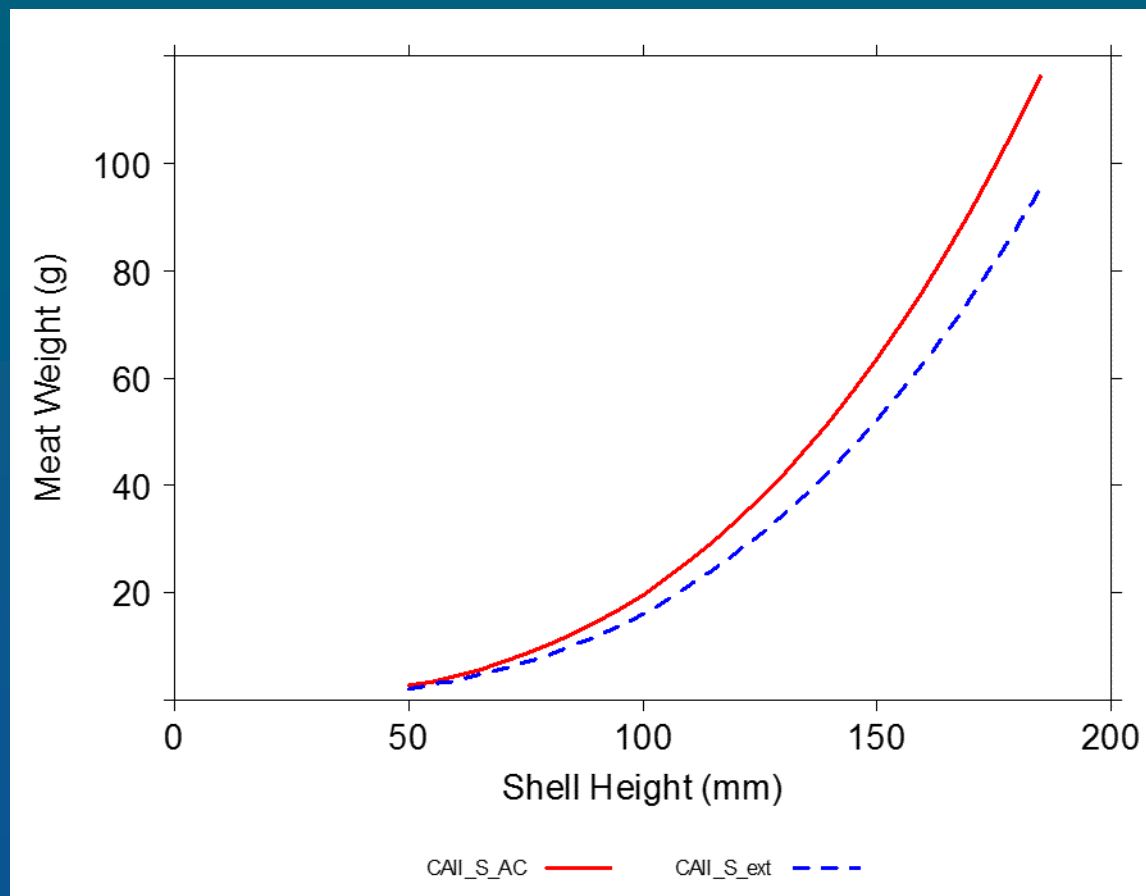
# 2017 VIMS-Industry Cooperative NLCA Survey

## SH:MW Results



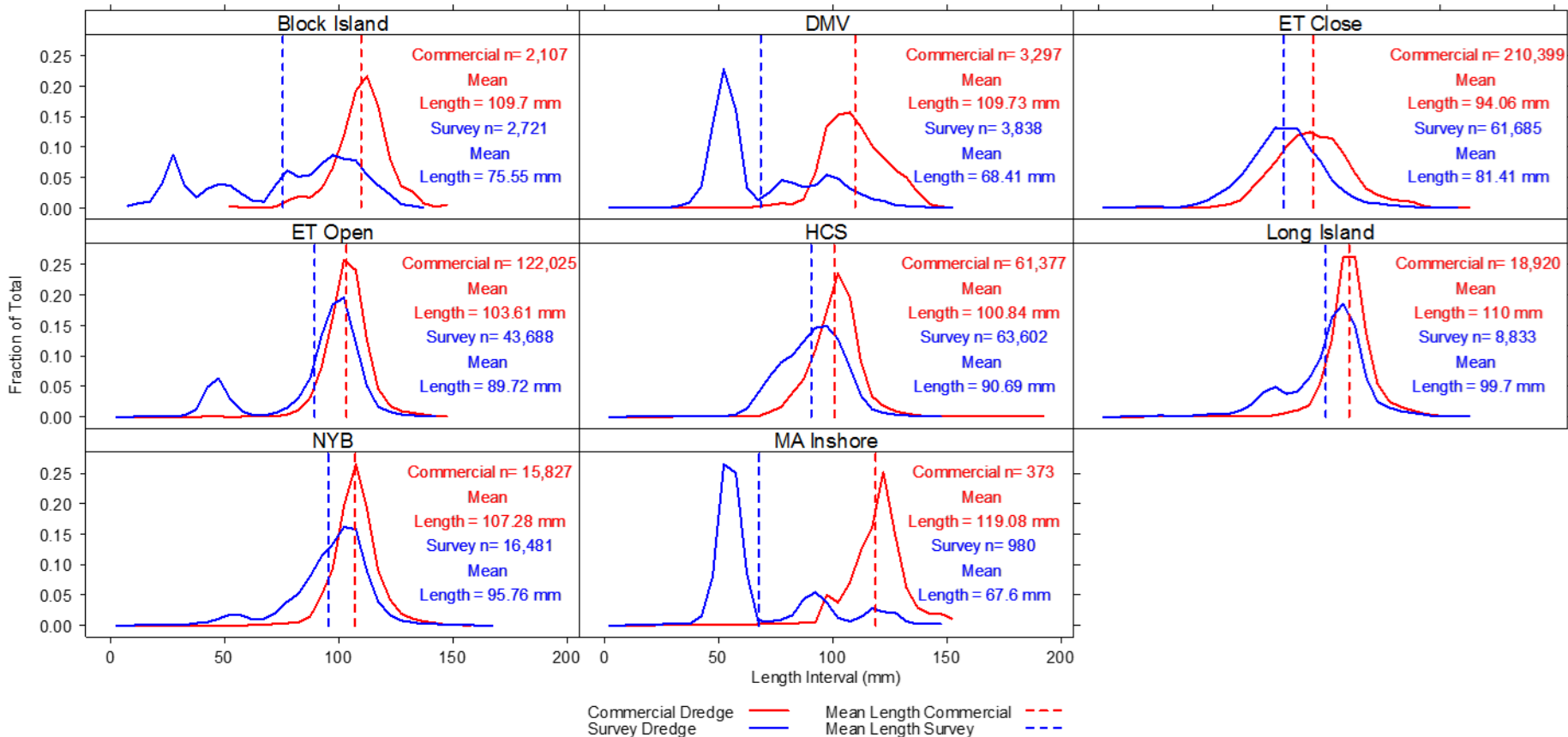
- Significantly different relationships by SAMS Area.
- Likely a function of the density of scallops and temporal spread of the sampling.

# 2017 VIMS-Industry Cooperative CA II Survey SH:MW Results

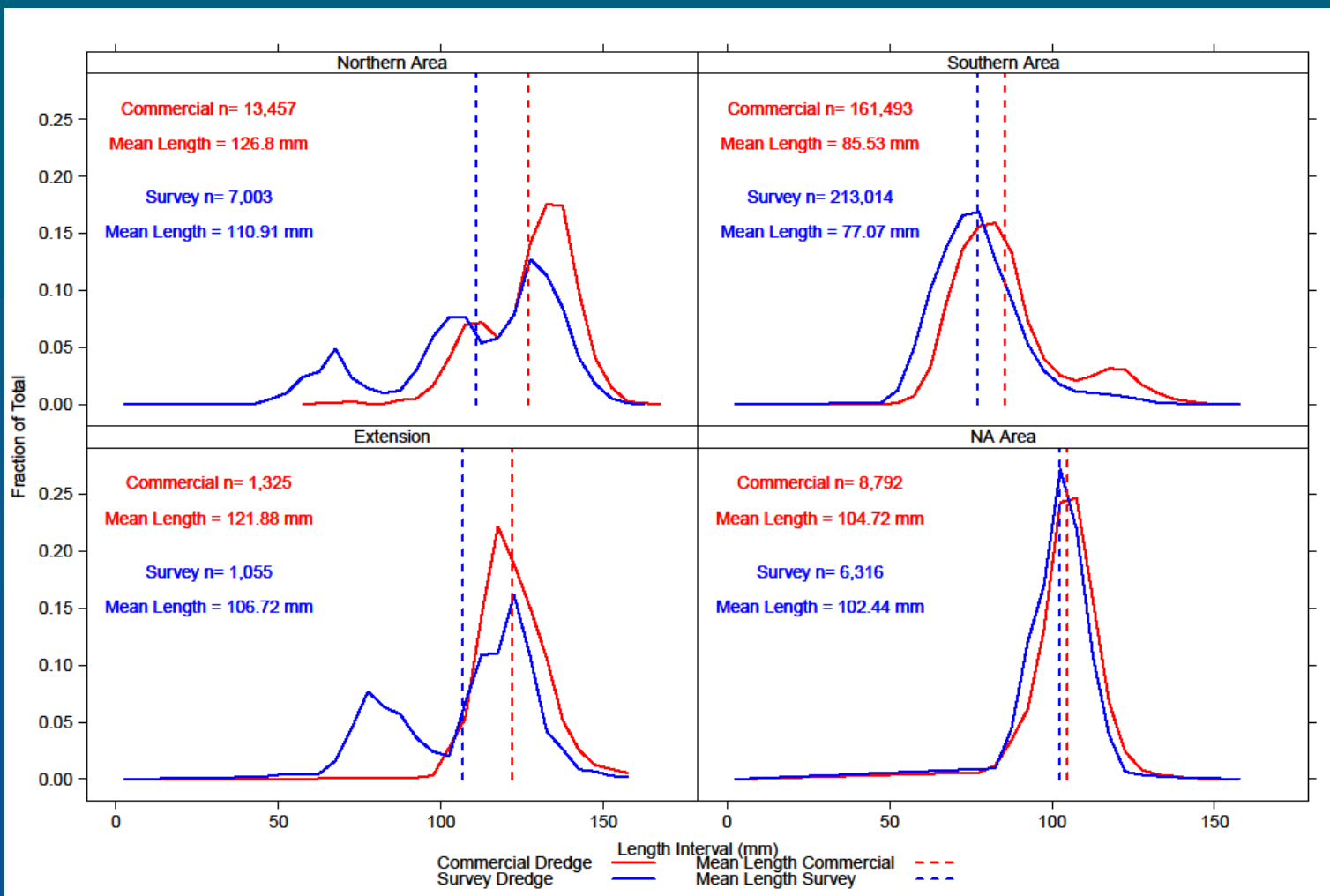


- Significantly different relationships between the two SAMS areas.
- Likely a function of average depths for each of subarea, as well as the temporal spread of the sampling

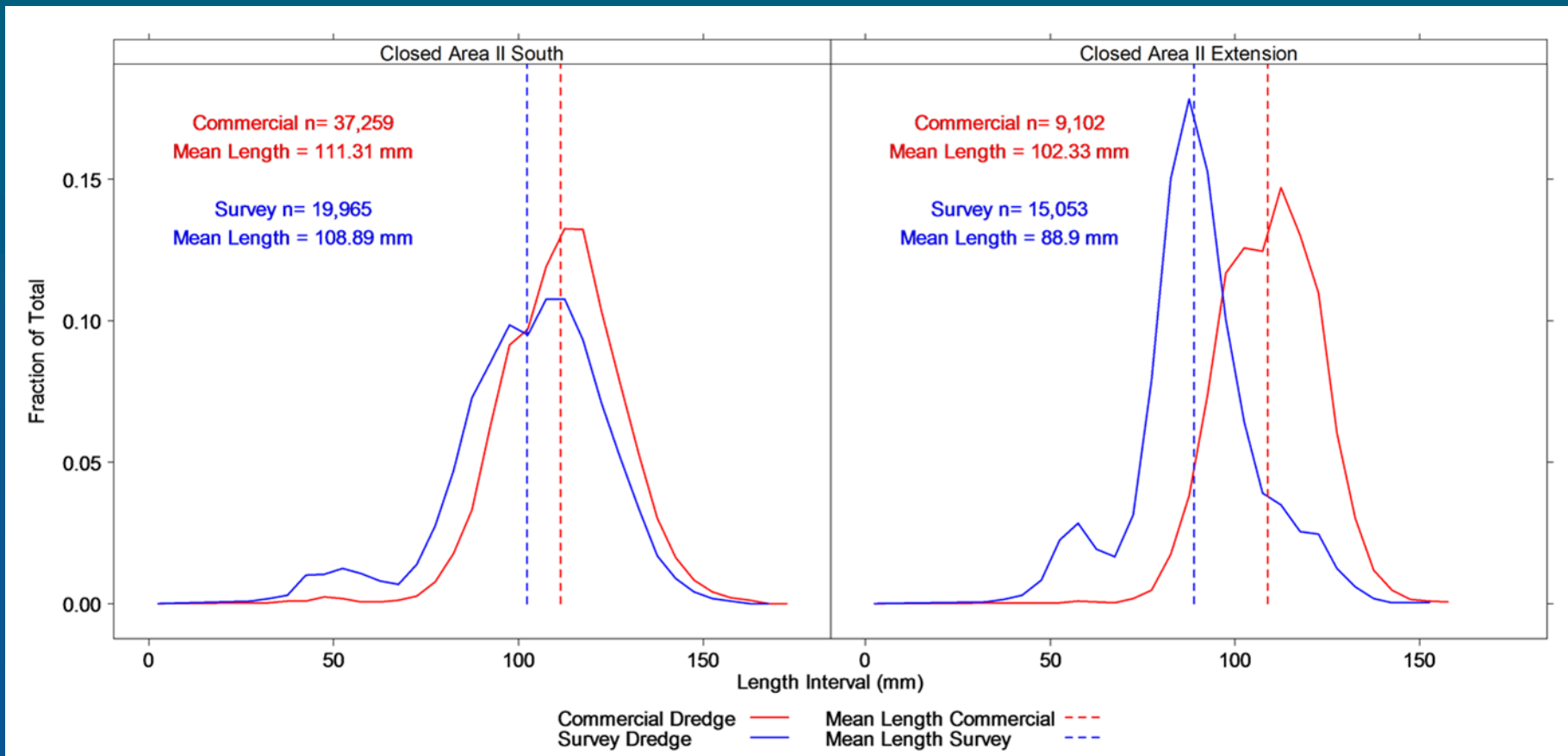
# 2017 VIMS-Industry Cooperative MAB Survey Length Frequency- SAMS Areas



# 2017 VIMS-Industry Cooperative NLCA Survey Length Frequency- SAMS Areas



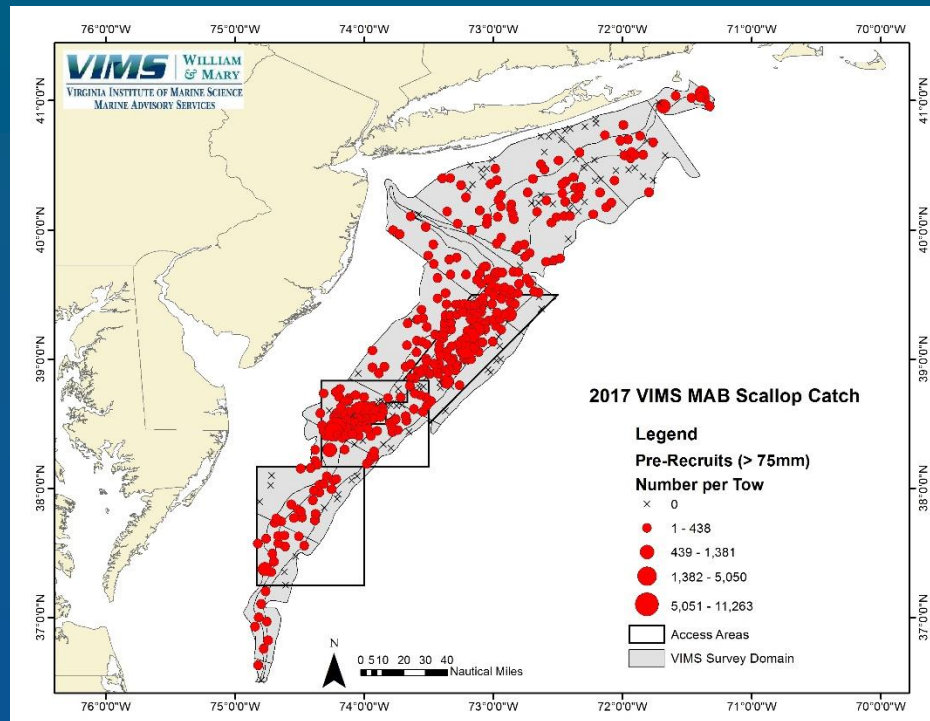
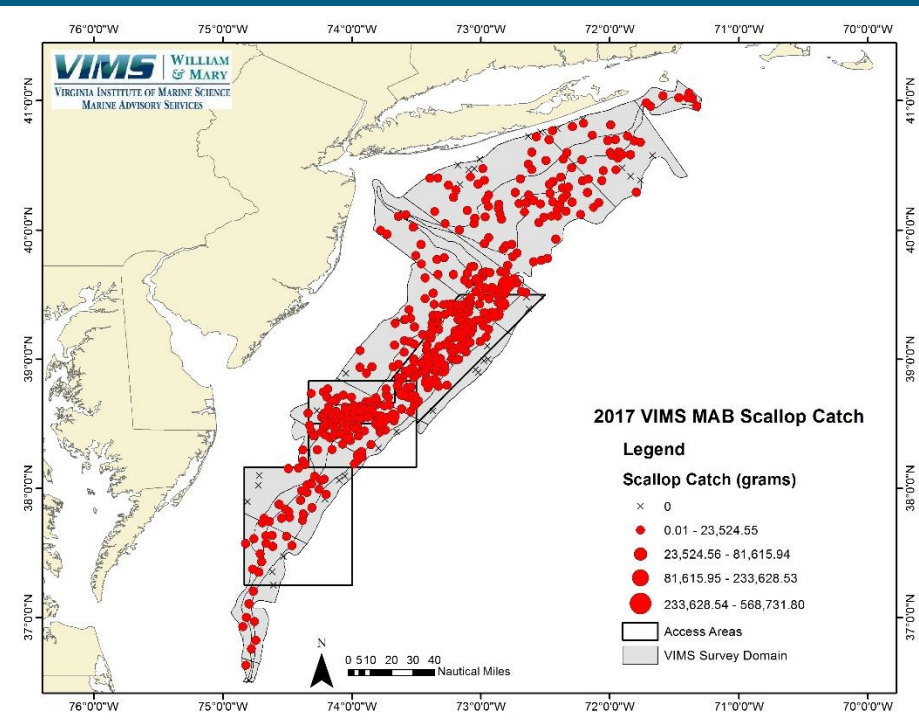
# 2017 VIMS-Industry Cooperative CA II Survey Length Frequency- SAMS Areas



# 2017 VIMS-Industry Cooperative MAB Survey Scallop Distribution

Total Catch (grams) from the Survey Dredge

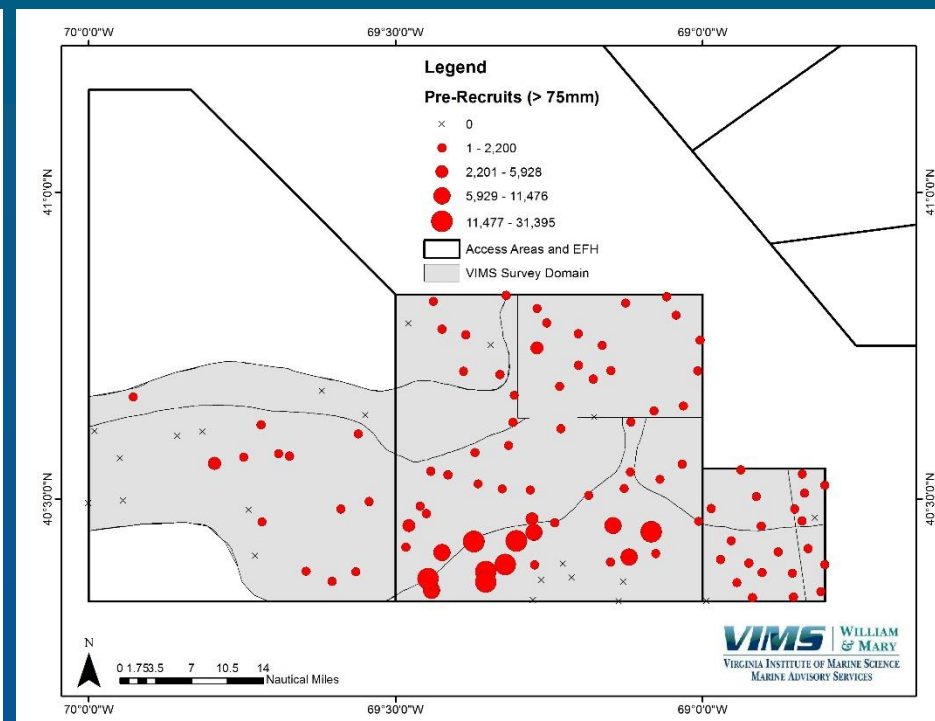
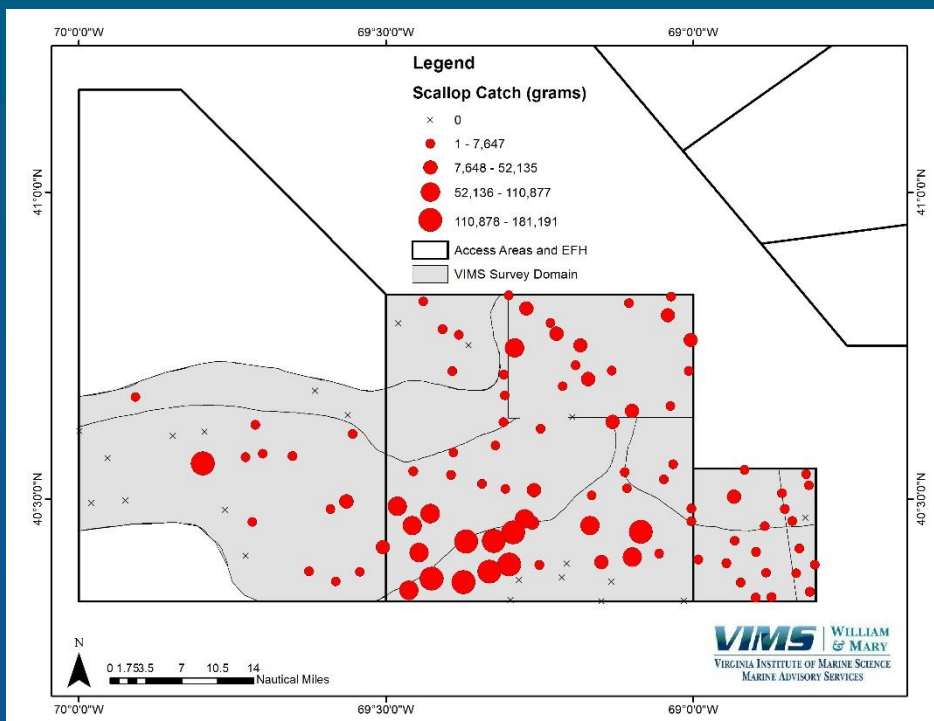
Pre-Recruit Catch (number) from the Survey Dredge



# 2017 VIMS-Industry Cooperative NLCA Surveys Scallop Distribution

Total Catch (grams) from the Survey  
Dredge

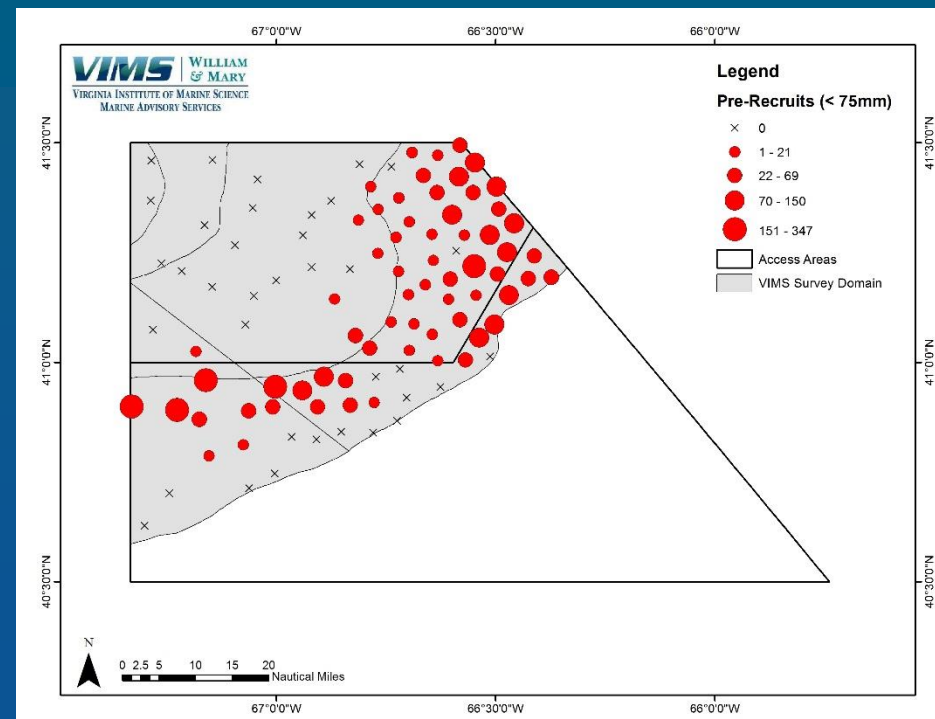
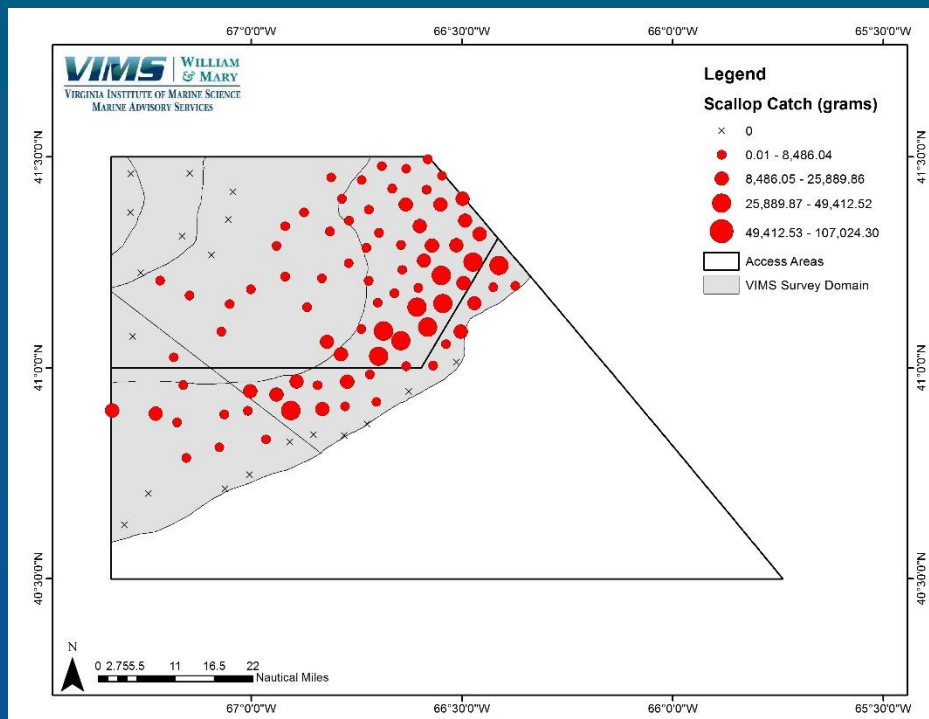
Pre-Recruit Catch (number) from the  
Survey Dredge



# 2017 VIMS-Industry Cooperative CA II Surveys Scallop Distribution

Total Catch (grams) from the Survey  
Dredge

Pre-Recruit Catch (number) from the  
Survey Dredge





# 2017 VIMS-Industry Cooperative Surveys

## Total Biomass – SAMS Areas

Survey	SAMS Area	Total Biomass (mt)	SE Biomass (mt)	CV Biomass (mt)	Density (scal/m <sup>2</sup> )	Avg MW (g)	Total Number
MAB	Block Island	1,969.62	226.11	28.7	0.19	15.68	121,806,267
	DMV	2,306.38	264.06	28.62	0.05	10.89	256,869,413
	ET Close	9,255.26	943.44	25.48	0.78	12.00	742,399,582
	ET Open	18,128.67	845.53	11.66	0.47	16.11	1,214,461,101
	HCS	21,405.69	1,259.06	14.7	0.43	16.80	1,275,480,323
	Long Island	15,104.66	697.57	11.55	0.05	25.32	596,790,163
	NYB	12,876.97	1,320.81	25.64	0.15	22.26	628,113,755
	MA Inshore	990.57	102.1	25.77	0.03	10.37	100,471,505
	Virginia	51.41	11.61	56.45	0.03	2.27	22,623,752
NL	Northern Area	6,097.78	483.57	19.83	0.19	46.87	132,447,574
	Southern Area	34,600.35	2,589.21	18.71	3.37	10.85	3,151,634,799
	Extension	488.06	106.29	54.44	0.03	31.78	14,729,166
	NA Area	5,781.98	2,046.08	88.47	0.16	26.19	220,723,753
	VIMS_45	133.43	40.88	76.60	0.01	55.35	2,410,436
CA II	CA II South	10,659.84	621.44	15	0.21	25.83	406,005,521
	CAII Extension	6,459.45	502.87	19	0.25	16.37	396,399,992

# 2017 VIMS-Industry Cooperative Surveys

## Exploitable Biomass Survey – SAMS Areas

Survey	SAMS Area	Exp Biomass (mt)	SE Biomass (mt)	CV Biomass (mt)	Density (scal/m <sup>2</sup> )	Avg MW (g)	Exp Number
MAB	Block Island	1,057.64	106.3	25.13	0.05	28.78	36,444,205
	DMV	891.6	137.36	38.52	0.01	26.61	34,268,402
	ET Close	3,418.64	236.53	17.3	0.17	18.29	172,897,663
	ET Open	9,060.67	417.48	11.52	0.19	20.68	436,462,773
	HCS	8,953.29	555.31	15.51	0.15	20.82	430,148,542
	Long Island	9,385.32	436.22	11.62	0.03	30.49	307,578,885
	NYB	7,134.97	725.72	25.43	0.07	27.47	253,793,588
	MA Inshore	458.59	57.45	31.32	0.004	31.63	14,563,562
	Virginia	0.42	0.07	44.06	0.0001	2.78	150,066
NL	Northern Area	5,060.70	350.49	17.31	0.12	58.69	87,252,360
	Southern Area	9,407.72	720.46	19.15	0.52	18.27	493,833,135
	Extension	383.91	88.02	57.32	0.02	40.01	9,924,475
	NA Area	3,372.68	1,148.95	85.17	0.09	27.98	120,482,424
	VIMS_45	118.14	37.08	78.48	0.01	60.06	1,967,112
CA II	CA II South	7,379.38	414.2	14	0.12	31.95	224,524,219
	CAII Extension	2,852.35	230.26	20	0.08	21.76	128,085,196

# 2017 VIMS-Industry Cooperative Surveys

## Exploitable Biomass - Commercial by SAMS Areas

Survey	SAMS Area	Exp Biomass (mt)	SE Biomass (mt)	CV Biomass (mt)	Density (scal/m <sup>2</sup> )	Avg MW (g)	Exp Number
MAB	Block Island	853.9	102.16	18.41	0.04	35.62	23,787,877
	DMV	1,393.10	266.51	29.43	0.01	34.49	41,243,491
	ET Close	8,907.62	916.59	15.83	0.38	22.81	373,526,895
	ET Open	13,711.89	1,093.07	12.26	0.26	22.82	599,432,322
	HCS	5,334.08	553.51	15.96	0.08	24.12	220,698,782
	Long Island	10,711.16	852.27	12.24	0.03	33.71	317,702,946
	NYB	3,800.50	665.78	26.95	0.03	31.09	118,589,367
	MA Inshore	418.51	69.81	25.66	0.002	42.15	9,937,667
	Virginia	0	0	0	0	0	0
NL	Northern Area	5,393.20	383.66	10.94	0.1	66.94	81,624,496
	Southern Area	6,400.87	1,002.58	24.1	0.23	24.8	238,944,186
	Extension	314.36	90.05	44.07	0.01	44.84	7,603,435
	NA Area	1,909.77	1,008.30	81.23	0.05	29.79	64,100,856
	VIMS_45	90.52	46.53	79.08	0.01	61.71	1,466,894
CA II	CA II South	6,296.40	455.77	11	0.09	35.05	172,033,946
	CAII Extension	1,636.90	261.88	25	0.03	28.5	55,471,564

# Biomass Estimates using SARC SHMW vs VIMS

## 2016/17 SHMW Parameters

### Comparison of total biomass

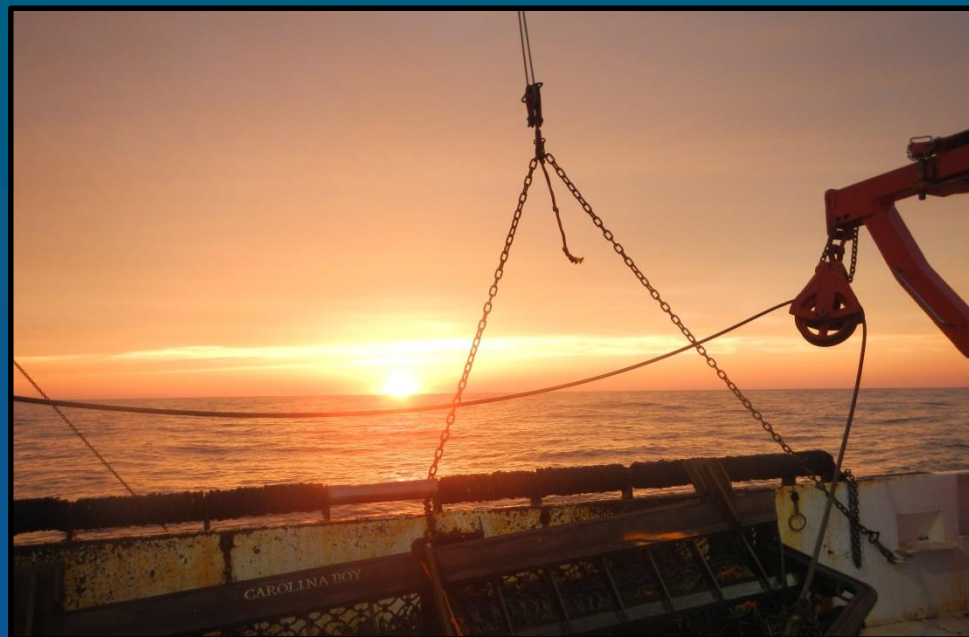
SAMS Area	Total Biomass SARC	Total Biomass VIMS	Difference (SARC-VIMS)
Northern Area	4,863.95	6,097.78	-1,233.83
Southern Area	41,544.89	34,600.35	6,944.54
Extension	503.58	488.06	15.52
NA Area	5,794.57	5,781.98	12.59
VIMS_45	105.35	133.43	-28.08

### Comparison of exploitable biomass

SAMS Area	Total Biomass SARC	Total Biomass VIMS	Difference (SARC-VIMS)
Northern Area	3,988.43	5,060.70	-1,072.27
Southern Area	11,093.49	9,407.72	1,685.77
Extension	395.47	383.91	11.56
NA Area	3,368.48	3,372.68	-4.20
VIMS_45	92.84	118.14	-25.30

# Acknowledgements

- The owners, captains and crews;
  - *F/V Carolina Capes II*
  - *F/V Sea Hawk*
  - *F/V Flavian S*
  - *F/V Celtic*
- Daniel Smith and Lee Rollins
- Support from NMFS NEFSC: Dvora Hart, Russ Brown, Vic Nordahl.
- Funding through Sea Scallop RSA program.



**VIMS**



# SHMW Parameter Estimates by Year (2016 , 2017 and 16/17 combined) and including Year as a factor in 2017

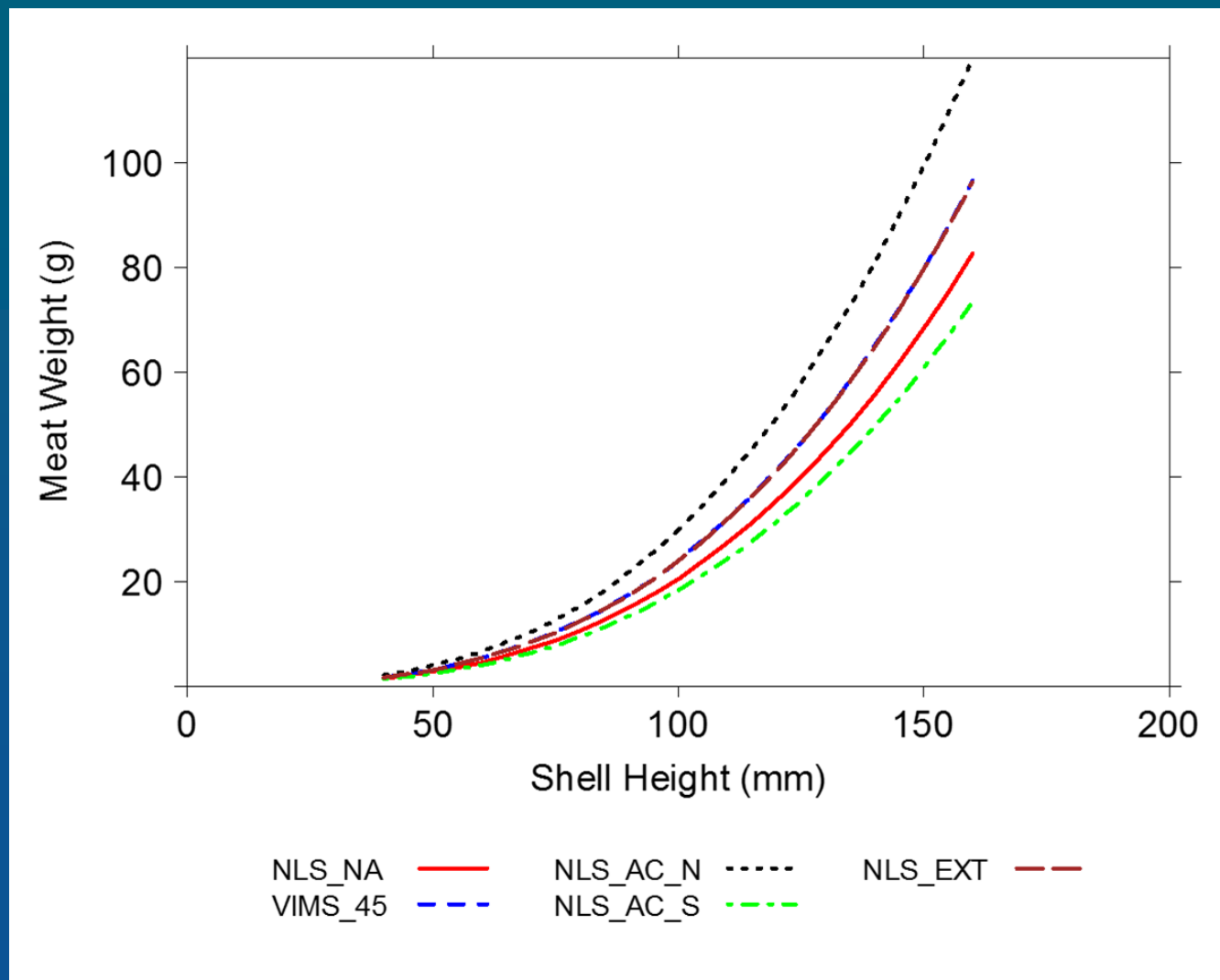
2016 Parameter Estimates	
Parameter	Parameter Estimate
Intercept	-25.76
logsh	6.75
logdepth	4.11
logsh:logdepth	-1.01
Southern Area	-0.49
Extension	-0.22
NA Area	-0.37
VIMS 45 Area	-0.22

2017 Parameter Estimates	
Parameter	Parameter Estimate
Intercept	-9.69
logsh	2.79
Southern Area	-0.31
Extension	-0.29
NA Area	-0.17
VIMS 45 Area	0.06

Combined 2016-17 Parameter Estimates	
Parameter	Parameter Estimate
Intercept	-13.18
logsh	3.69
logdepth	1.04
logsh:logdepth	-0.25
Southern Area	-0.41
Extension	-0.30
NA Area	-0.27
VIMS 45 Area	0.01

Parameter Estimates with Year included	
Parameter	Parameter Estimate
Intercept	-13.03
logsh	3.60
logdepth	0.98
logsh:logdepth	-0.23
Southern Area	-0.40
Extension	-0.30
NA Area	-0.27
VIMS 45 Area	0.009
Year: 2017	0.05

# Predicted SHMW Relationship for 2016 with VIMS 2016 Parameter Estimates





# Predicted SHMW Relationship with 2016/17 VIMS Parameter Estimates

