Preliminary analysis of gray meat distribution on Georges Bank

Coonamessett Farm Foundation

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Overview

- Goal is to develop a geostatistical model to examine the impact of biotic and abiotic factors on gray meat prevalence and the likelihood of individual scallops having gray meats
- Five survey trips between August 2013 and March 2014 on the southern portion of Georges Bank and fifteen survey trips between August 2015 and June 2017 on the northern portion of Georges Bank
- Meat quality was assessed based on a qualitative color scale with three categories with colors ranging from white to brown to gray

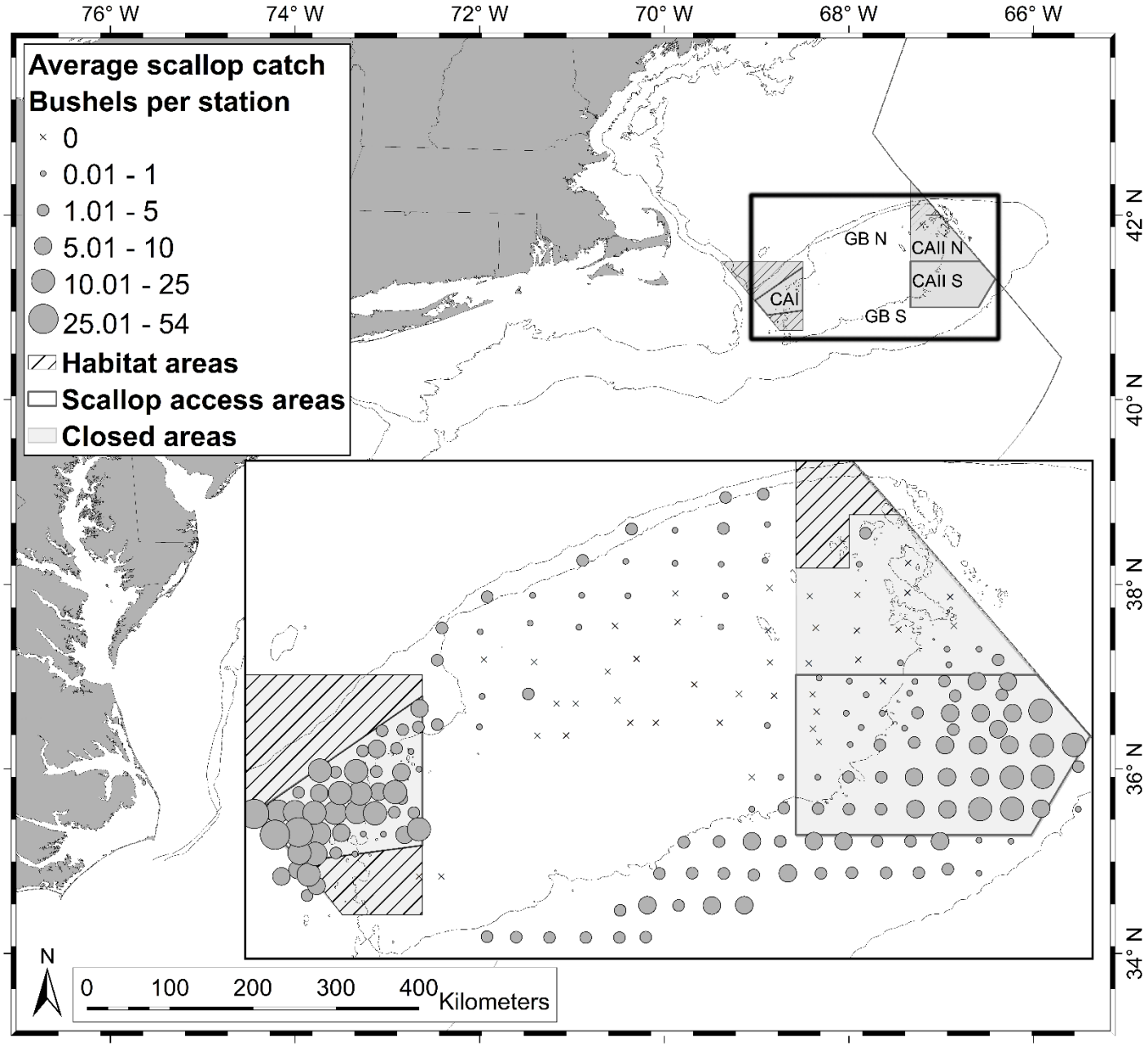
Total numbers of scallops assessed during each survey month.

Survey month and year	Number of scallops sampled
September 2013	396
October 2013	380
December 2013	364
January 2014	363
March 2014	399
August 2015	411
September 2015	558
October 2015	557
November 2015	605
January 2016	563
March 2016	654
May 2016	641
June 2016	527
July 2016	530
October 2016	517
November 2016	385
January 2017	483
March 2017	520
May 2017	628
June 2017	502

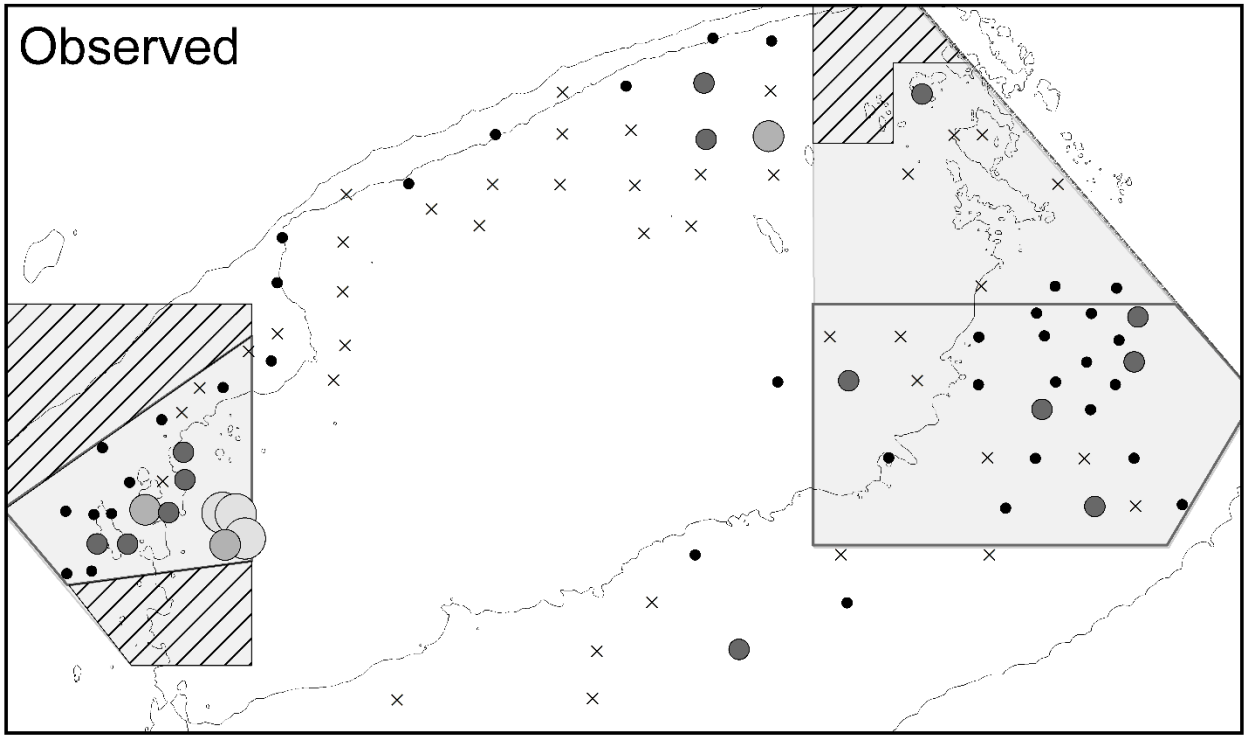
9,983 scallops sampled

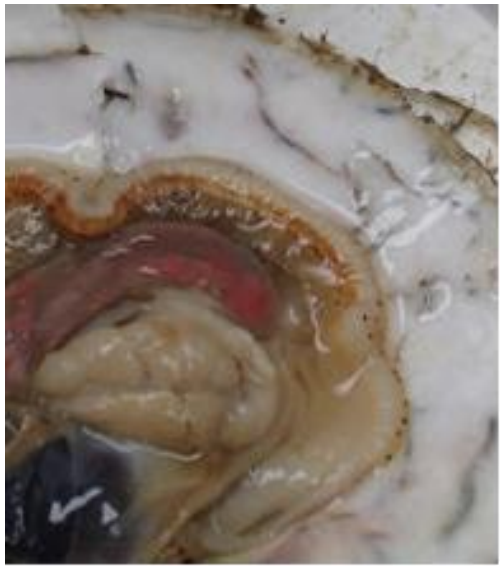
Gray meat percentages by month and overall

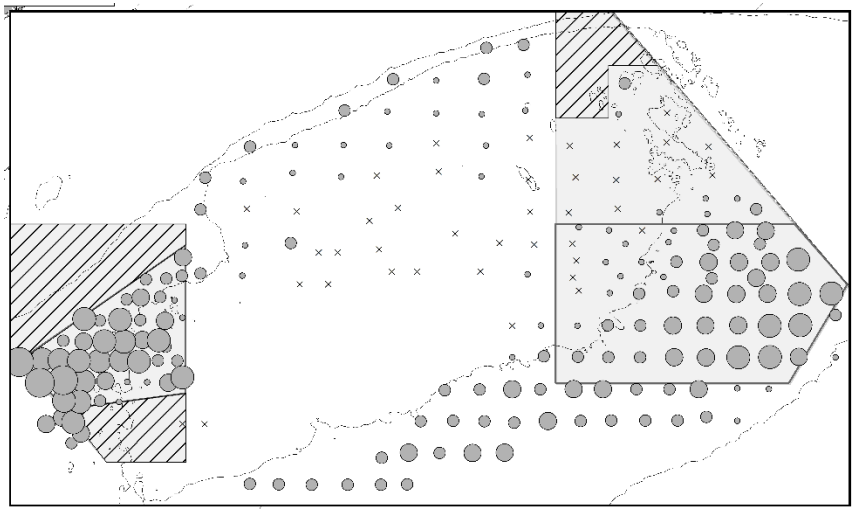
	CAI			CAII S			GB S							
	Gray	Brown	White	Gray	Brown	White	Gray	Brown	White		CAI	CAIIS	GBS	
Sep-13	3	29	130	2	23	138	0	2	69		19.75%	15.34%	2.82%	
Oct-13	5	14	143	3	10	134	0	3	68		11.73%	8.84%	4.23%	
Dec-13	7	6	146	1	5	132	0	2	65		8.18%	4.35%	2.99%	
Jan-14	14	16	115	0	5	144	0	2	67		20.69%	3.36%	2.90%	
Mar-14	12	13	144	0	0	160	0	0	70		14.79%	0.00%	0.00%	
Sub-totals	41	78	678	6	43	708	0	9	339		14.93%	6.47%	2.59%	
Totals			797			757			348				**8.00%**	**2013-2014 S average**
				CAII N			**GB N**					**CAIIN**	**GBN**	
Aug-15				6	8	164	0	3	230			7.87%	1.29%	
Sep-15				4	8	183	7	18	338			6.15%	6.89%	
Oct-15				7	23	185	11	9	322			13.95%	5.85%	
Nov-15				6	17	202	11	8	361			10.22%	5.00%	
Jan-16				7	10	193	5	11	337			8.10%	4.53%	
Mar-16				6	6	227	0	0	415			5.02%	0.00%	
May-16				2	6	233	3	3	394			3.32%	1.50%	
Jun-16				0	2	179	0	3	343			1.10%	0.87%	
Jul-16				0	3	178	0	7	342			1.66%	2.01%	
Oct-16				1	2	164	0	0	350			1.80%	0.00%	
Nov-16				0	0	202	0	0	183			0.00%	0.00%	
Jan-17				6	1	183	0	0	293			3.68%	0.00%	
Mar-17				1	0	174	1	1	343			0.57%	0.58%	
May-17				0	0	244	0	2	382			0.00%	0.52%	
Jun-17				4	1	191	0	1	305			2.55%	0.33%	
Sub-totals				50	87	2,902	38	66	4,938			4.51%	2.06%	
Totals						3,039			5,042				**3.19%**	**2015-2017 N average**
													4.92%	**Average overall**


76° W
74° W
72° W
70° W
68° W
66° W
42° N
40° N
38° N
36° N
34° N
Average scallop catch
Bushels per station
0
0.01 - 1
1.01 - 5
5.01 - 10
10.01 - 25
25.01 - 54
Habitat areas
Scallop access areas
Closed areas
GB N
CAII N
CAII S
CAI
GB S
N
0
100
200
300
400
Kilometers

Gray meat prevalence
Percent
- × 0
- • 0.01 - 10
- ● 10.01 - 25
- ● 25.01 - 50
- ● 50.01 - 100
- **Habitat areas**
- **Scallop access areas**
- **Closed areas**







- Gray meat prevalence at each station for each survey trip was modeled using a quasibinomial distribution
- Fixed effects used for modeling gray meat prevalence included
  - location ("easting" and "northing" with latitude and longitude coordinates projected into UTM space)
  - bottom depth (29 – 106 m)
  - bottom temperature (4 - 19°C)
  - scallop density (0.38 - 640 bushels/km^2)
  - clapper ratio as proxy for natural mortality (0 - 2.0)
  - Four categories for downstream distance from a closed area (in a closed area, < 5 km from a closed area, between 5 and 10 km from a closed area, or >10 km from a closed area)

- Meat quality of individual scallops, as gray meat presence (gray or brown) or absence (white), was modeled using a binomial distribution
- Fixed effects used for modeling gray meat presence included
  - location (“easting” and “northing”)
  - bottom depth
  - bottom temperature
  - scallop density
  - clapper ratio
  - shell height
  - downstream distance
  - reproductive stage (developing, ripe, partially spent, or spent based on visual criteria including color, texture, and fullness)

Model for gray meat prevalence

Included

- location
- bottom depth (non-linear)
- clapper ratio (non-linear)

Not included

- bottom temperature
- scallop density
- downstream distance from closed area

Gray meat prevalence on Georges Bank varies by location and depth, with higher gray meat prevalence at stations with higher estimated natural mortality rates*

Model for meat color of individual scallops

Included

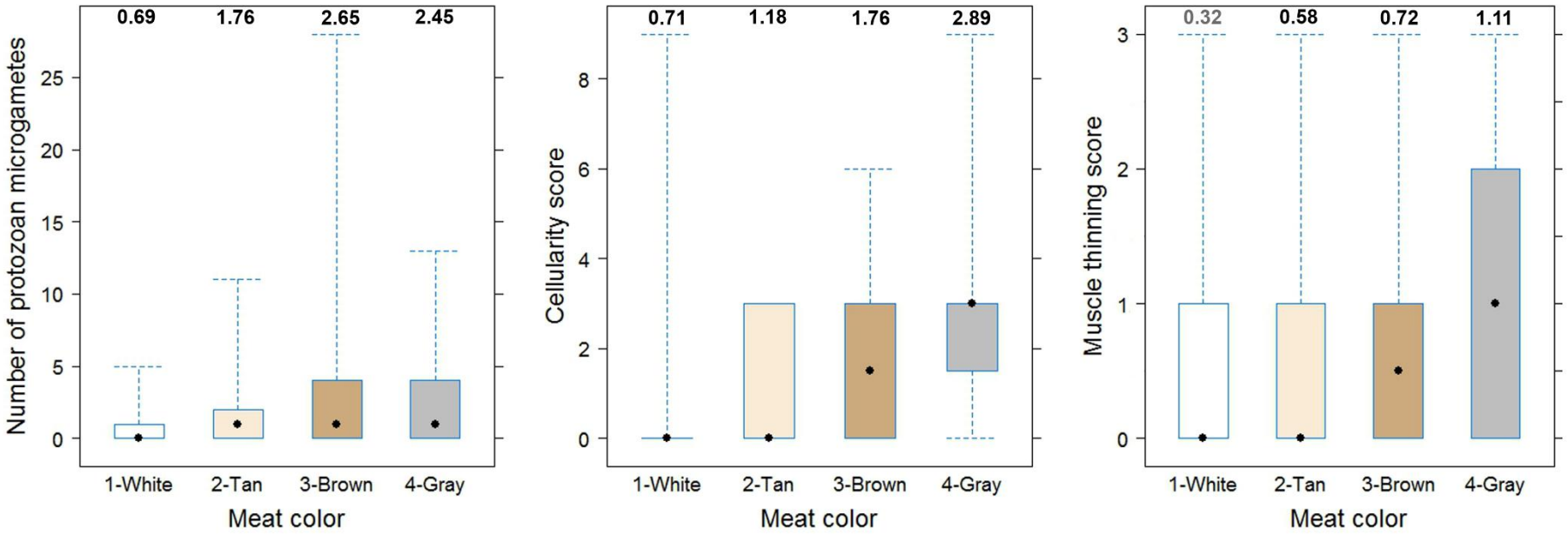
- location
- scallop density (negative linear)
- clapper ratio (non-linear)
- shell height (positive linear)
- reproductive stage

Not included

- bottom depth
- bottom temperature
- downstream distance from closed area

Individual scallops were more likely to have discolored meats when they were larger and after spawning.

- Aquatic Diagnostic Lab at RWU analyzed gray and white meat scallops for evidence of apicomplexan parasites (microgametes, changes in cellularity, evidence of muscle thinning)



- No clear relationship between meat color and severity of infection
- Look for other causes of gray meats – toxin?