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Review of Oyster Data - 2018

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STATE OF NEW HAMPSHIRE

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SUBJECT: Review of Oyster Data - 2018

DATE: January 10, 2019

I have reviewed the Year 2018 oyster density data developed this fall. Specifically, the following samples were collected:

10/23 5 quadrats from Squamscott River
10/24 5 quadrats from Woodman Point
10/29 5 quadrats from Oyster River
10/30 5 quadrats from Piscataqua River
11/1 5 quadrats from Nannies Island
11/2 5 quadrats from Adams Point

Collection of the samples was done by SCUBA diver placement of a quarter meter square frame over the bottom where oysters were observed. The oysters within the frame were removed by hand down to the point where no living oysters were present. Catch bags were used to bring the sample to the attending boat. Finally the catch bag contents were sorted and rinsed clean then examined for live oysters. Each live oyster was measured (height in mm) with calipers and the size recorded.

From these data, the usual quantitative density indices have been generated; average total/0.25M^2, average 0-20mm/0.25M^2, average 0-40mm/0.25M^2, average 61mm and greater/0.25M^2, and average 81mm and greater/0.25M^2. The 0-20mm and 0-40mm size classes capture the spatfall for the 2018 reproductive period. Although smaller males may be capable, oysters 61mm and greater can confidently be considered capable of gametogenesis and are potential contributors to the annual spawning event. This provides an index of the spawning stock biomass for the population. A measure of harvestable oysters is expressed with the 81mm and greater size class, however, some harvesters may take oysters smaller because of the relative scarcity of large oysters thus, looking at the density of oysters at all size ranges greater than 61 mm may be more appropriate. A complete display of the 2018 sample counts and averages are shown in the attached Tables 1 and 2. These same data are shown graphically as Figure 1. Figure 2 shows total oyster density over the time series.

The 2018 oyster survey results provide a basis for some conclusions as well as speculation. From these data, one can gain insight on annual spatfall, population composition, and harvestable oysters. The collection also provides information on oyster associates, both predators and commensals.

When compared to spatfall records collected since 1991, the 2018 numbers were poor (i.e. lower than the most recent 5 year average for 0-20mm) for Adams Point, Nannies Island, and Woodman Point, all of which had no

spatfall in samples. This was the fifth straight year without a spatfall at Nannies Island which, except for years 2006 and 2007, has ranked last for the six beds surveyed. Spatfalls at the Oyster River, Squamscott River, and Piscataqua River sites were all above average, with 2018 value in the Squamscott being the highest of the time series for that location.

Inconsistency of spatfalls, year to year, seems to be a regular occurrence for Great Bay oysters. In addition, there are clearly some site by site annual differences. This was observed over forty years ago when annual spatfalls were monitored 1965 to 1968 (Ayer et al 1970[1]). Figure 3 shows this variability. Highest spatfalls over the 26 years sampling period were seen in 2006 and 2007. Also, 2008 and 2014 to 2017 had relatively high spatfalls when compared to other years since the late 1990s. What conditions are in play to cause this can only be subject to speculation. Additional detailed studies of the complete reproductive events, gametogenesis to successful spatfall, would be needed to further elucidate spatfall inconsistency.

The total live oyster counts (mean #/.25m^2) on the Adam's Point, Nannies Island, and Woodman Point beds were the lowest of all sampled years. This is the second consecutive year that no live spat or adult oysters were found in the Nannies Island sample. It is noteworthy to mention that the predaceous snail *Urosalpinx cinereus* (oyster drill) has been found here in greatest numbers over the past years. It has also historically been an area with the highest prevalence of the oyster disease Dermo. The Oyster River bed, unlike Adams Point, Nannies Island and Woodman Point, is not open for harvest by those holding recreational licenses. This difference may provide some insight on harvest related impact. Comparisons continue to show only a slight difference between numbers of harvestable sized oysters (i.e. those in excess of 81mm) between these four beds. When numbers of harvestable oysters present are tallied over the past five years of this survey, Oyster River numbers are marginally higher than Adams point, at times higher than Woodman point, and are about four times those at the Nannies Island bed which seems to have a recruitment deficiency and survival problem. In contrast, the Piscataqua River total oyster count was the fourth highest since 1997, and the Squamscott River was the highest of all samples taken since 1998.

The Piscataqua River is unique being farthest from all other beds and also appearing to have had a numbers drop in 2008 and beyond following a possible oiling of the bottom that occurred following dredging of the lower Cocheco River. For 2018 total oyster numbers increased from 2017, and are the highest since the drop. It should be noted that the sampling has moved to the edges of the channel in recent sampling years as the reef in the center of the river has become very sporadic possibly due to sedimentation.

The abundance of larger, harvestable sized oysters continues to remain low. The three beds affected by harvest; Woodman Point, Nannies Island, and Adams Point show low numbers, due in part to these areas being utilized by licensed harvesters.

The annual oyster survey offers an opportunity for observation of the various oyster associates, both predators and commensals. Two gastropod predators, oyster drill (*Urosalpinx* sp.) and *Odostomia* sp. have been present in Great Bay oyster beds in the past but only oyster drills were seen in 2018. The only other gastropod associates noted were the somewhat ubiquitous slipper shell (both *Crepidula plana* and *fornicata*) and the mud snails (*Ilyanassa* spp). Crab predators found on the beds were the mud crabs (*Xanthidae*), green crabs, and cancer crabs.

While boring sponge (*Cliona* sp.) is not an actual predator since it derives no nutrition from the oyster, it nevertheless may have an adverse effect on its host. Shells in some instances can be heavily infested with sponge and this no doubt results in an energy expenditure for the oyster when sponge penetration reaches the point the host must lay down more nacre to seal off the shell interior. *Cliona* sponge may also make shells very fragile and tonging damage to unharvested oysters can result. Another sponge, *Microciona prolifera* can be found on Great Bay oysters.

[1] An investigation of the possibility of Seed Oyster Production in Great Bay, New Hampshire – Marine Survey Report No. 2

The mud worm *Polydora* is a common commensal of Great Bay oysters and results in the formation of what are known as “mud blisters”. Heavy infestation of mud worms can impose an energy drain to the host oyster as they cover the accumulating mud with the nacre necessary to protect the visceral mass.

A colonial chelostomate ectoproct was first seen on old shell at Nannies Island in 2013. While this was likely present in previous years, it had never before undergone further examination. A tentative identification of it suggests either *Schizoporella* sp. or *Cribrilina* sp. The only foreseeable negative impact it may have on oysters is the likelihood its growth on shell makes an unsuitable surface for spatfall.

During this fall’s sampling of oysters, specimens were taken from Adams Point, Oyster River, Nannies Island, Squamscott River, Woodman Point, and Piscataqua River for testing by the Rutgers Shellfish Lab for MSX and DERMO. Results of these examinations show the continued presence Dermo in all sampled beds, as well as a limited number of MSX infected oysters.

Kevin Sullivan
Marine Biologist II

KMS

Attachments

Table 1. Measurement summary of size ranges by sample site for all sampled years.

Adams Pt.		**Mean #/.25m^2**				
Year	Replicates	0-20mm	0-40mm	61+	81+ mm	Total Oysters
1993	6	0.0	3.5	57.2	30.0	78.0
1996	6	0.0	1.2	18.2	13.2	24.2
1998	8	1.5	3.3	9.8	6.9	14.1
2000	3	0.7	15.7	3.7	1.7	25.3
2001	4	0.0	0.5	2.5	1.8	9.3
2002	10	15.5	16.9	5.2	0.7	27.8
2003	5	1.0	14.4	7.6	3.4	33.4
2004	5	0.0	1.2	15.4	1.8	29.2
2005	5	0.0	0.8	21.4	8.4	25.6
2006	5	122.4	131.4	11.2	6.6	143.6
2007	5	35.4	221.0	6.0	2.2	289.8
2008	5	3.2	33.4	16.4	1.8	91.4
2009	5	2.8	13.4	27.2	1.8	75.0
2010	5	2.2	12.4	9.2	0.4	35.4
2011	5	9.0	17.8	12.4	4.6	38.0
2012	5	1.0	5.4	6.4	3.2	15.6
2013	5	28.4	32.2	6.2	1.0	42.4
2014	5	0.4	11.4	4.4	1.6	25.2
2015	5	16.8	18.4	2.6	0.4	25.0
2016	5	0.6	2.0	8.8	1.0	14.2
2017	5	0.0	0.4	8.8	3.2	11.0
2018	5	0.0	0.0	1.8	1.2	2.0

Nannies Island		**Mean #/.25m^2**				
Year	Replicates	0-20mm	0-40mm	61+ mm	81+ mm	Total Oysters
1991	4	20.3	45.5	36.5	22.3	103.3
1993	6	0.2	3.2	55.8	29.8	67.2
1995	10	0.0	1.1	16.1	12.2	19.2
1996	4	0.3	3.3	30.8	16.8	53.5
1998	27	3.5	6.1	12.1	7.2	21.0
1999	5	2.8	13.2	5.4	3.0	21.8
2000	5	1.4	8.6	1.8	1.2	15.0
2001	4	0.3	3.0	13.3	3.5	29.5
2002	5	0.2	0.4	5.0	0.8	7.4
2003	5	0.8	1.8	6.2	1.8	9.0
2004	3	0	0.0	1.3	0.7	1.3
2005	2	0	0.0	1.0	1.0	1.0
2006	5	152.6	165.0	0.0	0.0	165.0
2007	5	15.6	185.0	6.6	1.4	283.8
2008	5	1.2	16.6	16.4	0.8	74.8
2009	5	2.2	11.4	25.6	2.2	80.0
2010	5	2.8	9.0	18.2	3.0	41.4
2011	5	2.8	8.6	9.4	0.8	24.8
2012	5	0.2	4.6	4.6	2.2	16.2
2013	5	1.0	1.8	2.2	0.6	6.2
2014	5	0.0	0.0	1.6	0.8	1.8
2015	5	0.0	0.0	1.2	0.4	1.4
2016	5	0.0	0.0	2.6	1.6	2.6
2017	5	0.0	0.0	0.0	0.0	0.0
2018	5	0.0	0.0	0.0	0.0	0.0

Oyster River		**Mean #/.25m^2**				
Year	Replicates	0-20mm	0-40mm	61+ mm	81+ mm	Total Oysters
1993	11	0.0	0.7	36.3	27.4	39.6
1995	6	0.2	3.2	17.0	11.7	30.5
1996	5	0.0	1.6	17.6	10.2	23.6
1998	6	1.3	7.0	9.2	6.5	20.5
1999	5	7.8	11.4	3.8	2.6	16.6
2000	5	0.4	10.2	4.6	3.0	20.6
2001	5	0.6	2.0	9.8	3.6	21.6
2002	5	34.8	36.4	5.2	2.4	43.4
2003	5	2.4	21.2	6.8	2.6	60.8
2004	5	0.0	5.4	33.8	6.2	80.6
2005	5	0.6	1.4	24.6	7.2	33.6
2006	5	235.6	247.6	21.4	7.4	270.6
2007	5	37.4	231.8	20.4	10.2	381.0
2008	5	2.8	28.0	68.4	19.8	139.2
2010	5	4.4	13.4	24.0	9.0	45.0
2011	5	0.8	2.8	12.8	5.8	19.2
2012	5	0.8	4.8	7.2	4.4	15.6
2013	5	20.4	23.4	7.8	4.0	33.8
2014	5	1.6	17.2	3.8	1.6	27.8
2015	5	10.8	16.4	6.2	0.6	32.8
2016	5	2.0	4.4	4.6	1.8	13.6
2017	5	0.2	1.6	9.8	4.0	15.6
2018	5	10.2	12.0	13.6	5.0	29.2

Piscataqua River		**Mean #/.25m^2**				
Year	Replicates	0-20mm	0-40mm	61+ mm	81+ mm	Total Oysters
1993	7	5.7	5.9	16.9	5.1	25.9
1997	3	6.3	9.0	1.3	0.7	11.3
1998	7	1.9	9.0	1.7	1.3	14.0
1999	5	8.2	13.0	0.2	0.0	14.8
2000	3	2.0	19.0	1.0	0.3	22.3
2001	4	0.0	3.5	2.5	0.3	13.3
2002	5	75.2	75.8	1.4	0.2	79.2
2003	5	1.2	78.0	1.6	0.2	93.0
2004	5	0.2	23.4	2.6	0.0	67.8
2005	2	0.0	2.5	7.5	1.0	40.0
2006	5	15.2	15.2	6.4	1.2	25.2
2007	5	13.0	62.4	10.0	5.0	77.4
2008	5	0.2	2.2	0.4	0.0	4.4
2010	5	1.2	2.0	2.4	0.6	6.0
2011	5	0.0	0.4	2.8	1.2	4.4
2012	5	0.0	0.4	0.0	0.0	0.6
2013	5	34.4	37.4	2.8	1.0	44.2
2014	5	1.2	9.6	1.2	0.0	11.8
2015	5	3.6	4.2	1.0	0.2	11.0
2016	5	5.0	13.6	5.4	0.2	28.6
2017	5	0.0	4.2	8.4	1.2	19.6
2018	5	32.4	37.6	7.0	1.6	49.0

Woodman Pt.		**Mean #/.25m^2**				
Year	Replicates	0-20mm	0-40mm	61+ mm	81+ mm	Total Oysters
1991	4	2.3	16.3	68.5	38.3	102.3
1993	19	0.0	0.4	28.1	15.7	32.1
1995	7	2.0	14.7	18.7	8.6	64.9
1996	4	0.3	5.3	30.0	9.8	57.8
1998	6	1.0	2.8	15.0	7.2	20.5
1999	5	16.4	21.2	7.6	5.6	30.6
2000	3	1.3	22.7	4.3	1.0	31.7
2001	6	0.3	5.2	10.5	3.5	34.8
2002	5	24.0	24.2	5.4	1.6	33.6
2003	5	0.4	12.4	4.8	2.6	29.8
2004	5	0.2	0.6	12.4	3.0	25.0
2005	5	0.4	0.4	4.6	2.2	7.6
2006	5	187.2	216.2	12.8	7.4	231.6
2007	5	11.4	93.4	5.6	1.0	149.6
2008	5	1.2	17.8	22.0	2.2	75.0
2009	5	1.2	14.2	24.8	2.2	76.4
2010	5	1.8	6.8	14.6	2.0	33.4
2011	5	1.6	7.0	10.2	3.2	22.2
2012	5	0.6	2.8	7.0	2.2	14.8
2013	5	17.4	22.6	5.4	2.2	30.8
2014	5	1.6	6.4	4.4	1.6	21.2
2015	5	6.2	7.4	7.8	0.8	22.6
2016	5	0.2	0.2	6.6	2.8	8.0
2017	5	0.0	0.6	18.4	9.2	20.4
2018	5	0.0	0.0	5.8	3.6	6.0

Bellamy River		**Mean #/.25m^2**				
Year	Replicates	0-20mm	0-40mm	61+ mm	81+ mm	Total Oysters
1993	3	0.0	0.0	28.0	24.7	28.7
1996	4	0.0	0.0	5.8	3.5	7.8

Pomeroy Cove		**Mean #/.25m^2**				
Year	Replicates	0-20mm	0-40mm	61+ mm	81+ mm	Total Oysters
1996	7	0.0	0.4	3.4	2.0	4.0

Salmon Falls River		**Mean #/.25m^2**				
Year	Replicates	0-20mm	0-40mm	61+ mm	81+ mm	Total Oysters
1997	3	3.3	6.0	0.7	0.0	7.0

Squamscott River		**Mean #/.25m^2**				
Year	Replicates	0-20mm	0-40mm	61+ mm	81+ mm	Total Oysters
1998	6	10.3	24.3	4.0	2.3	35.8
2001	3	5.0	12.0	4.7	2.0	25.0
2005	3	7.3	17.3	100.3	40.3	151.7
2008	5	2.8	43.8	46.6	11.0	149.8
2010	5	9.0	18.4	22.6	8.0	51.8
2011	5	4.2	14.0	14.0	6.2	33.8
2012	5	3.0	7.6	8.6	3.4	21.4
2014	5	36.2	67.4	18.8	4.6	115.0
2015	5	16.2	28.0	17.2	3.2	59.2
2016	5	50.2	65.8	13.4	5.4	93.6
2017	5	2.8	22.2	28.0	7.2	93.4

Table 2. Oyster counts and averages of each size range for all sampled sites, 2018.

Nannies Island							
Replicate	**0-20mm**	**21-40mm**	**41-60mm**	**61-80mm**	**81-100mm**	**101-120m**	**121-140mm**
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
Average	0	0	0	0	0	0	0
STDev	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	0	0	0	0	0	0	0
%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Oyster River							
Replicate	**0-20mm**	**21-40mm**	**41-60mm**	**61-80mm**	**81-100mm**	**101-120m**	**121-140mm**
1	14	1	8	18	6	1	0
2	28	5	7	13	6	0	0
3	10	1	0	1	3	1	0
4	4	2	3	5	3	0	0
5	5	0	0	6	3	2	0
Average	10.2	1.8	3.6	8.6	4.2	0.8	0.0
STDev	10.26	1.92	3.78	6.80	1.64	0.84	0.00
Sum	51	9	18	43	21	4	0
%	34.9%	6.2%	12.3%	29.5%	14.4%	2.7%	0.0%

Adams Pt.							
Replicate	**0-20mm**	**21-40mm**	**41-60mm**	**61-80mm**	**81-100mm**	**101-120m**	**121-140mm**
1	0	0	0	0	1	0	0
2	0	0	0	1	2	0	0
3	0	0	0	1	0	1	0
4	0	0	1	0	0	1	0
5	0	0	0	1	1	0	0
Average	0	0.0	0.2	0.6	0.8	0.4	0
STDev	0.00	0.00	0.45	0.55	0.84	0.55	0.00
Sum	0	0	1	3	4	2	0
%	0.0%	0.0%	10.0%	30.0%	40.0%	20.0%	0.0%

Woodman Pt.							
Replicate	**0-20mm**	**21-40mm**	**41-60mm**	**61-80mm**	**81-100mm**	**101-120m**	**121-140mm**
1	0	0	1	4	4	3	0
2	0	0	0	2	3	0	0
3	0	0	0	0	4	0	1
4	0	0	0	4	2	1	0
5	0	0	0	1	1	0	0
Average	0	0	0.2	2.2	2.8	0.8	0
STDev	0.00	0.00	0.45	1.79	1.30	1.30	0.00
Sum	0	0	1	11	14	4	0
%	0.0%	0.0%	3.3%	36.7%	46.7%	13.3%	0.0%

Piscataqua River							
Replicate	**0-20mm**	**21-40mm**	**41-60mm**	**61-80mm**	**81-100mm**	**101-120m**	**121-140mm**
1	43	6	3	4	2	0	0
2	45	9	8	5	5	0	0
3	29	3	6	5	1	0	0
4	31	5	4	9	0	0	0
5	14	3	1	4	0	0	0
Average	32.4	5.2	4.4	5.4	1.6	0.0	0
STDev	12.48	2.49	2.70	2.07	2.07	0.00	0.00
Sum	162	26	22	27	8	0	0
%	66.1%	10.6%	9.0%	11.0%	3.3%	0.0%	0.0%

Squamscott River							
Replicate	**0-20mm**	**21-40mm**	**41-60mm**	**61-80mm**	**81-100mm**	**101-120m**	**121-140mm**
1	95	16	8	16	11	3	0
2	123	23	9	22	19	4	0
3	140	39	9	13	3	0	0
4	92	21	12	29	8	1	0
5	111	23	13	22	13	2	0
Average	112.2	24.2	10.2	20.4	10.8	2.0	0.0
STDev	19.97	8.65	2.17	6.19	5.93	1.58	0.00
Sum	561	122	51	102	54	10	0
%	62.3%	13.6%	5.7%	11.3%	6.0%	1.1%	0.0%

Figure 1. Density of various size classes per 0.25 m^2 quadrat at Great Bay Oyster Beds sampled in 2018.

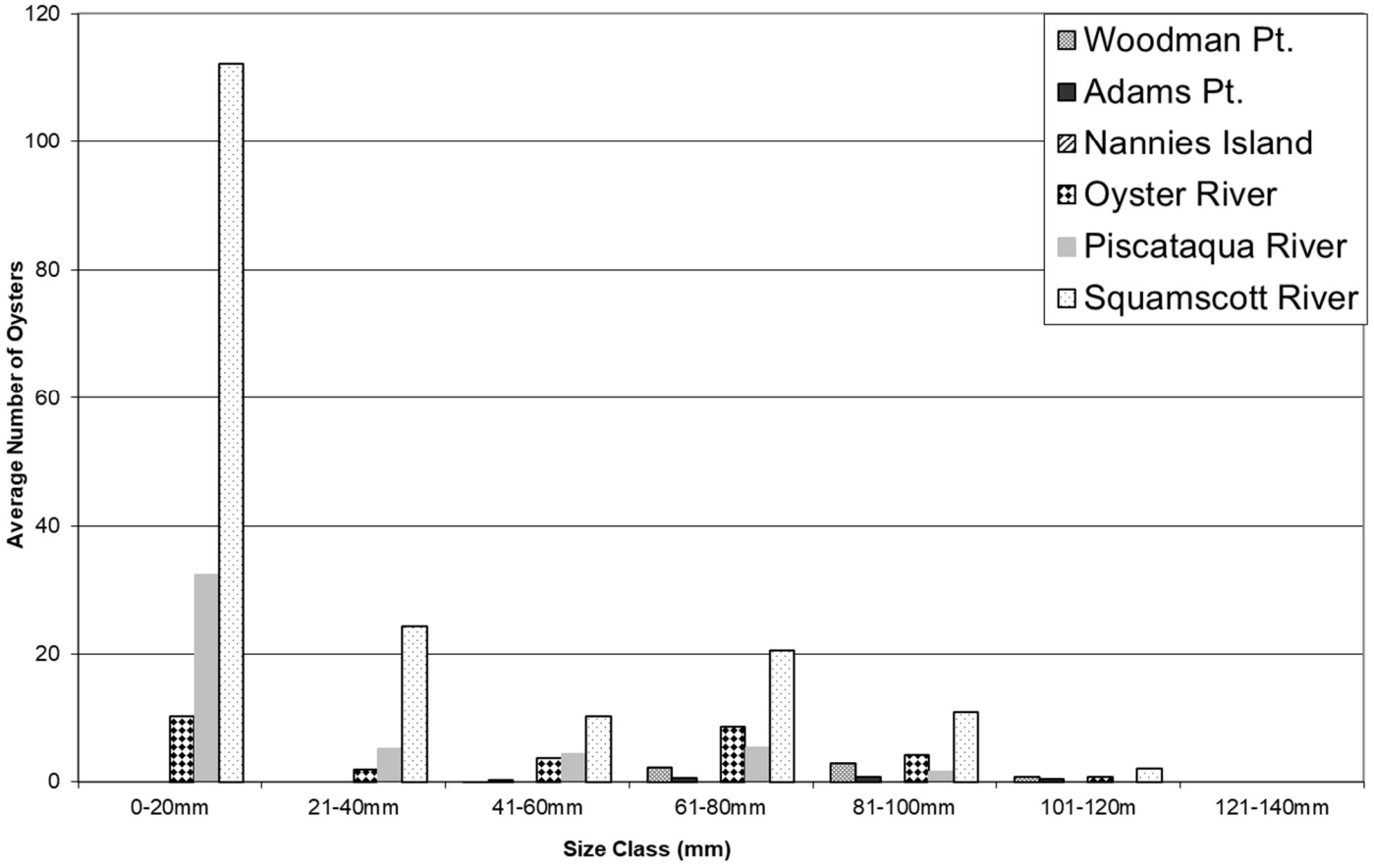
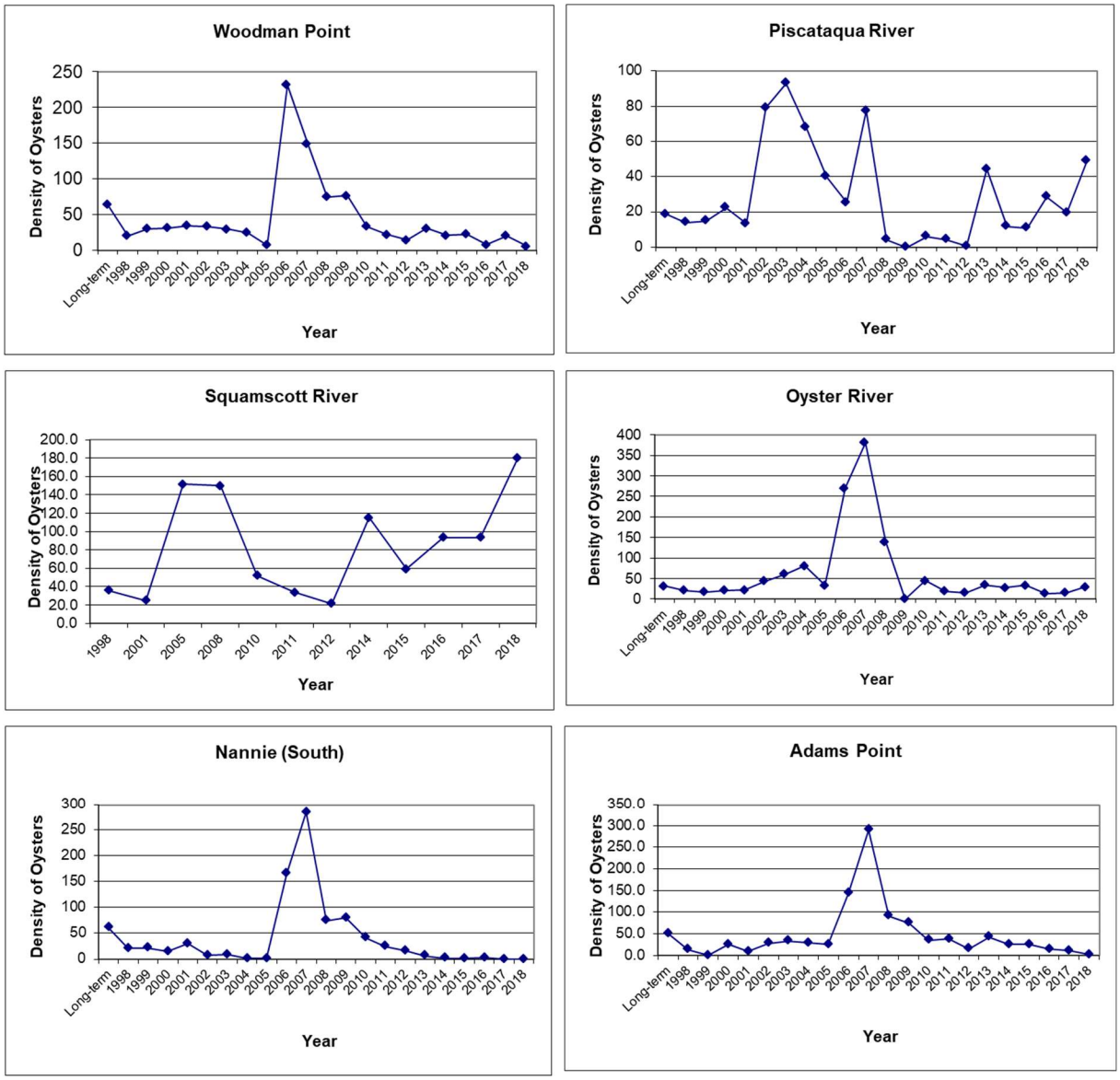


Figure 2. Total oyster density per 0.25 m^2 quadrat, 1991-2018.



Note: "Long-term" is the average of 1991 through 1997 data.

Figure 3. Density of spat per 0.25 m^2 quadrat at six Great Bay Oyster Beds, 1991-2018.