Post-Cruise Report: Pursuit Cruise

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December 15, 2021

The following is a short synopsis of the recent Pursuit cruise. The cruise plan was designed using information canvassed from clam boat captains who relayed locations of high densities of surfclams and ocean quahogs, augmented by recent (2016-2018) NMFS survey data. This information suggested a central tendency for species overlap in the 40-50 m depth range, deeper in the south than in the north. The cruise track was designed to run transects across this depth range from inshore (~35 m) to offshore (~60 m) so that the most inshore location had surfclams only and the most offshore stations had ocean quahogs only. The cruise track oriented the transects at an angle so that the boat zig-zagged through the region to limit time lost in steaming between stations.

At each station, two 5-min dredge tows were taken, one with a wider bar spacing than the other, termed the surfclam and ocean quahog dredges, respectively, hereafter. Analysis was limited to the number and size of clams of the two target species caught in the tow and the GPS-measured tow length. Depth was also recorded.

The following data are available upon request. Tow position (decimal degrees latitude and longitude), station depth, tow distance (m), tow swept area (m^2), number of clams caught (by species), clam size frequency (by species), and clam density (by species and by size class: clams m^{-2}).

In total 117 tows were taken on the cruise, somewhat over 50 stations. With a few exceptions, these stations ranged from offshore Ocean City, Maryland to Hudson Canyon. We briefly sampled a deeper section of the Long Island shelf just north of Hudson Canyon, but full sample analyses were not performed. Summary data are found in Tables 1 and 2. Figure 1 is a map showing the distribution of stations partitioned into 4 groups. The green boxes, oriented offshore, are locations where more than 24 of every 25 clams was an ocean quahog. In most cases, these tows were exclusively ocean quahog. Note that most of these stations are in the 55-60 m range. The dark pink boxes oriented inshore are locations where more than 24 of every 25 clams was a surfclam. In most cases, these tows were exclusively surfclam. Note that most of these stations are in the 30-40 m range. The yellow boxes generally on the inshore half of the intervening region are stations where at least 1 ocean quahog was present for every 25 clams, but no more than 12 (a 50:50 split). The brown boxes generally on the offshore half of the intervening region are stations where at least 1 surfclam was present for every 25 clams, but no more than 12 (a 50:50 split). Both of the station types yielding mixed clams occupy a substantial region between 40 and 55 m with the surfclam-rich stations somewhat inshore of the ocean quahog-rich stations.

Figure 2 shows the estimated density of ocean quahogs at each station. Largest catches were between 40 and 60 m and scattered over most of the surveyed domain. Figure 3 shows the estimated density of surfclams. Largest catches were between 45 and 50 m. Thus, the two species are both abundant over much of the overlap zone.

Figure 4 shows the estimated density of surfclams <120 mm. Generally, these animals would be in the 3-6-year-old age range. We cannot be sure for the offshore samples, as growth is likely slower in colder water, but certainly most of these animals have recruited since 2015. These smaller animals mark locations of surfclam population expansion. Note that most large catches are between 40 and 50 m, but some are between 50 and 60 m. This is clear evidence of population expansion consistently at least out to 55 m.

Note also on Figure 4 areas on the Long Island shelf between 50 and 60 m just north of Hudson Canyon. These are small animals, likely 3-5 years old. The NMFS survey has never recorded surfclams in this region. Their last survey likely was prior to recruitment or the clams were still too small to be caught in the survey dredge. Their capture now is strong evidence that the anticipated expansion of the surfclam population offshore Long Island is well underway. This should be seen as a region likely supporting a future surfclam fishery, if the issue of species overlap can be overcome. We were not able to survey extensively in this region, but we suspect that the surfclam recruitment dynamics observed will extend over much of the western Long Island shelf and we would reiterate the urgency of including that expectation in the positions taken relative to the BOEM windfarm plan.

Tables 1 and 2 have the following basic information: station position in decimal degrees longitude and latitude and the station name (e.g., 1P). The P and S designations stand for port and starboard dredges. The "ocean quahog" dredge was on the starboard side; the "surfclam" dredge was on the port side. DensityS is surfclam density in clams m^{-2} based on measured tow length and dredge width (i.e., swept area). DensityQ is ocean quahog density in clams m^{-2}. The group designations tie into Figure 1. Group clamS are the dark pink squares on Figure 1. Group clamQ are the green squares on Figure 1. Group mixSQ are the yellow squares on Figure 1. Group mixQS are the brown squares on Figure 1.

The densities reported in Tables 1 and 2 are not corrected for dredge efficiency or dredge selectivity. Users of the data should be aware that comparison to NMFS survey data would require both corrections. An estimate of dredge efficiency is provided in Poussard et al. (Fishery Bulletin 119:274-293) and estimates of dredge selectivity are provided in NEFSC (Northeast Fisheries Science Center Reference Document 17-05) for the ocean quahog dredge.

Estimated LPUEs are also provided, broken down by clam species (LpueS, LpueQ) and total LPUE. These estimates are in cages hr^{-1} and are based on the following assumptions. Tow speed is 3.1 kn; the dredge is fished 50 min out of every hour; dredge width is 120 in; dredge efficiency is set to 1.0 because the density estimates provided are not corrected for dredge efficiency. For each species, clams were aggregated into bushels (1.88 ft^3) based on their size-dependent volumetric contribution to the total. For Atlantic surfclams, this procedure is based on the number of clams per bushel for a given 1-cm size interval obtained from direct counts of clams of known size landed in Atlantic City, NJ in 2012. Each sized clam (1 cm interval) is associated with a volume occupied in the bushel, including clam plus void space, and the volumes summed to estimate the total cage volume provided by the dredge haul. These values were originally developed by Powell et al. (J. Northw. Atl. Fish. Sci. 47:1-27) and have been used frequently since then to support modeling of LPUE. For ocean quahogs, detailed conversions are not available. The ocean quahog conversions were estimated from the surfclam 1-cm-scale conversions based on comparison of numbers per volume obtained on the present cruise. The correction factor, 0.654, indicates that a surfclam of a given length occupies 65.4% of the space of an ocean quahog of similar length, a relationship consistent with the larger width of an ocean quahog for a given length than present for a surfclam of similar length,

Table 1. Data obtained using the Ocean Quahog dredge									
Longitude	Latitude	Depth (m)	Surfclam Density (m^{-2})	Ocean Quahog Density (m^{-2})	Surfclam LPUE	Ocean Quahog LPUE	Total LPUE	Station	Group
74.49717	38.19002	45	0.05973	0.00063	0.207	0.002	0.209	1S	clamS
74.35658	38.88325	27	0.10233	0.00000	0.552	0.000	0.552	17S	clamS
73.80994	39.08397	33	0.18303	0.00282	0.810	0.005	0.815	24S	clamS
74.01324	39.17535	34	0.05376	0.00000	0.343	0.000	0.343	25S	clamS
73.74592	39.26125	37	0.29970	0.00789	1.288	0.026	1.314	26S	clamS
73.60512	39.61412	32	0.15932	0.00115	0.746	0.004	0.750	32S	clamS
73.34087	39.53630	34	0.12727	0.00439	0.512	0.014	0.526	59S	clamS
73.56870	39.48947	34	0.07014	0.00164	0.361	0.004	0.365	60S	clamS
73.77235	39.44668	34	0.04292	0.00000	0.230	0.000	0.230	61S	clamS
73.69480	39.03968	35	0.11207	0.00117	0.425	0.005	0.430	66S	clamS
73.79880	39.00035	37	0.27294	0.01032	0.982	0.031	1.013	67S	clamS
74.33360	38.18830	46	0.24459	0.03655	0.659	0.128	0.788	2S	mixSQ
74.29971	38.35662	46	0.35601	0.01826	1.084	0.063	1.147	9S	mixSQ
74.19444	38.82553	37	0.38469	0.01960	1.767	0.066	1.833	16S	mixSQ
73.89962	38.93042	38	0.23145	0.20259	0.951	0.533	1.484	18S	mixSQ
73.78551	38.93970	38	0.35348	0.16452	1.267	0.526	1.793	19S	mixSQ
73.69728	39.02680	40	0.14308	0.01596	0.424	0.057	0.481	23S	mixSQ
73.22440	39.48160	38	0.02858	0.01402	0.106	0.046	0.153	28S	mixSQ
73.18542	39.55359	36	0.26862	0.05797	1.099	0.221	1.320	30S	mixSQ
73.39838	39.57817	33	0.10253	0.01233	0.459	0.031	0.490	31S	mixSQ
73.51019	39.68673	41	0.26322	0.04223	1.034	0.106	1.140	33S	mixSQ
73.40093	39.81208	37	0.51696	0.16334	1.587	0.601	2.188	34S	mixSQ
73.54055	39.78853	36	0.09524	0.03612	0.355	0.141	0.496	56S	mixSQ
73.32508	39.67282	36	0.08738	0.00511	0.340	0.014	0.354	57S	mixSQ
73.16918	39.58937	41	0.53053	0.04803	2.095	0.157	2.252	58S	mixSQ
73.66911	39.23162	44	0.02640	0.01269	0.098	0.041	0.139	63S	mixSQ
73.59760	39.15275	42	0.59925	0.11769	1.937	0.384	2.320	65S	mixSQ
73.83113	38.96912	42	0.25695	0.13892	1.024	0.383	1.407	68S	mixSQ
74.18777	38.71068	43	0.23369	0.11684	0.809	0.327	1.136	72S	mixSQ
74.32066	38.66872	40	0.00955	0.00106	0.038	0.004	0.042	73S	mixSQ
74.19904	38.40705	49	0.04268	0.22266	0.087	0.583	0.670	10S	mixQS
73.59915	38.96940	49	0.20181	0.25715	0.431	0.853	1.284	20S	mixQS
73.51434	38.97567	48	0.23761	0.59461	0.546	1.744	2.290	21S	mixQS
73.61501	39.01775	49	0.02785	0.36522	0.056	1.019	1.074	22S	mixQS
73.12363	39.51688	42	0.29849	0.30793	1.037	1.065	2.102	29S	mixQS
73.56721	39.18380	44	0.04640	0.17186	0.137	0.503	0.639	64S	mixQS
73.81723	38.87762	44	0.14746	0.93117	0.469	2.234	2.703	69S	mixQS
73.78408	38.81348	45	0.15741	0.33260	0.381	0.872	1.253	70S	mixQS
74.20883	38.21985	60	0.00000	0.66345	0.000	1.771	1.771	3S	clamQ

74.10651	38.21643	60	0.00057	0.40243	0.002	0.789	0.791	4S	clamQ
74.08525	38.22570	63	0.00000	0.74285	0.000	1.578	1.578	5S	clamQ
74.16918	38.25153	64	0.00000	0.08182	0.000	0.231	0.231	6S	clamQ
74.18543	38.29092	59	0.00000	0.96490	0.000	2.799	2.799	7S	clamQ
74.26033	38.31777	57	0.00000	0.20438	0.000	0.476	0.476	8S	clamQ
74.10930	38.43638	52	0.00000	0.20137	0.000	0.435	0.435	11S	clamQ
73.85049	38.55887	56	0.01539	0.70812	0.028	1.268	1.296	12S	clamQ
73.63775	38.67033	62	0.00000	1.07275	0.000	2.564	2.564	13S	clamQ
73.73227	38.68022	59	0.00525	0.54013	0.008	1.229	1.238	14S	clamQ
74.00278	38.79352	47	0.00000	0.15269	0.000	0.402	0.402	15S	clamQ
73.49702	38.89820	61	0.00121	0.80428	0.002	1.876	1.878	21AS	clamQ
73.49143	39.37147	45	0.01489	0.84725	0.042	1.714	1.756	27S	clamQ
73.09184	39.49997	62	0.00000	1.38394	0.000	3.465	3.465	29AS	clamQ
73.93015	38.78027	46	0.01595	0.66366	0.037	1.683	1.720	71S	clamQ

Table 2. Data obtained using the Surfclam dredge

Longitude	Latitude	Depth (m)	Surfclam Density (m^{-2})	Ocean Quahog Density (m^{-2})	Surfclam LPUE	Ocean Quahog LPUE	Total LPUE	Station	Group
74.49735	38.18708	45	0.21698	0.00000	0.743	0.000	0.743	1P	clamS
74.32925	38.19422	46	0.10585	0.00306	0.289	0.011	0.300	2P	clamS
74.36740	38.88052	27	0.11716	0.00000	0.686	0.000	0.686	17P	clamS
73.39668	39.57423	33	0.20638	0.00702	1.050	0.018	1.068	31P	clamS
73.60136	39.61305	32	0.14684	0.00056	0.687	0.002	0.689	32P	clamS
73.50055	39.81263	32	0.00000	0.00000	0.000	0.000	0.000	55P	clamS
73.77811	39.43188	34	0.07237	0.00000	0.370	0.000	0.370	61P	clamS
73.85725	39.32998	39	0.00000	0.00000	0.000	0.000	0.000	62P	clamS
73.69442	39.04053	35	0.22442	0.00490	0.839	0.019	0.857	66P	clamS
73.80025	39.00113	37	0.17851	0.00689	0.628	0.025	0.654	67P	clamS
74.32328	38.67428	40	0.12745	0.00451	0.681	0.015	0.696	73P	clamS
74.30932	38.35063	46	0.38901	0.03985	1.205	0.139	1.344	9P	mixSQ
74.19933	38.81902	37	0.12247	0.00993	0.567	0.034	0.601	16P	mixSQ
73.89145	38.93215	38	0.35297	0.04985	1.465	0.146	1.611	18P	mixSQ
73.78555	38.93470	38	0.45794	0.10059	1.709	0.294	2.003	19P	mixSQ
73.69528	39.02945	40	0.28908	0.02652	0.878	0.096	0.973	23P	mixSQ
73.81374	39.08985	33	0.27574	0.02079	1.205	0.057	1.262	24P	mixSQ
74.00657	39.17197	34	0.00220	0.00055	0.011	0.002	0.013	25P	mixSQ
73.74339	39.26282	37	0.17590	0.00962	0.852	0.030	0.882	26P	mixSQ
73.21989	39.48248	38	0.02680	0.01457	0.091	0.046	0.137	28P	mixSQ
73.12148	39.52527	42	0.28412	0.27385	1.038	0.987	2.025	29P	mixSQ
73.18660	39.55438	36	0.30440	0.03986	1.258	0.154	1.412	30P	mixSQ
73.51556	39.68857	41	0.28325	0.02529	1.157	0.072	1.229	33P	mixSQ
73.40493	39.81460	37	0.36083	0.10278	1.259	0.403	1.662	34P	mixSQ
73.54175	39.78718	36	0.17951	0.04727	0.674	0.173	0.848	56P	mixSQ

73.32173	39.67862	36	0.20060	0.01813	0.804	0.068	0.872	57P	mixSQ
73.16205	39.58272	41	0.23259	0.04276	0.932	0.157	1.090	58P	mixSQ
73.34286	39.53703	34	0.15216	0.00733	0.624	0.026	0.650	59P	mixSQ
73.56689	39.49140	34	0.09026	0.00525	0.437	0.014	0.451	60P	mixSQ
73.59435	39.15653	42	0.16722	0.07237	0.541	0.245	0.786	65P	mixSQ
73.83208	38.96972	42	0.19272	0.13983	0.786	0.385	1.171	68P	mixSQ
74.18237	38.71038	43	0.84843	0.20141	3.007	0.568	3.575	72P	mixSQ
74.12290	38.43118	52	0.04952	0.21984	0.091	0.518	0.609	11P	mixQS
73.73700	38.69027	59	0.04063	0.35172	0.076	0.953	1.029	14P	mixQS
73.59728	38.97152	49	0.11541	0.20662	0.249	0.640	0.889	20P	mixQS
73.52625	38.97429	48	0.27433	0.51463	0.758	1.607	2.365	21P	mixQS
73.61602	39.01850	49	0.02066	0.44886	0.043	1.326	1.369	22P	mixQS
73.67030	39.22910	44	0.00851	0.02102	0.032	0.065	0.097	63P	mixQS
73.56478	39.19370	44	0.04928	0.09585	0.153	0.290	0.442	64P	mixQS
73.81760	38.88123	44	0.02615	0.47225	0.077	1.158	1.235	69P	mixQS
74.20831	38.21753	60	0.00103	0.12603	0.003	0.351	0.354	3P	clamQ
74.11842	38.21542	60	0.00000	0.30827	0.000	0.656	0.656	4P	clamQ
74.07982	38.22538	63	0.00000	0.13105	0.000	0.290	0.290	5P	clamQ
74.17188	38.25373	64	0.00000	0.04842	0.000	0.135	0.135	6P	clamQ
74.19125	38.28450	59	0.00000	0.27565	0.000	0.751	0.751	7P	clamQ
74.26311	38.32463	57	0.00000	1.06100	0.000	2.032	2.032	8P	clamQ
74.18533	38.40788	49	0.00122	0.03659	0.002	0.100	0.102	10P	clamQ
73.85475	38.55715	56	0.00693	0.38102	0.012	0.677	0.688	12P	clamQ
73.64083	38.66555	62	0.00000	0.75834	0.000	1.891	1.891	13P	clamQ
74.01715	38.78078	47	0.00000	0.13588	0.000	0.343	0.343	15P	clamQ
73.49258	39.37038	45	0.00676	0.78030	0.017	1.702	1.719	27P	clamQ
73.78412	38.80696	45	0.00057	0.14693	0.002	0.401	0.403	70P	clamQ
73.56277	38.81300	52	0.01398	0.39565	0.022	1.055	1.078	70AP	clamQ
73.92128	38.77783	46	0.01015	0.45677	0.024	1.273	1.297	71P	clamQ

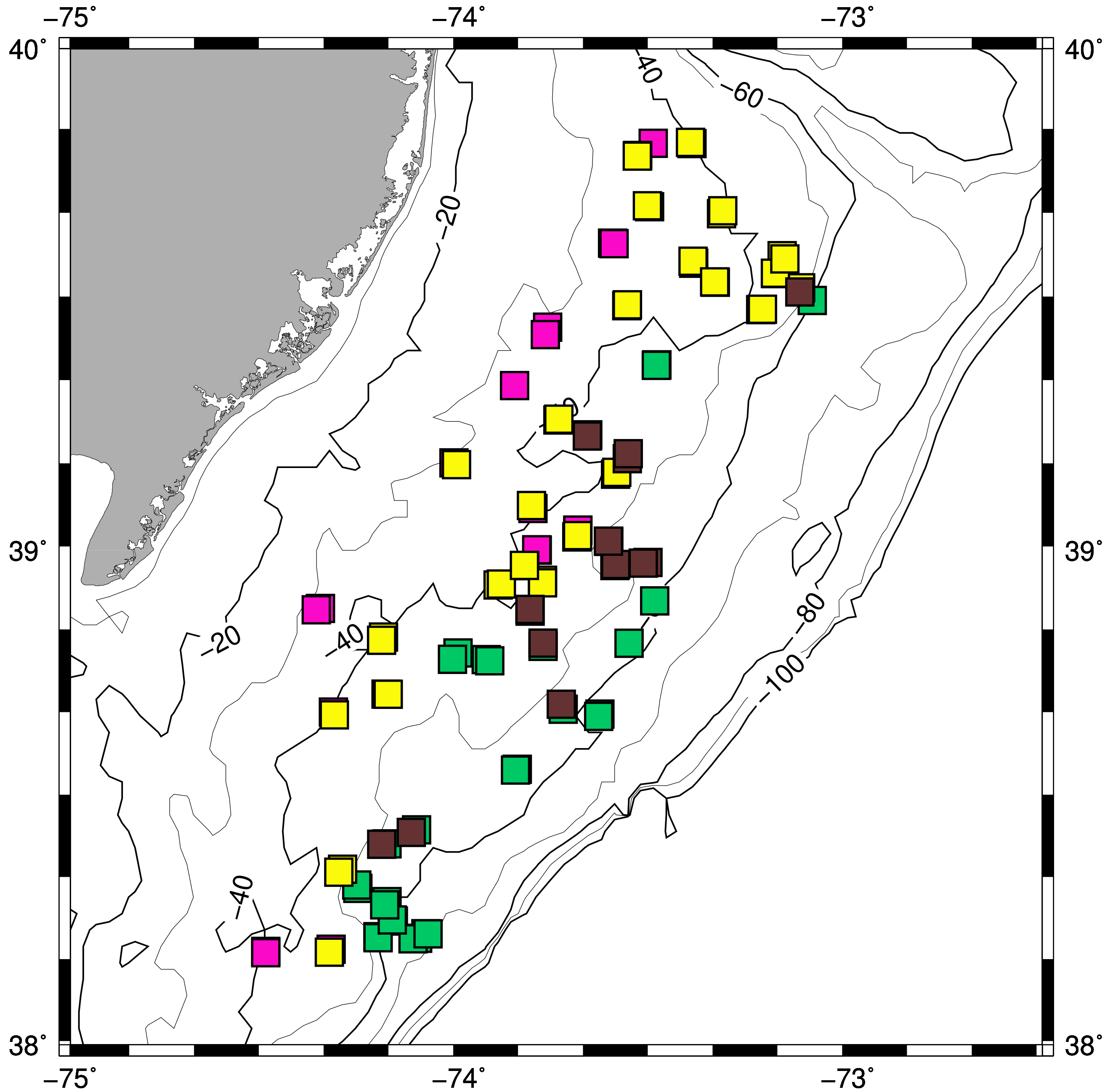

Figure 1. Locations sampled and catch characteristics. Dark pink boxes show locations where >24 of 25 clams were surfclams. Green boxes show locations where >24 of 25 clams were ocean quahogs. Yellow boxes show locations where at least 1 in 24 clams, but less than 12 in 24 were ocean quahogs. Brown boxes show locations where at least 1 in 24 clams, but less than 12 in 24 were surfclams

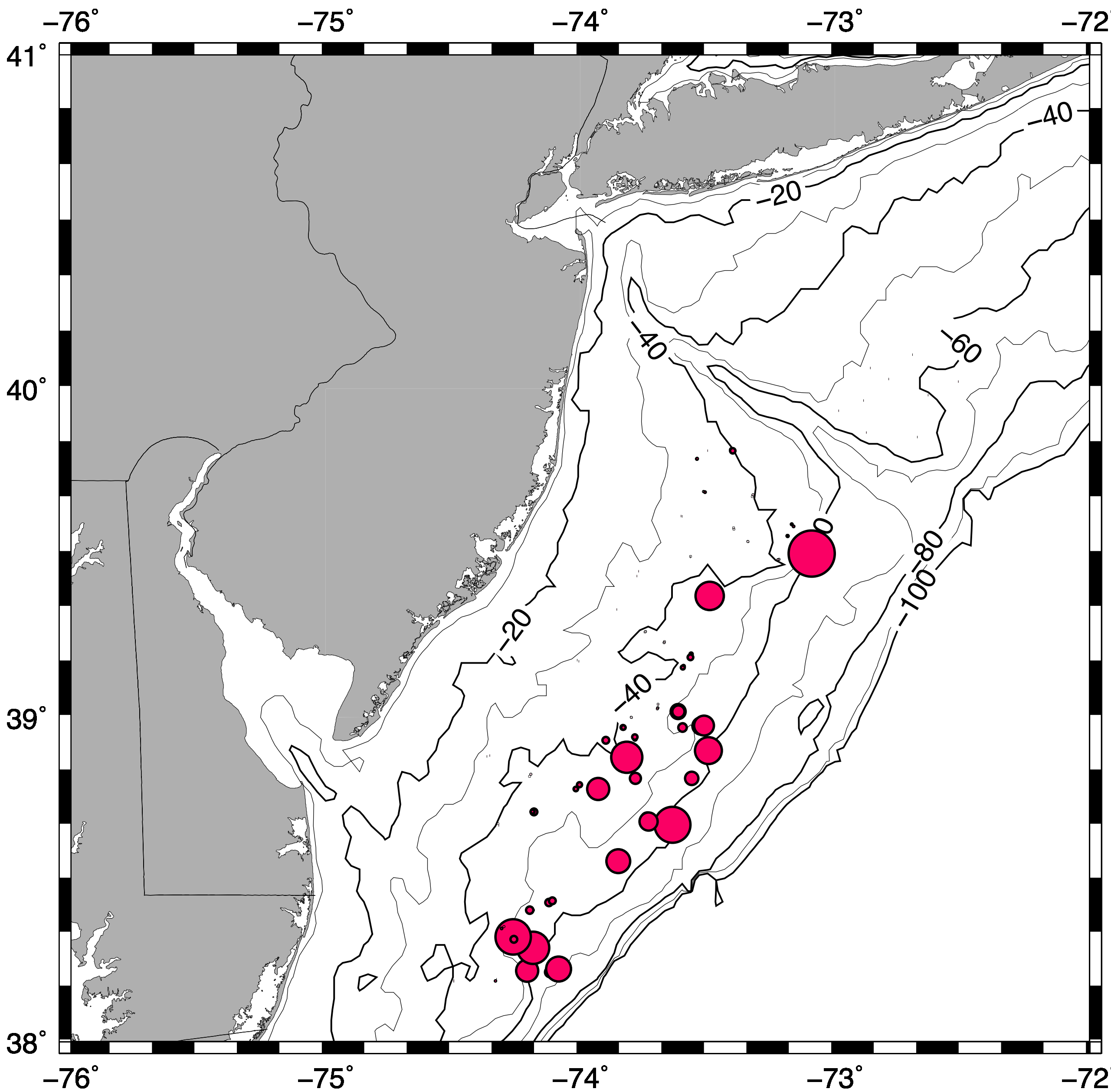

Figure 2. Ocean quahog (*Arctica islandica*) catch. Circle diameters are proportional to numbers per square meter.

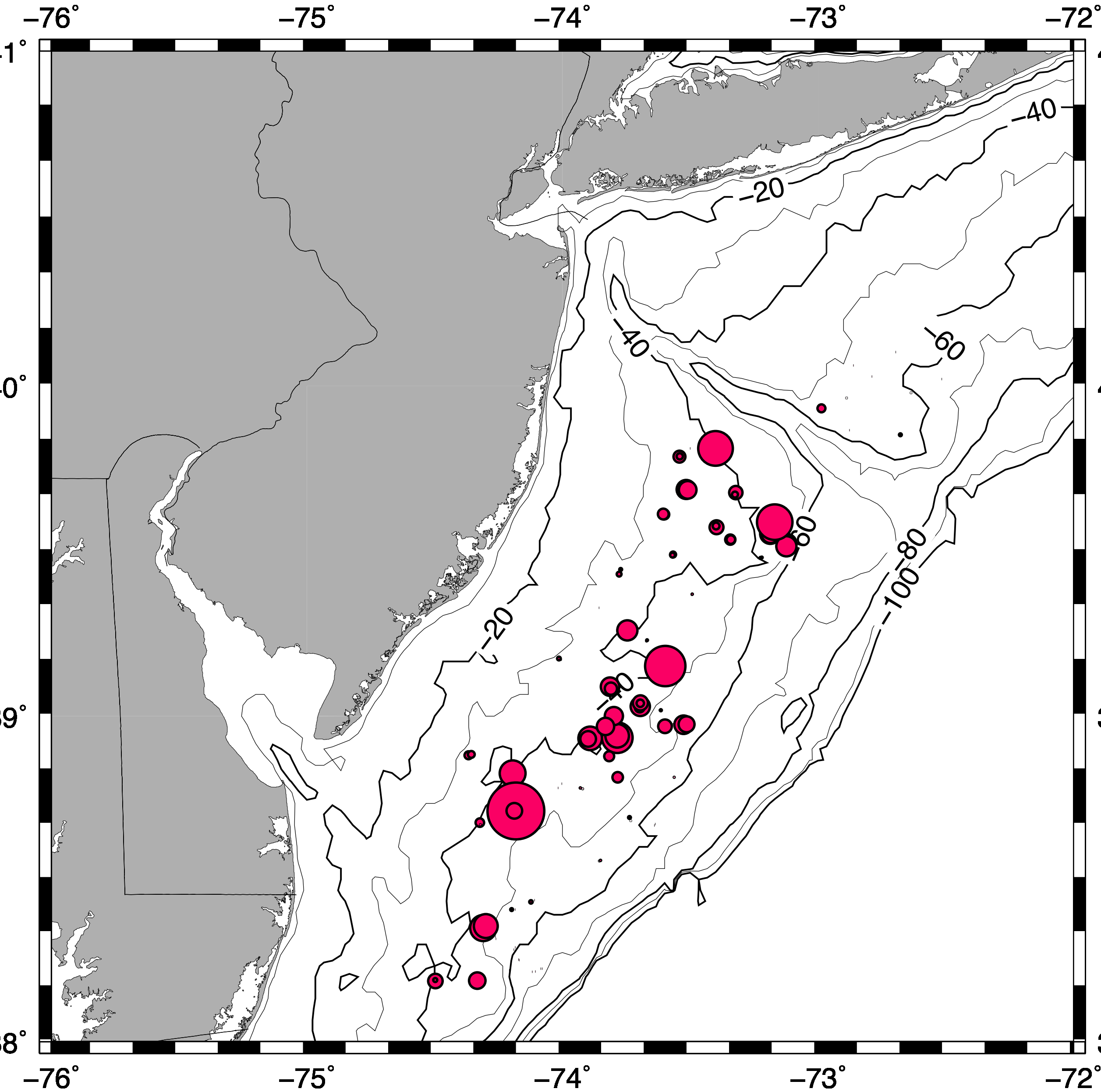

Figure 3. Atlantic surfclam (*Spisula solidissima*) catch. Circle diameters are proportional to numbers per square meter.

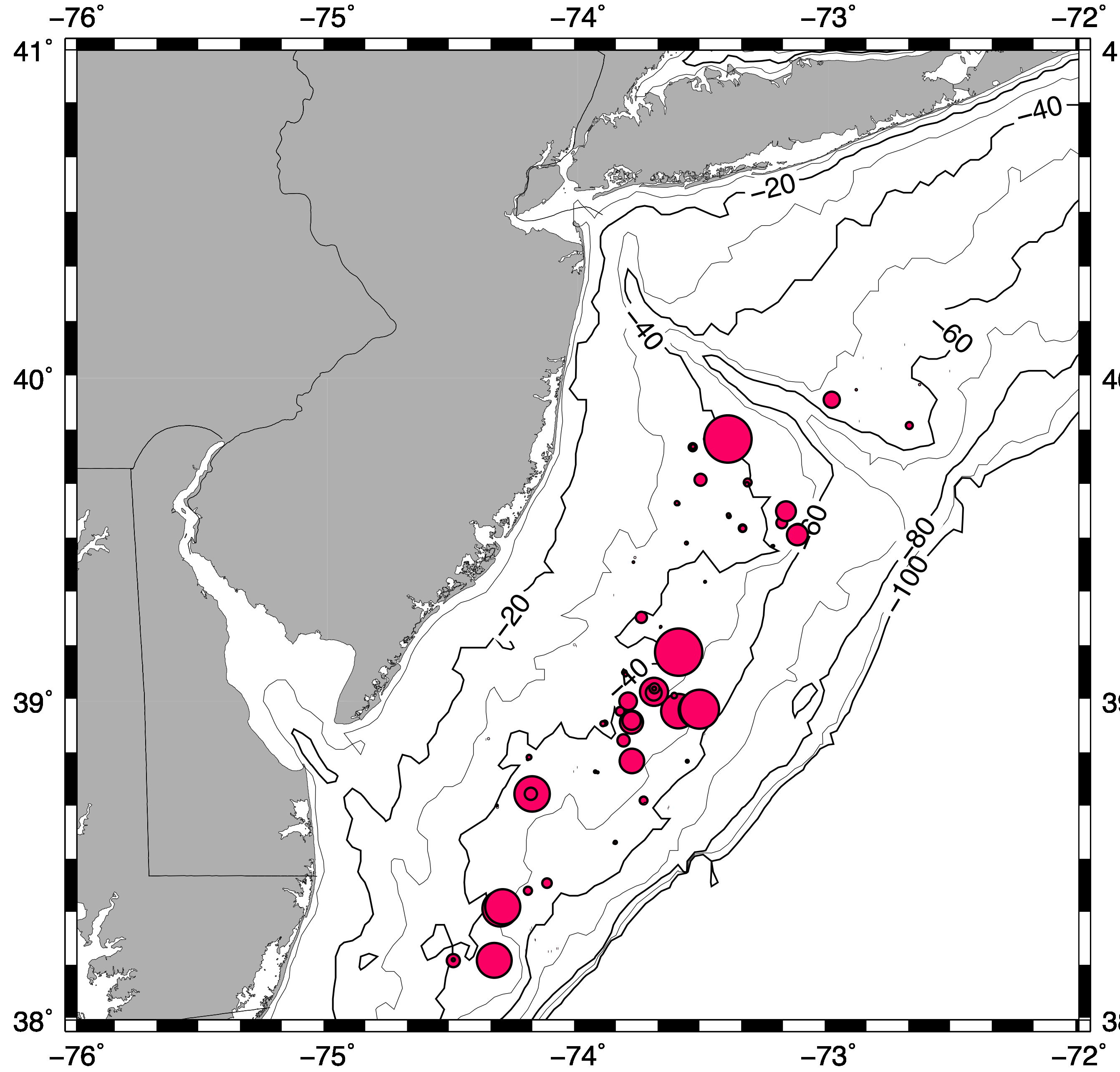

Figure 4. Density of Atlantic surfclams <120 mm. Circle diameter is proportional to numbers per square meter.