

Appendices

Tables & Figures

Table 1.

Exact G Test pairwise comparisons of allelic frequencies at 13 microsatellite loci among 19 collections of monkfish. Pairwise G Test values are above the diagonal and pairwise P Values are below the diagonal. INF= Infinity; HS= Highly Significant. P Values In Bold Are Significant at $P < 0.0091$.

	1A	1B	2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	4C	5A	5B	5C	5D	6A	6B
1A	0	25.52	26.79	29.83	43.69	33.19	27.85	36.88	36.98	61.35	25.069	41.49	26.53	17.9	29.76	36.85	26.86	32.87	32.41
1B	0.49	0	30.05	44.39	44.41	33.97	50.53	41.46	54.22	INF	32.43	42.76	40.08	21.77	28.51	38.19	27.37	47.08	43.12
2A	0.421	0.265	0	32.93	26.45	17.35	21.46	22.17	32.65	INF	29.28	30.21	35.93	17.95	29.58	33.95	24.49	42.16	47.73
2B	0.275	0.0137	0.164	0	31.26	28.31	30.68	25.1	37.15	INF	21.52	35.86	33.96	18.54	28.56	41.53	28.37	43.3	56.32
2C	0.0163	0.0137	0.439	0.219	0	29.52	35.66	40.55	INF	INF	28.67	35	38.77	27.1	30.54	37.91	32.75	50.09	INF
2D	0.157	0.136	0.898	0.344	0.288	0	26.1	30.28	35.87	INF	27.03	34.61	26.36	26.74	29.48	43.01	23.99	45.87	47.81
3A	0.366	0.003	0.718	0.24	0.098	0.457	0	41.73	46.71	INF	28.71	39.72	46.25	26.65	32.91	45.92	30.17	43.69	57.51
3B	0.077	0.028	0.679	0.513	0.034	0.256	0.026	0	52.72	INF	21.43	42.36	36.03	25.4	29.51	31.8	30.88	33.4	48.06
3C	0.075	<0.001	0.173	0.072	HS	0.094	0.008	0.001	0	INF	21.74	51.92	35.14	19.89	24.39	34.25	29.25	532.66	INF
3D	<0.001	HS	HS	HS	HS	HS	HS	HS	HS	0	22.09	INF	39.47	23.97	23.4	35.6	25.91	INF	54.83
4A	0.515	0.179	0.299	0.715	0.327	0.408	0.324	0.719	0.703	0.684	0	20.98	11.22	18.2	16.38	14.78	24.5	28.78	23.84
4B	0.028	0.02	0.259	0.094	0.111	0.12	0.042	0.023	0.002	HS	0.742	0	30.41	23.25	26.1	30.37	20.14	59.96	47.57
4C	0.434	0.038	0.093	0.136	0.051	0.434	0.009	0.091	0.109	0.044	0.995	0.251	0	22.73	17.93	26.29	32.95	39.78	28.34
5A	0.879	0.701	0.877	0.855	0.404	0.423	0.428	0.496	0.797	0.577	0.868	0.619	0.648	0	21.92	23.39	26.07	21.96	19.84
5B	0.269	0.334	0.286	0.331	0.246	0.29	0.165	0.288	0.554	0.61	0.927	0.458	0.878	0.693	0	19.96	23.04	29.94	30.03
5C	0.077	0.058	0.136	0.027	0.062	0.019	0.009	0.199	0.129	0.099	0.96	0.252	0.447	0.611	0.793	0	42.24	43.35	39.08
5D	0.417	0.39	0.548	0.34	0.169	0.577	0.261	0.233	0.3	0.468	0.547	0.785	0.164	0.459	0.631	0.023	0	32.46	35.29
6A	0.166	0.006	0.024	0.018	0.003	0.009	0.016	0.151	0.001	HS	0.321	<0.001	0.041	0.691	0.27	0.018	0.178	0	31.87
6B	0.18	0.019	0.006	<0.001	HS	0.006	<0.001	0.005	HS	<0.001	0.585	0.006	0.342	0.799	0.267	0.048	0.105	0.198	0

Table 2.

Pairwise F_{ST} comparison of 19 collections of monkfish based on data from 13 microsatellite loci. P values are above the diagonal and F_{ST} values are below the diagonal. P values in bold are significant at a P value = 0.001

	Pop 1A	Pop 1B	Pop 2A	Pop 2B	Pop 2C	Pop 2D	Pop 3A	Pop 3B	Pop 3C	Pop 3D	Pop 4A	Pop 4B	Pop 4C	Pop 5A	Pop 5B	Pop 5C	Pop 5D	Pop 6A	Pop 6B
Pop 1A	0	0.482	0.708	0.165	0.013	0.065	0.274	0.079	0.219	0.011	0.622	0.074	0.689	0.980	0.270	0.185	0.385	0.213	0.142
Pop 1B	0.000	0	0.448	0.060	0.051	0.301	<0.001	0.095	0.061	0.018	0.473	0.054	0.383	0.866	0.251	0.369	0.348	0.023	0.262
Pop 2A	0.000	-0.003	0	0.090	0.321	0.867	0.427	0.693	0.509	0.017	0.639	0.291	0.427	0.954	0.197	0.399	0.535	0.062	0.047
Pop 2B	-0.001	0.000	-0.002	0	0.092	0.231	0.213	0.420	0.161	<0.001	0.862	0.109	0.558	0.934	0.358	0.153	0.291	0.027	0.011
Pop 2C	0.005	0.001	-0.005	-0.002	0	0.320	0.026	0.015	0.017	<0.001	0.580	0.262	0.185	0.619	0.164	0.316	0.102	<0.001	0.002
Pop 2D	-0.003	0.000	-0.006	-0.005	-0.002	0	0.259	0.219	0.178	0.030	0.691	0.292	0.682	0.586	0.177	0.129	0.741	0.013	0.130
Pop 3A	-0.002	0.001	-0.005	-0.001	-0.001	-0.003	0	0.016	0.080	<0.001	0.784	0.056	0.072	0.692	0.159	0.100	0.445	0.010	0.009
Pop 3B	0.007	0.003	-0.004	-0.004	-0.004	-0.002	-0.002	0	0.027	<0.001	0.892	0.026	0.234	0.345	0.130	0.412	0.151	0.121	0.024
Pop 3C	-0.002	0.002	-0.002	-0.001	0.000	-0.003	0.001	0.004	0	0.001	0.821	0.054	0.444	0.932	0.313	0.377	0.333	0.032	0.030
Pop 3D	0.003	0.002	0.004	0.007	0.005	0.005	0.004	0.011	0.005	0	0.876	0.017	0.210	0.832	0.446	0.347	0.524	<0.001	0.096
Pop 4A	-0.023	-0.003	-0.011	-0.028	-0.010	-0.031	-0.018	-0.022	-0.020	-0.023	0	0.768	0.977	0.813	0.805	0.891	0.389	0.518	0.655
Pop 4B	0.001	0.000	-0.003	-0.004	-0.002	-0.006	-0.002	0.000	-0.001	0.003	-0.026	0	0.235	0.717	0.148	0.428	0.650	0.005	0.015
Pop 4C	-0.011	0.002	-0.004	-0.007	-0.003	-0.014	-0.006	-0.004	-0.006	0.002	-0.057	-0.009	0	0.589	0.786	0.646	0.122	0.195	0.372
Pop 5A	-0.030	-0.025	-0.026	-0.032	-0.021	-0.026	-0.026	-0.025	-0.028	-0.026	-0.046	-0.024	-0.036	0	0.657	0.466	0.327	0.910	0.865
Pop 5B	-0.012	-0.014	-0.012	-0.031	-0.008	-0.034	-0.018	-0.021	-0.028	-0.024	-0.088	-0.041	-0.077	-0.101	0	0.976	0.428	0.270	0.211
Pop 5C	0.010	-0.004	0.006	0.001	0.007	-0.004	0.006	-0.004	0.000	0.003	-0.072	-0.009	-0.025	-0.051	-0.132	0	0.003	0.267	0.063
Pop 5D	0.060	0.052	0.065	0.058	0.092	0.035	0.070	0.086	0.056	0.038	0.071	0.024	0.019	0.018	-0.155	0.036	0	0.239	0.098
Pop 6A	0.004	0.006	0.002	0.003	0.008	0.003	0.004	0.002	0.005	0.019	-0.011	0.003	-0.005	-0.026	-0.037	0.007	0.057	0	0.649
Pop 6B	-0.002	0.019	0.014	0.013	0.019	0.012	0.013	0.009	0.015	0.026	-0.012	0.016	-0.002	-0.034	-0.001	0.019	0.102	0.001	0

Table 3.**Monkfish microsatellite loci isolated, characterized, and screened in 1,329 monkfish specimens in this project**

Locus Name	Primers used in PCR	Repeat	Annealing ⁰
MK2183	Forward: TTGAAATGGACAAGAACCCTG Reverse: TCCTCAATACTGAAACCGCC	(AATG) ⁿ	64° C
MK2242	Forward: AATTCTATGAAATAAATATGCGAAACA Reverse: TGCGTTCAGTCAACATGGA	(ATC) ⁿ	64° C
MK2227	Forward: AAGTCTGAGAGGAGGGAGGG Reverse: GTGTCTGGACCTCAATCACCT	(GGA) ⁿ	56° C
MK4490	Forward: CCTCAGGCTTAGAGTGGTGC Reverse: GTTGTGTCTGGCGTAAGGCT	(TG) ⁿ	56° C
OVI-Lb-B20	Forward: CAGCCCATAGGAAATAGACTG Reverse: AGAAAAGTGAAAGCAACACAA	(CT) ⁿ	64° C
MK25862	Forward: TTCGCCCTCTGTTTGTCTCT Reverse: TAACGCTCCCAAGTCAAAG	(TCTG) ⁿ	64° C
MK17706	Forward: TCCTGTGATGCTGATGATTGAC Reverse: TGAGAGTGAGACCTCCTACAAC	(TTG) ⁿ	58° C
MK64199	Forward: GTACGTGTAAGCTATTTGGAAGG Reverse: TTTTAAAACGTCGGAAGTGCTG	(GAATA) ⁿ	64° C
MK14651	Forward: GCTCTCCTCTTGCAACCTATAG Reverse: TCCTGTTGTGATAAAGTGGCTC	(ATG) ⁿ	58° C
MK156116	Forward: TCATCTACATGCCTTTCAACAAG Reverse: CTTTCAACGACAGTGAACATC	(CTCT) ⁿ	58° C
MK177332	Forward: TGGTCATCTGAAGAACTCCAC Reverse: CCACTTTCCACATGCTGATTATG	(TTG) ⁿ	58° C
MK178262	Forward: CGTTATTGTCTTTGTCTGCGAC Reverse: TCATGGGTTCTATCGTCAGTC	(CTT) ⁿ	58° C
Lobu(CA)1	Forward: AACATTATTGTTTCTTTCTTGG Reverse: TTTACCTGACTGCTGAGGAT	(TG) ⁿ	58° C

Table 4.

Characterization of allelic diversity, mean allelic richness, observed and expected, Fst, and Fis at 13 monkfish microsatellite loci in 19 collections of monkfish

Monkfish Locus	Total N Alleles	Mean Allelic Richness	Observed Hetero	Expected Hetero	Fst	Fis
MK2183	7	2.842	0.406	0.422	0.0023	0.0381
MK2242	7	3.236	0.594	0.583	0.0005	0.0118
MK2227	10	2.955	0.516	0.626	0.0003	0.0153
MK4490	5	2.092	0.656	0.667	0.0041	0.0203
OVI-Lb-B20	15	4.523	0.859	0.807	0.0006	0.0469
MK25862	12	2.048	0.344	0.331	0.0007	0.0024
MK17706	81	7.374	0.641	0.746	0.0015	0.0593
MK64199	10	3.821	0.969	0.972	0.0008	0.0198
MK14651	18	3.617	0.594	0.643	0.0025	0.0172
MK156116	27	5.439	0.656	0.717	0.0022	0.1436
MK177332	16	3.414	0.719	0.775	0.0015	0.0141
MK178262	14	4.098	0.781	0.851	0.0012	0.0271
Lobu(CA)1	6	2.019	0.375	0.359	0.0001	0.0823
Total	228					
Mean	17.5	3.652	0.624	0.654	0.0005	0.0361

Table 5. Monkfish Sampling Network Roster

Fisherman	Vessel	State
Scott Dudley	Laura Peggy	Connecticut
Roger Wooleyhan	Wooly Bully	Maryland
William Grimm	Perception	New York
Charles Etzel	Clover	New York
Rick Stevenson	Sea Smoke	New York
Hank Lackner	Jason and Danielle	New York
Jim Rhule	Darana R	North Carolina
Jamie Wescott	Risky Business	North Carolina & Virginia
Tommy Danchise		North Carolina & Virginia
Fox Fisheries (Jim Fox)	Rayda Cheramie	Rhode Island
Tim Caldwell	CW Griswold	Rhode Island
Ted Platz	Louise	Rhode Island
John Stoltsgif	Martha Porter	Rhode Island
Todd Sutton	Sweet Misery	Rhode Island
Chris Roebuck	Karen Elizabeth & Yankee Pride	Rhode Island
Chris Walker	Krists~Caleb~Morgan	Virginia

Fleet Contributors	Vessel(s) or Number of Vessels	State
Town Dock	7	Rhode Island
Lund's Fisheries	5	New Jersey
Viking Village	Various	New Jersey
Cape May Fisheries	Various	New Jersey

Dockside Contributors	Vessels	State
Portland Fish Exchange	Various	Maine
Cape Anne Seafood Display Auction	Various	Massachusetts
New Bedford Whaling City Seafood Display Auction	Various	Massachusetts
Fulton Fish Market	Various	New York

Figure 1: Sampling Strata Map

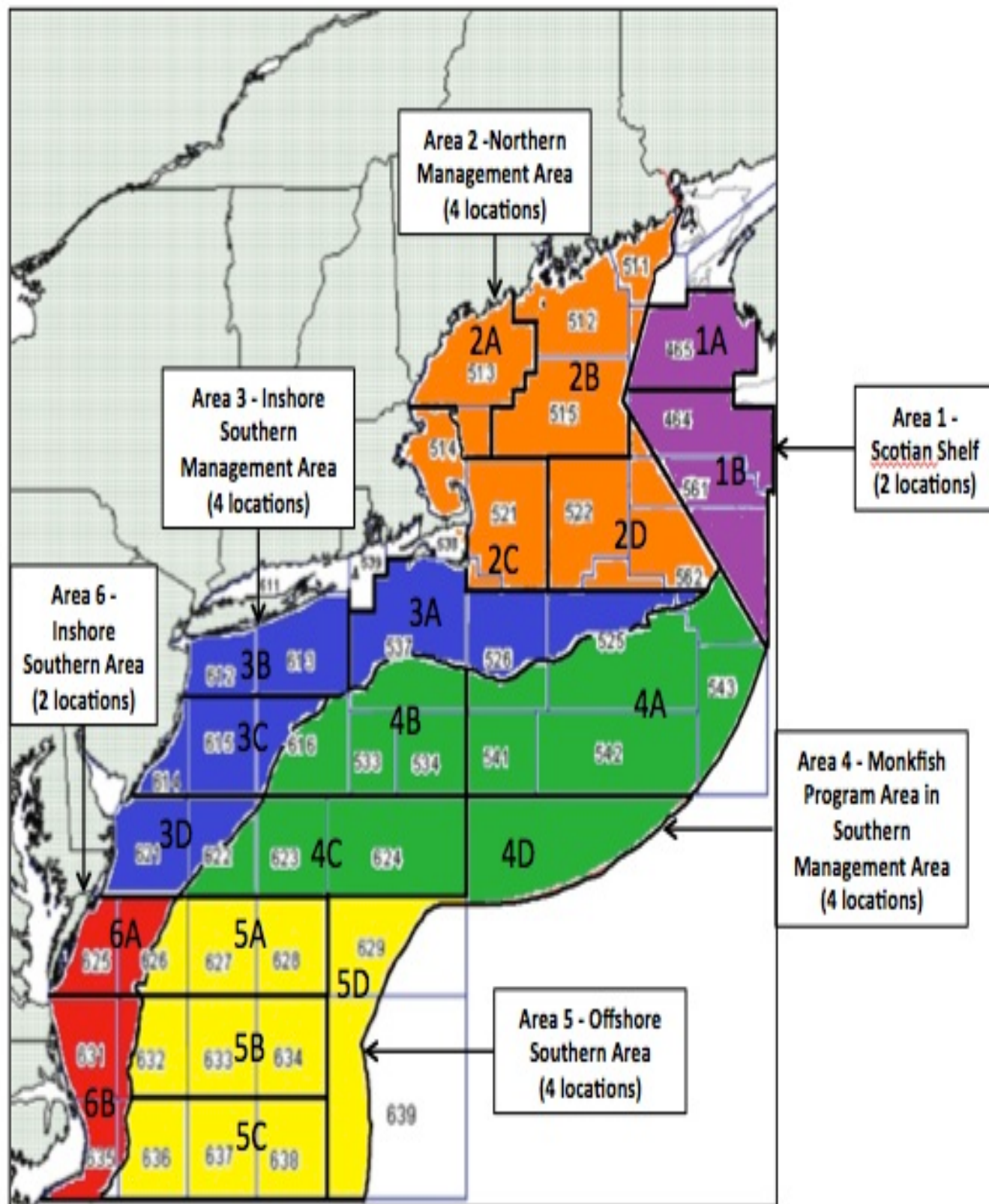
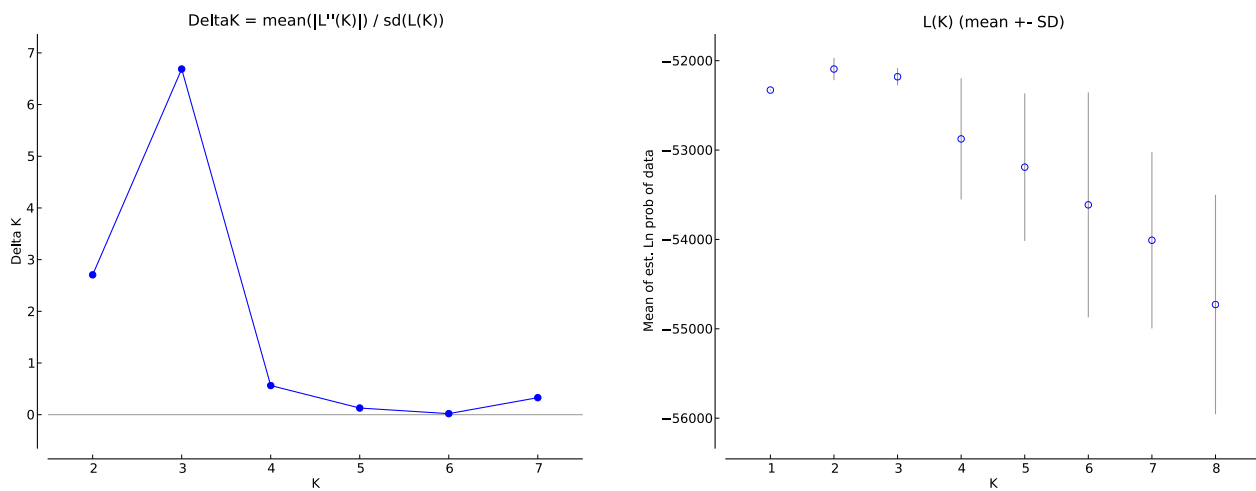


Figure 2. STRUCTURE Analysis

Results of STRUCTURE Analysis



K = number of genetic clusters among all the specimens genotyped

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
166 Water Street
Woods Hole, MA 02543

November 16, 2015

To whom it may concern:

As the lead monkfish scientist for NOAA Fisheries, I am writing to express my support for the Monkfish RSA project, "Fine Scale Genetic Population Structure of Monkfish". This is a continuation of an earlier Monkfish RSA project that was very well done and provided results that could have important implications for monkfish management. However, a continuation of this study is needed to strengthen and further test the preliminary conclusions from the first project.

Sincerely,

Anne Richards, Ph.D.
Research Fishery Biologist
Northeast Fisheries Science Center
Woods Hole, MA 02540
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Richard B. Robins, Jr., Chairman | Lee G. Anderson, Vice Chairman
Christopher M. Moore, Ph.D., Executive Director

November 13, 2015

Mr. Emerson Hasbrouck
Cornell Cooperative Extension
423 Griffing Avenue, Suite 100
Riverhead, New York 11901

Dear Emerson:

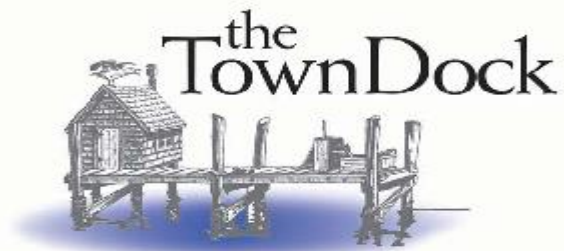
Please accept this letter of support for your research project titled "Fine Scale Genetic Population Structure of Monkfish" being submitted by the Cornell University Marine Program and the NYU Medical center in response to the 2016 Monkfish RSA FFO. Further exploration of Monkfish stock structure appears warranted given your previous work.

Please call or write if you have any questions.

Sincerely,

Christopher M. Moore, Ph.D.
Executive Director

cc: R. Robins, L. Anderson, M. Luisi, J. Didden



Tara Froehlich
Cornell Cooperative Extension
Marine Program
423 Griffing Avenue
Riverhead, NY 11901

November 16th, 2015

Dear Ms. Froehlich,

We are writing in support for your Monkfish RSA project titled: "A Fine Scale Genetic Population Structure of Monkfish".

We support any opportunity for expanding research on Monkfish, especially any studies that might clarify stock structure and ensure healthy populations.

Sincerely,

Katie Almeida
Fishery Policy Analyst