



ROY COOPER  
*Governor*

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*Secretary*

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To: Jason Didden, MAFMC  
From: Holly White, NCDMF  
CC: Chris Batsavage, NCDMF

Subject: 2021 and 2022 River Herring and American Shad Indices Update

Hey Jason,

Please find attached the updates to the annual indices that you requested on May 22, 2023. If you need anything else. Please let me know.

Best,

Holly White

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## Description of work: Juvenile Abundance Index

Eleven seine stations were sampled by DMF bi-monthly with an 18.5 m (60 ft.) bag seine in the western Albemarle Sound area during June-October 2020 (Figure 7). Juvenile Abundance Indices (JAI) for Blueback Herring and Alewife were calculated for the eleven core stations sampled from 1972 through 2022. Only the first sample of each month are use in the calculation.

During the ASMFC 2020 benchmark stock assessment for American Shad a combination of seine stations from the river herring survey (five stations) and the striped bass survey (nine stations), all samples, were selected to determine a juvenile abundance starting in 1996 (zero catches in 1995). A Zero-inflated Negative Binomial (ZINB) generalized linear model (GLM) model was determined as the best recommended predictor of relative annual abundance. Water temperature, salinity, month and cloud cover were all shown to significantly impact catch rates and presence. The best performing model was Counts ~ Year + water temperature + salinity | salinity + cloud cover + month.

Updates to annual trends in abundance are included here as arithmetic mean, in lieu of updating the ZINB model annually. Juvenile Abundance Indices (JAI) for American Shad were calculated for 14 stations sampled from 1996 through 2022.

One unit of effort is equal to one haul of the seine. Samples were sorted by species and 30 randomly selected individuals of each alosine species present were measured. Other species present were also noted. Water temperature, salinity, and other environmental characteristics were measured and recorded.

- Source: Previously, ASMFC North Carolina Shad and River Herring Compliance Report. In 2022 and 2023, compliance report data reporting moved to a workbook format. Tables are updated below, but are no longer provided to the ASMFC in the body of the report.

American Shad juvenile abundance index, from the 14 core stations, Albemarle Sound area, NC, 1972-2022.

Year	# caught	# samples	JAI	SE	PSE
1996	62	85	0.73	0.33	45
1997	43	85	0.51	0.21	42
1998	10	89	0.11	0.11	100
1999	19	86	0.22	0.16	71
2000	195	100	1.95	1.26	65
2001	35	99	0.35	0.20	55
2002	84	100	0.84	0.22	27
2003	752	100	7.52	1.93	26
2004	188	103	1.83	0.54	30
2005	203	99	2.05	0.68	33
2006	35	106	0.33	0.13	38
2007	2	105	0.02	0.01	70
2008	70	294	0.24	0.04	19
2009	129	167	0.77	0.23	29
2010	80	167	0.48	0.24	50
2011	134	157	0.85	0.24	28
2012	52	158	0.33	0.13	40
2013	97	157	0.62	0.22	35
2014	393	167	2.35	0.56	24
2015	391	158	2.47	0.64	26
2016	1,991	163	12.21	5.23	43
2017	203	167	1.22	0.38	31
2018	910	167	5.45	1.39	25
2019	1,163	158	7.36	4.34	59
2020	155	167	0.93	0.23	24
2021	532	167	3.19	1.20	38
2022	307	167	1.84	0.57	31

Blueback Herring juvenile abundance index, from the 11 core stations, Albemarle Sound area,  
NC, 1972-2022.

Year	# caught	# samples	JAI	PSE	Geo. Mean
1972	4,166	13	320.46	95	8.63
1973	16,209	38	426.55	34	36.45
1974	3,008	48	62.67	33	7.90
1975	6,641	50	132.82	33	11.73
1976	7,755	47	165.00	73	5.27
1977	5,784	50	115.68	39	11.32
1978	4,626	49	94.41	29	8.16
1979	4,605	36	127.92	34	10.98
1980	11,111	46	241.54	54	16.38
1981	55	50	1.10	54	0.25
1982	3,541	49	72.27	39	7.58
1983	12,561	50	251.22	61	3.80
1984	1,038	52	19.96	42	1.81
1985	7,124	51	139.69	53	2.47
1986	758	55	13.78	64	1.16
1987	1,378	55	25.06	49	1.25
1988	602	52	11.58	54	0.95
1989	1	55	0.02	100	0.01
1990	505	55	9.18	47	0.99
1991	1,196	55	21.75	96	0.40
1992	51	55	0.93	92	0.10
1993	3,571	39	91.56	98	0.83
1994	0	32	0.00		0.00
1995	78	55	1.42	60	0.30
1996	827	55	15.04	72	1.09
1997	404	55	7.35	47	0.97
1998	24	55	0.44	69	0.13
1999	97	54	1.80	78	0.20
2000	85	55	1.55	47	0.39
2001	228	55	4.15	48	0.55
2002	43	55	0.78	51	0.22
2003	71	55	1.29	56	0.31
2004	815	55	14.82	51	1.17
2005	354	55	6.44	77	0.49
2006	28	55	0.51	86	0.10
2007	1	55	0.02	100	0.01
2008	143	55	2.60	100	0.09
2009	56	55	1.02	68	0.17
2010	30	55	0.55	93	0.09
2011	3	55	0.06	100	0.03
2012	30	55	0.55	74	0.10
2013	733	55	13.33	63	0.72
2014	100	55	1.82	92	0.15
2015	298	55	5.42	59	0.56
2016	0	55	0.00		0.00
2017	206	56	3.68	74	0.27
2018	53	55	0.96	96	0.10
2019	1,783	54	33.02	51	2.56
2020	223	55	4.06	91	0.19
2021	82	55	1.49	61	0.22
2022	608	55	11.06	76	0.54

Alewife juvenile abundance index, from the 11 core stations, Albemarle Sound area, NC, 1972-2022.

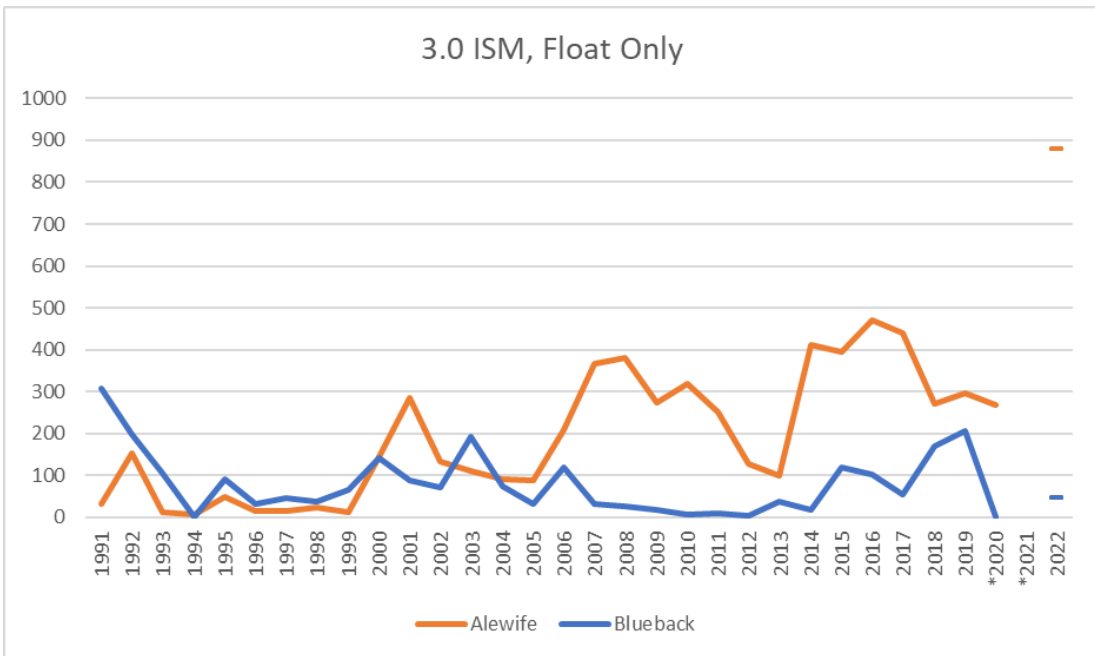
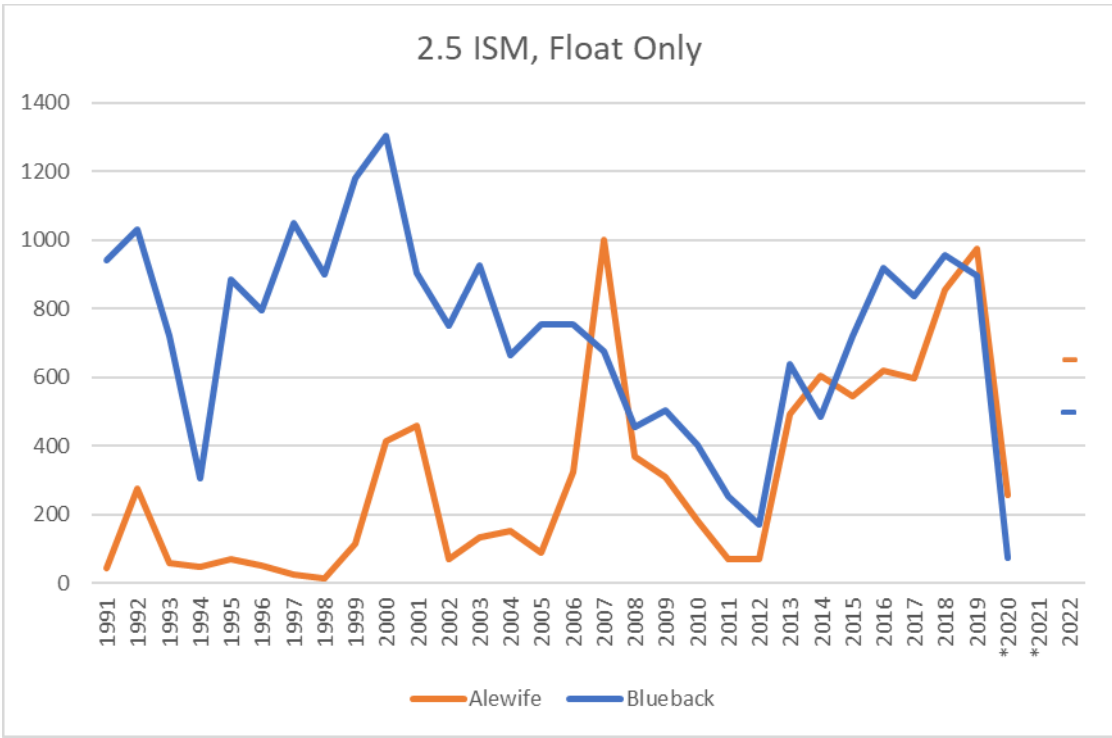
Year	# caught	# samples	JAI	PSE	Geo. Mean
1972	64	13	4.92	95	0.53
1973	320	39	8.21	52	0.76
1974	49	48	1.02	39	0.37
1975	410	50	8.20	68	0.71
1976	64	47	1.36	51	0.38
1977	391	50	7.82	42	1.66
1978	608	51	11.92	27	2.49
1979	160	36	4.44	64	1.03
1980	633	47	13.47	50	1.85
1981	249	50	4.98	96	0.26
1982	28	49	0.57	29	0.32
1983	105	50	2.10	68	0.36
1984	38	52	0.73	45	0.25
1985	200	51	3.92	72	0.46
1986	131	56	2.34	50	0.58
1987	1	55	0.02	100	0.01
1988	10	52	0.19	59	0.09
1989	3	55	0.05	74	0.03
1990	33	55	0.60	94	0.09
1991	0	55	0.00		0.00
1992	1	55	0.02	100	0.01
1993	0	39	0.00		0.00
1994	0	32	0.00		0.00
1995	8	55	0.15	100	0.04
1996	219	55	3.98	37	0.86
1997	1	55	0.02	100	0.01
1998	69	55	1.25	75	0.17
1999	16	54	0.30	58	0.14
2000	23	55	0.42	45	0.19
2001	289	55	5.25	83	0.41
2002	7	55	0.13	50	0.08
2003	81	55	1.47	40	0.42
2004	115	55	2.09	58	0.40
2005	48	55	0.87	82	0.16
2006	1	55	0.02	100	0.01
2007	4	55	0.07	79	0.04
2008	0	55	0.00		0.00
2009	0	55	0.00		0.00
2010	227	55	4.13	40	0.67
2011	44	55	0.80	62	0.17
2012	38	55	0.69	44	0.24
2013	525	55	9.55	46	0.78
2014	0	55	0.00		0.00
2015	392	55	7.13	63	0.40
2016	21	55	0.38	56	0.13
2017	46	55	0.84	82	0.13
2018	329	55	5.98	58	0.51
2019	4	54	0.07	70	0.04
2020	0	55	0.00		0.00
2021	805	55	14.64	50	0.62
2022	25	55	0.45	96	0.07

## Description of work: Albemarle Sound Independent Gill Net Survey

Since 1990, DMF has been conducting an independent gill net survey (IGNS) throughout the Albemarle Sound area. The survey was designed for Striped Bass data collection, however, American Shad and river herring are captured during the survey and size, age, and sex data are collected. American shad and river herring are aged using the scale-age method. Gill net mesh sizes from 2.5 through 7.0 ISM in half-inch increments and 8.0 and 10.0 ISM in whole mesh increments are utilized. The Albemarle Sound IGNS is conducted from November through May, but results for shad and river herring are only reported for January through May. River herring catch is only reported from gill net mesh 2.5 and 3.0, because catches of these fish at other times and larger gill net mesh are rare. Areas fished, sampling effort and sampling frequency vary seasonally. Each unit of effort is one 40-yard net, fished for 24-hours. Gill nets are fished in 40-yard shots totaling 960 yards per set.

Program 135 was suspended in February 2020 due to COVID-19 restrictions and protected species interactions. The survey resumed in the fall of 2021. In November 2021, the Albemarle Sound Independent Gill Net Survey (IGNS) expanded from six to eight zones and reduced soak time from 24-hours to 12-hours. Additionally, in March 2022, sink gill nets were removed from the survey, reducing effort to 480 yards per set (12 units of effort). Additional zones were added to meet NCDMF research priorities to expand the spatial coverage of the survey. Soak times were reduced and sink nets were removed to reduce interactions with endangered species through ongoing consultation with the United States Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Association (NOAA Fisheries). It should be noted that with such a major change in survey design, the index derived from this survey starting in November 2021 will not be directly comparable to the prior historical time series. When calculating relative abundance using historical IGNS data, all sink gill nets were removed.

- Source: Previously, ASMFC North Carolina Shad and River Herring Compliance Report. In 2023, compliance report data reporting moved to a workbook format. Tables are updated below, but are no longer provided to the ASMFC in the body of the report.
- Total number of river herring from the NC Albemarle Sound independent gill net survey, 1991-\*2022.
  - \*January-February 2020 sampling only, not sufficient to determine index for 2020. Survey did not occur in 2021.



- Total number of river herring from the NC Albemarle Sound independent gill net survey, 1991-\*2022, float net only.

Year	2.5 ISM		3.0 ISM	
	Blueback	Alewife	Blueback	Alewife
1991	942	43	307	33
1992	1031	277	199	152
1993	722	60	105	12
1994	304	47	1	7
1995	886	69	92	49
1996	794	51	31	16
1997	1048	26	45	16
1998	901	12	38	24
1999	1179	115	67	11
2000	1305	413	142	143
2001	902	460	87	286
2002	749	69	72	133
2003	926	132	192	110
2004	666	151	74	92
2005	754	90	32	87
2006	754	324	119	209
2007	675	1002	32	367
2008	455	367	27	381
2009	505	309	17	274
2010	402	182	7	320
2011	252	71	10	252
2012	171	69	3	128
2013	640	491	37	99
2014	486	603	19	411
2015	719	546	120	396
2016	918	620	101	471
2017	835	598	53	439
2018	955	856	169	272
2019	898	975	206	297
*2020	72	256	2	269
*2021				
2022	496	653	46	880

\*January-February sampling only, not sufficient to determine index for 2020. Survey did not occur in 2021.

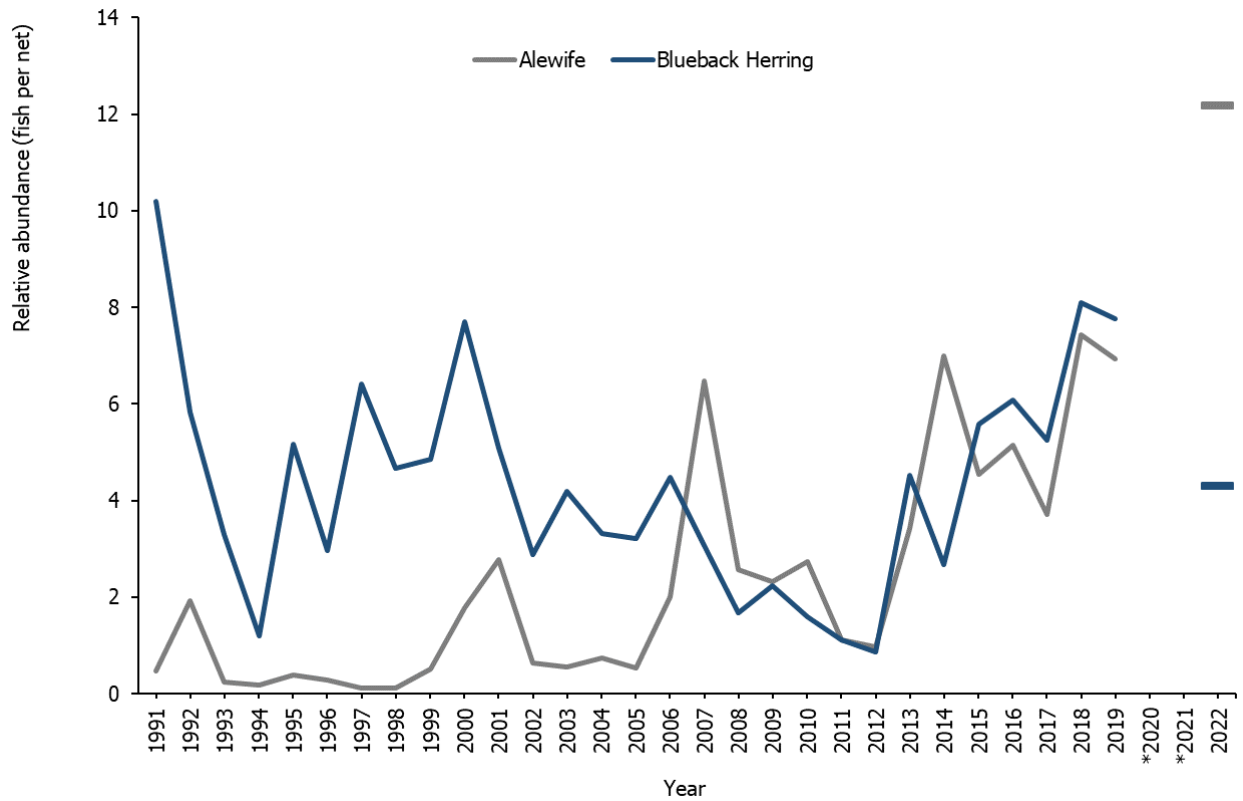


- River herring CPUE from the Albemarle Sound independent gill net survey (2.5 and 3.0 ISM combined, float net only), 1991-\*2022. \*January-February sampling only, not sufficient to determine index for 2020. Survey did not occur in 2021.
- Source: ASMFC Shad and River Herring Compliance Report NC 2023

Alewife					Blueback Herring				
Year	Effort	Sum	CPUE	PSE	Year	Effort	Sum	CPUE	PSE
1991	235	76	0.3234	22	1991	235	1249	5.3149	15
1992	273	429	1.5714	18	1992	273	1230	4.5055	12
1993	279	72	0.2581	36	1993	279	827	2.9642	15
1994	264	54	0.2045	30	1994	264	305	1.1553	25
1995	257	118	0.4591	21	1995	257	978	3.8054	14
1996	256	67	0.2617	46	1996	256	825	3.2227	16
1997	262	42	0.1603	23	1997	262	1093	4.1718	14
1998	257	36	0.1401	21	1998	256	939	3.668	15
1999	270	126	0.4667	31	1999	272	1246	4.5809	13
2000	260	556	2.1385	15	2000	260	1447	5.5654	12
2001	246	746	3.0325	12	2001	246	989	4.0203	15
2002	251	202	0.8048	14	2002	251	821	3.2709	15
2003	276	242	0.8768	15	2003	276	1118	4.0507	13
2004	249	243	0.9759	16	2004	249	740	2.9719	16
2005	252	177	0.7024	14	2005	252	786	3.119	17
2006	258	533	2.0659	13	2006	258	873	3.3837	14
2007	253	1369	5.4111	10	2007	253	707	2.7945	16
2008	252	748	2.9683	11	2008	250	482	1.928	19
2009	222	583	2.6261	12	2009	225	522	2.32	18
2010	207	502	2.4251	14	2010	207	409	1.9758	21
2011	214	323	1.5093	18	2011	211	262	1.2417	20
2012	178	197	1.1067	13	2012	181	174	0.9613	23
2013	188	590	3.1383	14	2013	188	677	3.6011	17
2014	195	1014	5.2	11	2014	193	505	2.6166	19
2015	223	942	4.2242	11	2015	223	839	3.7623	15
2016	229	1091	4.7642	11	2016	229	1019	4.4498	14
2017	227	1037	4.5683	10	2017	225	888	3.9467	15
2018	189	1128	5.9683	11	2018	189	1124	5.9471	13
2019	228	1272	5.5789	11	2019	230	1104	4.8	13
*2020	73	525	7.1918	15	*2020	73	74	1.0137	34
*2021					*2021				
2022	126	1533	12.1667	11	2022	126	542	4.3016	18

\*January-February sampling only, not sufficient to determine index for 2020. Survey did not occur in 2021.

- January-May adult river herring index of abundance (2.5 and 3.0 inch stretch mesh, float net only) from the North Carolina Albemarle Sound independent gill net survey 1991-2022. \*January-February sampling only, not sufficient to determine index for 2020. Survey did not occur in 2021.
- Source ASMFC Shad and River Herring Compliance Report NC 2023



- January-May adult American shad female abundance (Quad 2 – western Albemarle Sound, float net only), 2000-2022.
- Source: NC American shad SFP 2023-2027

Year	N	CPUE	SE	PSE
2000	1099	0.0606		
2001	1012	0.05781		
2002	1010	0.08688		
2003	1176	0.06084		
2004	1067	0.02905	0.00637	21.9117
2005	1032	0.05814	0.00933	16.0389
2006	1066	0.06004	0.008	13.3249
2007	1054	0.07875	0.00991	12.5819
2008	994	0.08954	0.01422	15.8795
2009	865	0.06358	0.00972	15.2932
2010	777	0.06306	0.02112	33.4871
2011	814	0.03808	0.00872	22.89675
2012	612	0.03105	0.00702	22.6019
2013	746	0.02681	0.00677	25.248
2014	772	0.06995	0.01336	19.0985
2015	938	0.05437	0.00848	15.6002
2016	924	0.04113	0.00722	17.5509
2017	863	0.02665	0.00655	24.5657
2018	785	0.04586	0.00886	19.3262
2019	924	0.04113	0.00784	19.0658
2020				
2021				
2022	420	0.02857	0.00814	28.4869

- January-May adult American shad female abundance (Quad 2 – western Albemarle Sound, float net only), 2000-2022.
- Source: NC American shad SFP 2023-2027

