Preliminary Genetic Population Structure of Blueline Tilefish *Caulolatilus microps* along the East Coast of the United States

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Preliminary Genetic Population Structure of Blueline Tilefish *Caulolatilus microps* along the East Coast of the United States

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Project Need

The goal of the present study is to obtain a coarse evaluation of the genetic population structure of blueline tilefish, *Caulolatilus microps,* along the east coast of the United States as requested by the South and Mid-Atlantic Fishery Management Councils (SAFMC, MAFMC, respectively). The northern range extent of blueline tilefish was historically documented in NC (Dooley 1978) until recent evidence revealed significant population numbers in VA. Blueline tilefish quickly became the focus of a substantial amount of fishing effort in VA from the commercial and recreational sectors. Commercial landings in VA in the early 2000's averaged ~11,000 lb per year and increased to ~217,000 lb in 2014; likewise, recreational anglers landed ~2,400 blueline tilefish in VA each year in the early 2000's, with recreational landings increasing to 10,000-16,000 in 2014 (NMFS 2015). Blueline tilefish were determined to be overfished and experiencing overfishing off the southeast coast of the United States in 2013 (SEDAR 32, 2013); however, a more recent assessment indicated the stock was no longer considered overfished (NMFS 2015). As blueline tilefish are considered vulnerable to overfishing due to their life history parameters, the fishery was closed in the southern extent of their range in the spring of 2015 in an effort to preserve the stock. With the increased fishing pressure along the entire east coast of the United States, it is imperative to understand the genetic stock structure of Atlantic blueline tilefish to make effective and responsible management decisions regarding the recent high harvest levels in the Mid-Atlantic region.

Sample Collection

A total of 259 genetic samples of blueline tilefish were included in our evaluation. In the northern portion of their range, fin clips (n=136) were collected in cooperation with National Marine Fisheries Service (NMFS) in Norfolk Canyon off the coast of VA in the summer of 2015 (Fig 1, Table 1). Blueline tilefish genetic samples (n=123) from the southern portion of their range were collected by SCDNR's Marine Resources Monitoring, Assessment, and Prediction (MARMAP) group, ranging from NC to FL. Blueline tilefish genetic samples in the south were collected from 2011-2014 and represented a number of tissue types including fin clips (n=57), muscle (n=6), and dried otoliths (n=60). Size ranges of individual fish ranged from 296-871 mm TL in the northern region and 429-722 mm TL in the southern area.

Sample Processing

DNA was isolated from fin clips preserved in sarcosyl urea using a metal beads isolation protocol. Magnetic metal beads (10 µL) (Sera-mag) were mixed with 80 µL 100% isopropanol and 50 µL fin clip sample. After incubating on a magnetic plate for five min, the solution was drained and the DNA-coated metal beads were washed five times with 100 µL of cold 70% ethanol. The samples were dried on the magnetic plate, DNA was eluted with 50 µL of 1x TE (10 mM Tris, 1 mM EDTA), and the isolated DNA was transferred to a clean microfuge tube for long-term storage (-20 °C).

DNA was isolated from otoliths and muscle tissue according to a modified Wizard SV Genomic DNA Purification System protocol (Promega Corporation, Fitchburg, Wisconsin). Each otolith or pea-size muscle sample was placed in a volume of 200 µL digestive solution comprised of nuclei lysis solution, 0.5 M EDTA, 20 mg/ml Proteinase K, and RNase. After incubation for 15 h, the otolith was rinsed with 180 µL of lysis buffer and removed from the solution, allowing the lysis buffer to drain into the digestive solution. Manufacturer's instructions were followed until the final step, when DNA was eluted with 100 µL of 55 °C nuclease-free water and transferred to a -20 °C freezer for long-term storage.

Microsatellite markers were amplified using PCR in singleplex reactions. All amplifications occurred in 11 µL reactions with reagent concentrations equal to those in established multiplexed lab protocols. Reactions were run on I-Cycler ® thermocyclers (Bio-Rad Laboratories, Hercules, CA) using cycling conditions reported for these loci in the species where each locus was developed (Bagley and Geller 1998; Gold et al. 2001; Tringali, M. pers. comm.). After DNA amplification, PCR products were separated and visualized using capillary gel electrophoresis. DNA was denatured with formamide and supplemented with a size standard (400 base pair, Beckman Coulter, Inc., Fullerton, CA) for accurate fragment length analysis. Fragments were separated by size on a CEQ™ 8000 (Beckman Coulter, Inc., Fullerton, CA). Two people independently scored the chromatograms using the CEQ™ 8000 Fragment Analysis Software and resulting genotypes were compared using Compare Spreadsheets software (Office Assistance LLC) for agreement.

Marker Selection and Testing

Genomic DNA was isolated from 14 blueline tilefish muscle samples and screened, using PCR as described above, with four in-house microsatellite suites that were originally optimized for four other species: red snapper, cobia, spotted seatrout, and red drum. These microsatellite suites were selected because the species belonged to families that were readily available and least divergent from Malacanthidae based on molecular phylogenetic data (Betancur et al. 2013). A total of 56 primer pairs were tested for polymorphic amplification in blueline tilefish, yielding four viable primer pairs (three from the red snapper suite and one from the spotted seatrout suite, Table 2).

Summary statistics for all loci including number of alleles (N_A), allelic richness (A), expected (H_E) and observed heterozygosity (H_O), probability of Hardy-Weinburg equilibrium

(HWE; P_{HW}), null allele frequencies, and inbreeding coefficient (F_{IS}) were calculated in Arlequin v3.0 (Excoffier et al. 2005), Genepop v4.1 (Raymond and Rousset 1995), Cervus v3.0.7 (Kalinosky et al. 2007), and FSTAT v1.2 (Goudet 1995) (Table 3). All four loci were tested for deviations from HWE and linkage disequilibrium using Genepop with input parameters set to 100 batches of 5,000 iterations per batch with a 10,000 step burn-in.

None of the loci were significantly linked ($p > 0.192$) and all showed low frequencies of null alleles (< 0.036). Ra7 showed a reduced level of polymorphism (N_A) and size range reduction in blueline tilefish as in their "original species;" Prs275 showed equivalent levels of polymorphism and size range; and Prs240 and Cneb22 showed minor reductions in polymorphism but similar size ranges. Three loci (Ra7, Prs275, and Cneb22) were in HWE in both the northern and southern samples while Prs240 was in HWE only in the southern sample. Although Prs240 did deviate from HWE in the northern sample ($p < 0.001$), it is highly unlikely the marker is under the influence of selection as the deviation only occurred in a portion of blueline tilefish range and in no portion of red snapper's range. Additionally, we conducted a STRUCTURE analysis (see simulation details below) of northern samples alone to determine if multiple genetic populations were the source of the HWE deviation; results indicated K=1 suggesting genetic structure is not confounding the northern sample set. Therefore, we are reporting results retaining locus Prs240 in all analyses; however, we verified no results were influenced by its presence or removal.

Genetic Population Structure

We based our main analyses on Cape Hatteras representing a hypothesized division between the north and south regions. Genetic differentiation between north and south blueline tilefish was evaluated using pairwise comparisons of F_{ST}, a measure of genetic distance, calculated in Arlequin. Allele frequency distributions between north and south samples were compared using an exact G test (1,000 dememorizations, 100 batches, and 5,000 iterations per batch) implemented in Genepop. Additionally, the program STRUCTURE 2.3.3 (Pritchard et al. 2000) was used to probabilistically assign blueline tilefish individuals into K=1 to 4 populations. Simulations were run using the admixture model with correlated allele frequencies with the locprior parameter. Five replicates were run for each K, burn-in period of 100,000, and Markov chain Monte-Carlo replicates after the burn in of 500,000. STRUCTURE HARVESTER was used to evaluate the results and help to select the most appropriate number of clusters.

The F_{ST} comparison showed no significant genetic differentiation between north and south blueline tilefish ($F_{ST} = 0.001$, $p = 0.170$). The comparisons of allele frequency distributions between north and south blueline tilefish agreed with the F_{ST} analysis, showing no significant differences in allele frequencies ($p = 0.138$). Finally, STRUCTURE found that the most appropriate number of clusters of individuals in Atlantic blueline tilefish was K=1 based on likelihood tests (Fig. 2).

To maximize the potential to detect genetic differences if they exist in blueline tilefish along the east coast of the United States, similar population genetic analyses were conducted on datasets which excluded NC samples to evaluate the geographic extremes of blueline tilefish distribution. No differentiation was detected (F_{ST} = 0.001, p = 0.189; G-test p = 0.129; K=1). Additionally, an AMOVA (as implemented in Arlequin) was used to attempt to iteratively determine locations of gene flow breaks in the complete sample distribution; no combinations of distributions resulted in signification partitioning of genetic variation (all F_{ST} p values > 0.481).

Genetic Diversity

All four loci were used to evaluate the genetic health of blueline tilefish along the United States Atlantic coast, although the more polymorphic loci produced higher estimates of all metrics. Genetic diversity (H_E) was low to moderate at individual loci (0.31-0.74), with a population mean of 0.52 (Table 3). Inbreeding was not detected at any locus at the population level (Table 3). The modified Garza-Williamson index (G-W) as implemented in Arlequin ranged from 0.46 (Prs240) and 0.87 (Prs275) for loci individually; the population metric for this index (0.62) is below the general threshold for indicating the population of blueline tilefish has undergone a genetic bottleneck.

Conclusions

Our preliminary investigation of the Atlantic genetic population structure of blueline tilefish with four microsatellite loci suggests there is gene flow across Cape Hatteras off the east coast of the United States. All analyses indicated that there is no significant genetic differentiation between northern and southern samples; therefore, Atlantic blueline tilefish represent a single genetic population (stock). While our limited microsatellite marker suite does provide enough statistical power to detect strong isolation between stocks if it were present, the marker suite does not have adequate power to detect minor changes in allele frequency distributions and subtle gene flow patterns. Therefore, evaluation with a more powerful marker suite would be beneficial to assess small-scale gene flow patterns along the east coast of the United States for blueline tilefish. The genetic health evaluation would also benefit from a more powerful marker suite; although no inbreeding was detected, the genetic diversity levels reported here are yellow flags in terms of the genetic health of the population.

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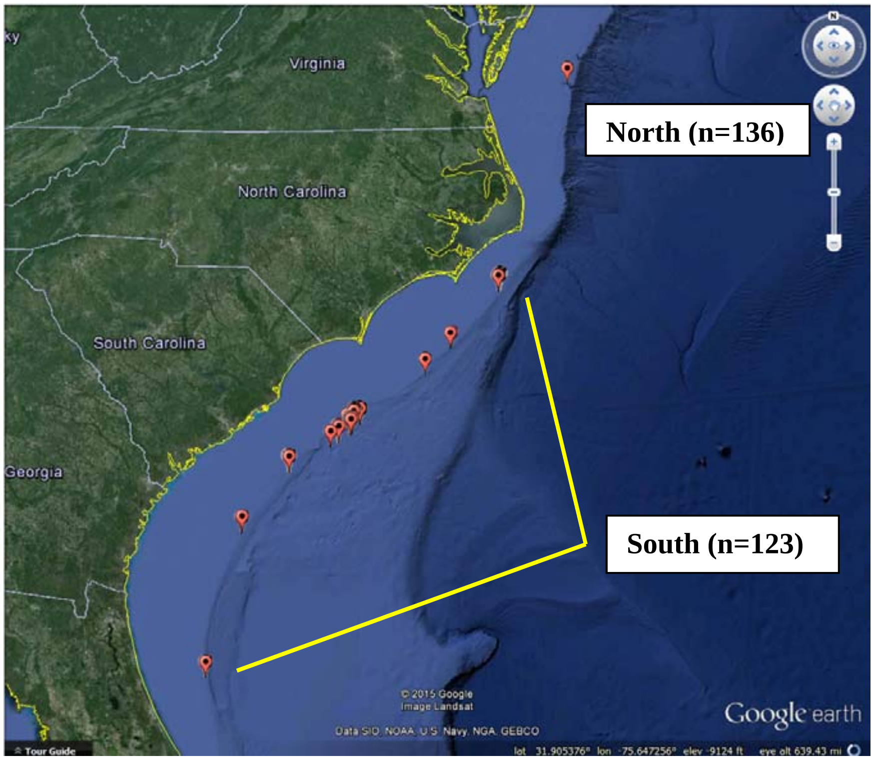

Figure 1. Genetic sample collection locations for blueline tilefish.

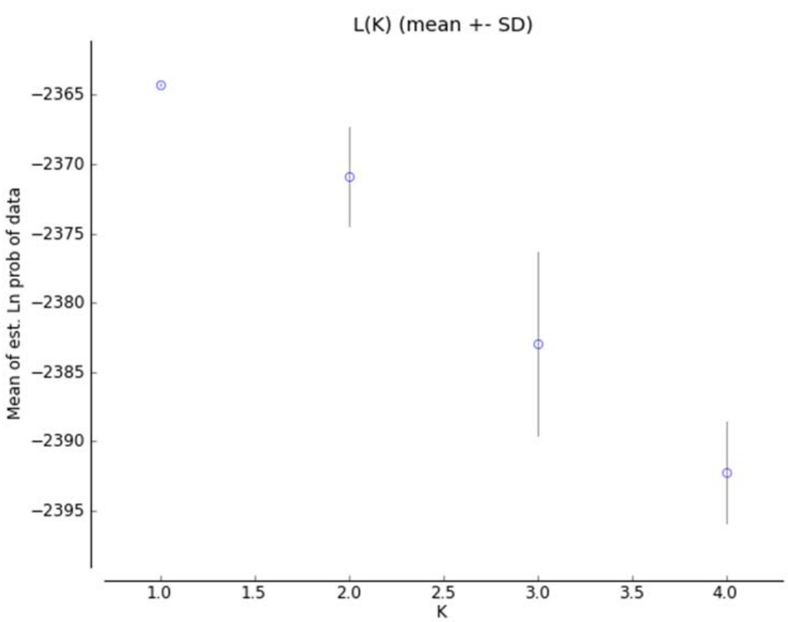

Figure 2. Graphical output from STRUCTURE HARVESTER identifying K=1 as the most appropriate number of clusters for blueline tilefish based on likelihood tests.

Table 1. A summary of genetic samples evaluated from the east coast of the United States.

State	Num. of Samples	Collection Dates	TL Range (mm)
VA	136	7/23/15 - 8/6/15	296-871
NC	31	Aug 2012 - Aug 2014	496-722
SC	82	May 2011 - Oct 2014	429-719
GA	5	Jul 2011 - Jun 2014	567-717
FL	5	Jun 2011 - Aug 2013	520-655
Total	**259**	---	---

Table 2. A summary of the microsatellite markers to evaluate blueline tilefish. Statistics are based on marker performance in the "Original species," referring to the species in which the locus was used in the SC DNR genetic lab.

Locus	Original species	# Alleles	Allelic Size Range	Motif
Ra7	Red Snapper	46	116-216	$[CA]_9TACAA[CA]_3CG[CA]_2A[CA]_7$ $ACACG[CA]_2TACAA[CA]_{10}$
Prs275	Red Snapper	13	124-160	$[CA]_{10}$
Prs240	Red Snapper	23	191-235	$[CA]_{21}$
Cneb22	Spotted Seatrout	14	110-136	$[TG]_{10}$

Table 3. Summary statistics for microsatellite markers grouped by the north, south, and all Atlantic with significant values denoted by bold values. The significant HWE value for the Ra7 locus in the Atlantic is the result of disproportionate influence of rare alleles and becomes non-significant when less stringent expectations are used.

Locus	North	South	Atlantic		Locus	North	South	Atlantic
Ra7					**Prs240**			
n	136	123	259		n	136	122	258
N_A	10	10	12		N_A	6	4	6
A	9.9	9.9	11.9		A	5.9	4.0	6.0
H_E	0.734	0.737	0.736		H_E	0.359	0.257	0.311
H_O	0.743	0.740	0.741		H_O	0.301	0.279	0.290
P_{HW}	0.088	0.278	**0.016**		P_{HW}	**0.000**	0.713	**0.000**
F_{IS}	-0.011	-0.004	-0.006		F_{IS}	0.160	-0.086	0.066
Prs275					**Cneb22**			
n	136	122	258		n	136	120	256
N_A	13	12	13		N_A	6	5	7
A	12.9	11.9	12.9		A	5.6	5.0	7.0
H_E	0.669	0.616	0.644		H_E	0.409	0.388	0.398
H_O	0.662	0.639	0.651		H_O	0.500	0.333	0.421
P_{HW}	0.495	0.938	0.681		P_{HW}	0.105	0.094	0.466
F_{IS}	0.011	-0.039	-0.011		F_{IS}	-0.224	0.142	-0.058

Genetic ID	Collector	Collection Number	2nd Collection Number	Vial #	Collection Date	Year	State	River	Location fine	Latitude	Longitude	TL (mm)	SL (mm)	FL (mm)	Weight (g)	Tissue	Preservative	Gear Type	Region
Cmi-0005	MARMAP	P05100671-1					SC	Atlantic Ocean		32.25	-79.04				1959	Muscle	Sarcosyl urea	Chevron trap	South
Cmi-0006	MARMAP	P05100677-1					SC	Atlantic Ocean		32.25	-79.04				1827	Muscle	Sarcosyl urea	Chevron trap	South
Cmi-0007	MARMAP	140073-1	P05140073061B4381		5/7/2014	2014	SC	Atlantic Ocean		32.56	-78.42	682	563	640	3510	Fin clip	Sarcosyl urea	Longline	South
Cmi-0008	MARMAP	140075-1	P05140075061B4381		5/7/2014	2014	SC	Atlantic Ocean		32.62	-78.31	655	538	616	3014	Fin clip	Sarcosyl urea	Longline	South
Cmi-0009	MARMAP	140078-1	P05140078061B4381		5/7/2014	2014	SC	Atlantic Ocean		32.64	-78.31	662	545	626	3252	Fin clip	Sarcosyl urea	Longline	South
Cmi-0010	MARMAP	140299-1	P05140299324B4381		7/23/2014	2014	SC	Atlantic Ocean		32.25	-79.05	586	486	558	2104	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0011	MARMAP	140300-1	P05140300324B4381		7/23/2014	2014	SC	Atlantic Ocean		32.25	-79.04	605	515	582	2570	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0012	MARMAP	140302-2	P05140302324B4382		7/23/2014	2014	SC	Atlantic Ocean		32.25	-79.03	642	528	613	2973	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0013	MARMAP	140302-3	P05140302324B4383		7/23/2014	2014	SC	Atlantic Ocean		32.25	-79.03	531	420	497	1676	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0014	MARMAP	140302-5	P05140302324B4385		7/23/2014	2014	SC	Atlantic Ocean		32.25	-79.03	429	354	402	873	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0015	MARMAP	140303-1	P05140303324B4381		7/23/2014	2014	SC	Atlantic Ocean		32.26	-79.04	583	480	552	2265	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0016	MARMAP	140303-3	P05140303324B4383		7/23/2014	2014	SC	Atlantic Ocean		32.26	-79.04	586	477	558	2324	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0017	MARMAP	140304-2	P05140304324B4382		7/23/2014	2014	SC	Atlantic Ocean		32.26	-79.04	532	440	500	1681	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0018	MARMAP	Q56140055-1					SC	Atlantic Ocean		32.57	-78.56				2585	Muscle	Sarcosyl urea	Snapper Reel	South
Cmi-0019	MARMAP	Q56140056-1					SC	Atlantic Ocean		32.58	-78.52				2087	Muscle	Sarcosyl urea	Snapper Reel	South
Cmi-0020	MARMAP	Q56140056-2					SC	Atlantic Ocean		32.58	-78.52				1678	Muscle	Sarcosyl urea	Snapper Reel	South
Cmi-0021	MARMAP	Q56140057-1					SC	Atlantic Ocean		32.55	-78.57				2177	Muscle	Sarcosyl urea	Snapper Reel	South
Cmi-0022	MARMAP	143476-1	T60143476324B4381		6/18/2014	2014	GA	Atlantic Ocean		31.5	-79.72	667	548	633	3322	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0023	MARMAP	130040-1	P05130040324B4381		5/14/2013	2013	SC	Atlantic Ocean		32.26	-79.03	693	573	648	4064	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0025	MARMAP	130254-1	P05130254061B4381		6/24/2013	2013	SC	Atlantic Ocean		32.82	-78.07	654	539	614	2849	Fin clip	Sarcosyl urea	Longline	South
Cmi-0026	MARMAP	130258-1	P05130258061B4381		6/24/2013	2013	SC	Atlantic Ocean		32.84	-78.08	662	557	620	3320	Fin clip	Sarcosyl urea	Longline	South
Cmi-0027	MARMAP	130345-1	P05130345061B4381		7/18/2013	2013	SC	Atlantic Ocean		32.63	-78.3	661	545	624	3200	Fin clip	Sarcosyl urea	Longline	South
Cmi-0028	MARMAP	130346-1	P05130346061B4381		7/18/2013	2013	SC	Atlantic Ocean		32.63	-78.3	631	522	600	2700	Fin clip	Sarcosyl urea	Longline	South
Cmi-0029	MARMAP	130347-1	P05130347061B4381		7/18/2013	2013	SC	Atlantic Ocean		32.63	-78.3	642	533	609	3100	Fin clip	Sarcosyl urea	Longline	South
Cmi-0030	MARMAP	130347-2	P05130347061B4382		7/18/2013	2013	SC	Atlantic Ocean		32.63	-78.3	656	534	610	3600	Fin clip	Sarcosyl urea	Longline	South
Cmi-0031	MARMAP	130348-1	P05130348061B4381		7/18/2013	2013	SC	Atlantic Ocean		32.62	-78.31	546	442	508	1850	Fin clip	Sarcosyl urea	Longline	South
Cmi-0032	MARMAP	130348-2	P05130348061B4382		7/18/2013	2013	SC	Atlantic Ocean		32.62	-78.31	642	538	615	2900	Fin clip	Sarcosyl urea	Longline	South
Cmi-0033	MARMAP	130349-1	P05130349061B4381		7/18/2013	2013	SC	Atlantic Ocean		32.62	-78.3	664	548	626	2900	Fin clip	Sarcosyl urea	Longline	South
Cmi-0034	MARMAP	130554-1	P05130554061B4381		8/21/2013	2013	SC	Atlantic Ocean		33.44	-77.02	653	538	618	2950	Fin clip	Sarcosyl urea	Longline	South
Cmi-0035	MARMAP	133941-1	T60133941324B4381		8/21/2013	2013	FL	Atlantic Ocean		29.66	-80.25	520	425	490	1835	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0036	MARMAP	133941-2	T60133941324B4382		8/21/2013	2013	FL	Atlantic Ocean		29.66	-80.25	621	516	592	2965	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0037	MARMAP	133942-1	T60133942324B4381		8/21/2013	2013	FL	Atlantic Ocean		29.66	-80.26	617	516	595	2977	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0038	MARMAP	134371-1	T60134371324B4381		9/21/2013	2013	GA	Atlantic Ocean		31.5	-79.73	692	574	660	4004	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0039	MARMAP	130641-1	P05130641324B4381		10/2/2013	2013	NC	Atlantic Ocean		34.46	-75.9	667	549	644	3506	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0040	MARMAP	130644-1	P05130644324B4381		10/2/2013	2013	NC	Atlantic Ocean		34.47	-75.9	630	517	600	2805	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0041	MARMAP	130650-1	P05130650324B4381		10/2/2013	2013	NC	Atlantic Ocean		34.48	-75.88	593	502	565	2429	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0042	MARMAP	143145-1	T60143145324B4381		5/6/2014	2014	FL	Atlantic Ocean		29.66	-80.25	595	501	562	2110	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0043	MARMAP	140071-1	P05140071061B4381		5/7/2014	2014	SC	Atlantic Ocean		32.56	-78.43	554	454	524	1834	Fin clip	Sarcosyl urea	Longline	South
Cmi-0044	MARMAP	140075-2	P05140075061B4382		5/7/2014	2014	SC	Atlantic Ocean		32.62	-78.31	677	564	637	3158	Fin clip	Sarcosyl urea	Longline	South
Cmi-0045	MARMAP	140076-1	P05140076061B4381		5/7/2014	2014	SC	Atlantic Ocean		32.63	-78.31	615	507	574	2781	Fin clip	Sarcosyl urea	Longline	South
Cmi-0046	MARMAP	140077-1	P05140077061B4381		5/7/2014	2014	SC	Atlantic Ocean		32.63	-78.31	700	567	655	3726	Fin clip	Sarcosyl urea	Longline	South
Cmi-0047	MARMAP	140077-2	P05140077061B4382		5/7/2014	2014	SC	Atlantic Ocean		32.63	-78.31	554	456	526	1860	Fin clip	Sarcosyl urea	Longline	South
Cmi-0048	MARMAP	140078-2	P05140078061B4382		5/7/2014	2014	SC	Atlantic Ocean		32.64	-78.31	562	475	538	2009	Fin clip	Sarcosyl urea	Longline	South
Cmi-0049	MARMAP	140225-1	P05140225324B4381		6/22/2014	2014	SC	Atlantic Ocean		33.76	-76.64	719	611	693	4928	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0050	MARMAP	140300-2	P05140300324B4382		7/23/2014	2014	SC	Atlantic Ocean		32.25	-79.04	616	502	574	2991	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0051	MARMAP	140301-1	P05140301324B4381		7/23/2014	2014	SC	Atlantic Ocean		32.25	-79.04	608	493	573	3028	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0052	MARMAP	140302-1	P05140302324B4381		7/23/2014	2014	SC	Atlantic Ocean		32.25	-79.03	614	506	588	2760	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0053	MARMAP	140303-2	P05140303324B4382		7/23/2014	2014	SC	Atlantic Ocean		32.26	-79.04	630	512	594	2860	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0054	MARMAP	140304-1	P05140304324B4381		7/23/2014	2014	SC	Atlantic Ocean		32.26	-79.04	665	544	626	3118	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0055	MARMAP	140413-1	P05140413324B4381		8/21/2014	2014	NC	Atlantic Ocean		34.46	-75.9	722	625	700	4152	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0056	MARMAP	140413-2	P05140413324B4382		8/21/2014	2014	NC	Atlantic Ocean		34.46	-75.9	552	445	521	2009	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0057	MARMAP	140414-1	P05140414324B4381		8/21/2014	2014	NC	Atlantic Ocean		34.47	-75.89	677	574	651	3462	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0058	MARMAP	140416-1	P05140416324B4381		8/21/2014	2014	NC	Atlantic Ocean		34.49	-75.87	543	459	513	1997	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0059	MARMAP	140416-2	P05140416324B4382		8/21/2014	2014	NC	Atlantic Ocean		34.49	-75.87	496	396	471	1389	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0060	MARMAP	140420-1	P05140420324B4381		8/21/2014	2014	NC	Atlantic Ocean		34.47	-75.88	598	515	576	2504	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0061	MARMAP	140420-2	P05140420324B4382		8/21/2014	2014	NC	Atlantic Ocean		34.47	-75.88	659	561	634	3374	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0062	MARMAP	140420-3	P05140420324B4383		8/21/2014	2014	NC	Atlantic Ocean		34.47	-75.88	570	474	544	2135	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0063	MARMAP	140421-1	P05140421324B4381		8/21/2014	2014	NC	Atlantic Ocean		34.47	-75.89	674	567	652	3774	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0064	MARMAP	140421-2	P05140421324B4382		8/21/2014	2014	NC	Atlantic Ocean		34.47	-75.89	542	462	523	1912	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0065	MARMAP	140423-1	P05140423324B4381		8/21/2014	2014	NC	Atlantic Ocean		34.49	-75.88	626	535	607	2806	Fin clip	Sarcosyl urea	Chevron trap	South
Cmi-0066	MARMAP	140605-1	P05140605061B4381		10/7/2014	2014	SC	Atlantic Ocean		32.73	-78.11	658	546	632	3406	Fin clip	Sarcosyl urea	Longline	South
Cmi-0067	MARMAP	140606-1	P05140606061B4381		10/7/2014	2014	SC	Atlantic Ocean		32.73	-78.11	629	518	596	2852	Fin clip	Sarcosyl urea	Longline	South

Cmi-0068	MARMAP	140614-1	P05140614061B4381		10/7/2014	2014	SC	Atlantic Ocean		32.73	-78.13	696	573	656	4166	Fin clip	Sarcosyl urea	Longline	South
Cmi-0069	NMFS			1	7/23/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	871			8028.5784	Fin clip	Sarcosyl urea		North
Cmi-0070	NMFS	2		2	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	490			1542.2128	Fin clip	Sarcosyl urea		North
Cmi-0071	NMFS	3		3	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	498			1315.4168	Fin clip	Sarcosyl urea		North
Cmi-0072	NMFS	4		4	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	475			1088.6208	Fin clip	Sarcosyl urea		North
Cmi-0073	NMFS	5		5	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	594			2857.6296	Fin clip	Sarcosyl urea		North
Cmi-0074	NMFS	6		6	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	445			952.5432	Fin clip	Sarcosyl urea		North
Cmi-0075	NMFS	7		7	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	400			635.0288	Fin clip	Sarcosyl urea		North
Cmi-0076	NMFS	8		8	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	387			589.6696	Fin clip	Sarcosyl urea		North
Cmi-0077	NMFS	9		9	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	462			952.5432	Fin clip	Sarcosyl urea		North
Cmi-0078	NMFS	10		10	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	753			5533.8224	Fin clip	Sarcosyl urea		North
Cmi-0079	NMFS	11		11	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	481			1133.98	Fin clip	Sarcosyl urea		North
Cmi-0080	NMFS	12		12	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	446			952.5432	Fin clip	Sarcosyl urea		North
Cmi-0081	NMFS	13		13	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	506			1315.4168	Fin clip	Sarcosyl urea		North
Cmi-0082	NMFS	14		14	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	409			589.6696	Fin clip	Sarcosyl urea		North
Cmi-0083	NMFS	15		15	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	419			725.7472	Fin clip	Sarcosyl urea		North
Cmi-0084	NMFS	16		16	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	518			1496.8536	Fin clip	Sarcosyl urea		North
Cmi-0085	NMFS	17		17	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	461			952.5432	Fin clip	Sarcosyl urea		North
Cmi-0086	NMFS	18		18	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	490			1133.98	Fin clip	Sarcosyl urea		North
Cmi-0087	NMFS	19		19	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	421			635.0288	Fin clip	Sarcosyl urea		North
Cmi-0088	NMFS	20		20	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	485			1133.98	Fin clip	Sarcosyl urea		North
Cmi-0089	NMFS	21		21	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	402			589.6696	Fin clip	Sarcosyl urea		North
Cmi-0090	NMFS	22		22	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	448			907.184	Fin clip	Sarcosyl urea		North
Cmi-0091	NMFS	23		23	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	503			1406.1352	Fin clip	Sarcosyl urea		North
Cmi-0092	NMFS	24		24	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	496			1224.6984	Fin clip	Sarcosyl urea		North
Cmi-0093	NMFS	25		25	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	437			816.4656	Fin clip	Sarcosyl urea		North
Cmi-0094	NMFS	26		26	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	494			1224.6984	Fin clip	Sarcosyl urea		North
Cmi-0095	NMFS	27		27	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	510			1451.4944	Fin clip	Sarcosyl urea		North
Cmi-0096	NMFS	28		28	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	463			952.5432	Fin clip	Sarcosyl urea		North
Cmi-0097	NMFS	29		29	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	435			771.1064	Fin clip	Sarcosyl urea		North
Cmi-0098	NMFS	30		30	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	389			498.9512	Fin clip	Sarcosyl urea		North
Cmi-0099	NMFS	31		31	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	455			952.5432	Fin clip	Sarcosyl urea		North
Cmi-0100	NMFS	32		32	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	480			1270.0576	Fin clip	Sarcosyl urea		North
Cmi-0101	NMFS	33		33	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	497			1179.3392	Fin clip	Sarcosyl urea		North
Cmi-0102	NMFS	34		34	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	444			907.184	Fin clip	Sarcosyl urea		North
Cmi-0103	NMFS	35		35	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	424			771.1064	Fin clip	Sarcosyl urea		North
Cmi-0104	NMFS	36		36	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	482			1043.2616	Fin clip	Sarcosyl urea		North
Cmi-0105	NMFS	37		37	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	469			997.9024	Fin clip	Sarcosyl urea		North
Cmi-0106	NMFS	38		38	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	522			1905.0864	Fin clip	Sarcosyl urea		North
Cmi-0107	NMFS	39		39	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	560			1859.7272	Fin clip	Sarcosyl urea		North
Cmi-0108	NMFS	40		40	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	858			7076.0352	Fin clip	Sarcosyl urea		North
Cmi-0109	NMFS	41		41	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	835			7257.472	Fin clip	Sarcosyl urea		North
Cmi-0110	NMFS	42		42	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	451			997.9024	Fin clip	Sarcosyl urea		North
Cmi-0111	NMFS	43		43	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	484			1224.6984	Fin clip	Sarcosyl urea		North
Cmi-0112	NMFS	44		44	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	488			1133.98	Fin clip	Sarcosyl urea		North
Cmi-0113	NMFS	45		45	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	490			1270.0576	Fin clip	Sarcosyl urea		North
Cmi-0114	NMFS	46		46	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	513			1270.0576	Fin clip	Sarcosyl urea		North
Cmi-0115	NMFS	47		47	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	458			997.9024	Fin clip	Sarcosyl urea		North
Cmi-0116	NMFS	48		48	7/30/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	778			5805.9776	Fin clip	Sarcosyl urea		North
Cmi-0117	NMFS	49		49	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	420			725.7472	Fin clip	Sarcosyl urea		North
Cmi-0118	NMFS	50		50	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	421			680.388	Fin clip	Sarcosyl urea		North
Cmi-0119	NMFS	51		51	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	395			589.6696	Fin clip	Sarcosyl urea		North
Cmi-0120	NMFS	52		52	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	481			1133.98	Fin clip	Sarcosyl urea		North
Cmi-0121	NMFS	53		53	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	467			997.9024	Fin clip	Sarcosyl urea		North
Cmi-0122	NMFS	54		54	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	368			362.8736	Fin clip	Sarcosyl urea		North
Cmi-0123	NMFS	55		55	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	498			1224.6984	Fin clip	Sarcosyl urea		North
Cmi-0124	NMFS	56		56	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	342			317.5144	Fin clip	Sarcosyl urea		North
Cmi-0125	NMFS	57		57	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	392			408.2328	Fin clip	Sarcosyl urea		North
Cmi-0126	NMFS	58		58	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	381			408.2328	Fin clip	Sarcosyl urea		North
Cmi-0127	NMFS	59		59	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	429			680.388	Fin clip	Sarcosyl urea		North
Cmi-0128	NMFS	60		60	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	430			725.7472	Fin clip	Sarcosyl urea		North
Cmi-0129	NMFS	61		61	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	391			544.3104	Fin clip	Sarcosyl urea		North
Cmi-0130	NMFS	62		62	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	336			272.1552	Fin clip	Sarcosyl urea		North

Cmi-0131	NMFS	63	63	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	353	362.8736	Fin clip	Sarcosyl urea	North
Cmi-0132	NMFS	64	64	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	385	362.8736	Fin clip	Sarcosyl urea	North
Cmi-0133	NMFS	65	65	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	404	907.184	Fin clip	Sarcosyl urea	North
Cmi-0134	NMFS	66	66	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	391	771.1064	Fin clip	Sarcosyl urea	North
Cmi-0135	NMFS	67	67	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	485	1315.4168	Fin clip	Sarcosyl urea	North
Cmi-0136	NMFS	68	68	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	382	272.1552	Fin clip	Sarcosyl urea	North
Cmi-0137	NMFS	69	69	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	374	317.5144	Fin clip	Sarcosyl urea	North
Cmi-0138	NMFS	70	70	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	422	952.5432	Fin clip	Sarcosyl urea	North
Cmi-0139	NMFS	71	71	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	375	362.8736	Fin clip	Sarcosyl urea	North
Cmi-0140	NMFS	72	72	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	390	997.9024	Fin clip	Sarcosyl urea	North
Cmi-0141	NMFS	73	73	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	735	4399.8424	Fin clip	Sarcosyl urea	North
Cmi-0142	NMFS	74	74	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	493	1315.4168	Fin clip	Sarcosyl urea	North
Cmi-0143	NMFS	75	75	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	473	1542.2128	Fin clip	Sarcosyl urea	North
Cmi-0144	NMFS	76	76	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	462	1587.572	Fin clip	Sarcosyl urea	North
Cmi-0145	NMFS	77	77	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	520	1995.8048	Fin clip	Sarcosyl urea	North
Cmi-0146	NMFS	78	78	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	498	1678.2904	Fin clip	Sarcosyl urea	North
Cmi-0147	NMFS	79	79	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	446	997.9024	Fin clip	Sarcosyl urea	North
Cmi-0148	NMFS	80	80	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	513	2041.164	Fin clip	Sarcosyl urea	North
Cmi-0149	NMFS	81	81	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	393	1133.98	Fin clip	Sarcosyl urea	North
Cmi-0150	NMFS	82	82	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	452	907.184	Fin clip	Sarcosyl urea	North
Cmi-0151	NMFS	83	83	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	370	362.8736	Fin clip	Sarcosyl urea	North
Cmi-0152	NMFS	84	84	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	465	861.8248	Fin clip	Sarcosyl urea	North
Cmi-0153	NMFS	85	85	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	504	1088.6208	Fin clip	Sarcosyl urea	North
Cmi-0154	NMFS	86	86	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	442	725.7472	Fin clip	Sarcosyl urea	North
Cmi-0155	NMFS	87	87	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	490	861.8248	Fin clip	Sarcosyl urea	North
Cmi-0156	NMFS	88	88	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	436	408.2328	Fin clip	Sarcosyl urea	North
Cmi-0157	NMFS	89	89	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	687	3855.532	Fin clip	Sarcosyl urea	North
Cmi-0158	NMFS	90	90	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	664	3583.3768	Fin clip	Sarcosyl urea	North
Cmi-0159	NMFS	91	91	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	331	272.1552	Fin clip	Sarcosyl urea	North
Cmi-0160	NMFS	92	92	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	436	544.3104	Fin clip	Sarcosyl urea	North
Cmi-0161	NMFS	93	93	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	435	544.3104	Fin clip	Sarcosyl urea	North
Cmi-0162	NMFS	94	94	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	443	907.184	Fin clip	Sarcosyl urea	North
Cmi-0163	NMFS	95	95	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	380	362.8736	Fin clip	Sarcosyl urea	North
Cmi-0164	NMFS	96	96	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	340	226.796	Fin clip	Sarcosyl urea	North
Cmi-0165	NMFS	97	97	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	515	1542.2128	Fin clip	Sarcosyl urea	North
Cmi-0166	NMFS	98	98	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	475	1043.2616	Fin clip	Sarcosyl urea	North
Cmi-0167	NMFS	99	99	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	612	2630.8336	Fin clip	Sarcosyl urea	North
Cmi-0168	NMFS	100	100	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	489	1133.98	Fin clip	Sarcosyl urea	North
Cmi-0169	NMFS	101	101	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	367	408.2328	Fin clip	Sarcosyl urea	North
Cmi-0170	NMFS	102	102	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	454	997.9024	Fin clip	Sarcosyl urea	North
Cmi-0171	NMFS	103	103	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	401	635.0288	Fin clip	Sarcosyl urea	North
Cmi-0172	NMFS	104	104	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	423	771.1064	Fin clip	Sarcosyl urea	North
Cmi-0173	NMFS	105	105	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	601	2313.3192	Fin clip	Sarcosyl urea	North
Cmi-0174	NMFS	106	106	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	503	1315.4168	Fin clip	Sarcosyl urea	North
Cmi-0175	NMFS	107	107	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	422	635.0288	Fin clip	Sarcosyl urea	North
Cmi-0176	NMFS	108	108	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	402	544.3104	Fin clip	Sarcosyl urea	North
Cmi-0177	NMFS	109	109	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	296	181.4368	Fin clip	Sarcosyl urea	North
Cmi-0178	NMFS	110	110	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	421	725.7472	Fin clip	Sarcosyl urea	North
Cmi-0179	NMFS	111	111	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	321	136.0776	Fin clip	Sarcosyl urea	North
Cmi-0180	NMFS	112	112	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	494	1406.1352	Fin clip	Sarcosyl urea	North
Cmi-0181	NMFS	113	113	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	450	725.7472	Fin clip	Sarcosyl urea	North
Cmi-0182	NMFS	114	114	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	480	907.184	Fin clip	Sarcosyl urea	North
Cmi-0183	NMFS	115	115	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	398	317.5144	Fin clip	Sarcosyl urea	North
Cmi-0184	NMFS	116	116	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	409	408.2328	Fin clip	Sarcosyl urea	North
Cmi-0185	NMFS	117	117	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	515	1360.776	Fin clip	Sarcosyl urea	North
Cmi-0186	NMFS	118	118	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	410	635.0288	Fin clip	Sarcosyl urea	North
Cmi-0187	NMFS	119	119	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	450	861.8248	Fin clip	Sarcosyl urea	North
Cmi-0188	NMFS	120	120	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	443	816.4656	Fin clip	Sarcosyl urea	North
Cmi-0189	NMFS	121	121	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	635	2812.2704	Fin clip	Sarcosyl urea	North
Cmi-0190	NMFS	122	122	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	440	771.1064	Fin clip	Sarcosyl urea	North
Cmi-0191	NMFS	123	123	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	511	1224.6984	Fin clip	Sarcosyl urea	North
Cmi-0192	NMFS	124	124	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	529	1360.776	Fin clip	Sarcosyl urea	North
Cmi-0193	NMFS	125	125	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	712	3674.0952	Fin clip	Sarcosyl urea	North

Cmi-0194	NMFS	126		126	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	415			453.592	Fin clip	Sarcosyl urea		North
Cmi-0195	NMFS	127		127	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	487			1133.98	Fin clip	Sarcosyl urea		North
Cmi-0196	NMFS	128		128	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	358			226.796	Fin clip	Sarcosyl urea		North
Cmi-0197	NMFS	129		129	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	620			2540.1152	Fin clip	Sarcosyl urea		North
Cmi-0198	NMFS	130		130	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	510			1224.6984	Fin clip	Sarcosyl urea		North
Cmi-0199	NMFS	131		131	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	493			1088.6208	Fin clip	Sarcosyl urea		North
Cmi-0200	NMFS	132		132	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	390			362.8736	Fin clip	Sarcosyl urea		North
Cmi-0201	NMFS	133		133	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	426			635.0288	Fin clip	Sarcosyl urea		North
Cmi-0202	NMFS	134		134	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	702			4036.9688	Fin clip	Sarcosyl urea		North
Cmi-0203	NMFS	135		135	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	474			997.9024	Fin clip	Sarcosyl urea		North
Cmi-0204	NMFS	136		136	8/6/2015	2015	VA	Atlantic Ocean	Norfolk Canyon	37.093	-74.694	490			1088.6208	Fin clip	Sarcosyl urea		North
Cmi-0219	MARMAP	110143-1	P05110143061B4381		5/19/2011	2011	SC	Atlantic Ocean		32.71	-78.14	595	473	564	2600	Otolith	Dry	Longline	South
Cmi-0220	MARMAP	110143-2	P05110143061B4382		5/19/2011	2011	SC	Atlantic Ocean		32.71	-78.14	620	488	581	2750	Otolith	Dry	Longline	South
Cmi-0221	MARMAP	110144-1	P05110144061B4381		5/19/2011	2011	SC	Atlantic Ocean		32.71	-78.14	621	504	590	2900	Otolith	Dry	Longline	South
Cmi-0222	MARMAP	110146-1	P05110146061B4381		5/19/2011	2011	SC	Atlantic Ocean		32.72	-78.15	617	514	579	2700	Otolith	Dry	Longline	South
Cmi-0223	MARMAP	110153-1	P05110153061B4381		5/19/2011	2011	SC	Atlantic Ocean		32.73	-78.13	601	501	567	2492	Otolith	Dry	Longline	South
Cmi-0224	MARMAP	110184-1	P05110184324B4381		5/25/2011	2011	SC	Atlantic Ocean		32.26	-79.03	607	508	575	2441	Otolith	Dry	Chevron trap	South
Cmi-0225	MARMAP	110185-1	P05110185324B4381		5/25/2011	2011	SC	Atlantic Ocean		32.26	-79.03	501	413	475	1558	Otolith	Dry	Chevron trap	South
Cmi-0226	MARMAP	110186-1	P05110186324B4381		5/25/2011	2011	SC	Atlantic Ocean		32.26	-79.04	581	469	547	2263	Otolith	Dry	Chevron trap	South
Cmi-0227	MARMAP	110186-2	P05110186324B4382		5/25/2011	2011	SC	Atlantic Ocean		32.26	-79.04	568	474	539	2387	Otolith	Dry	Chevron trap	South
Cmi-0228	MARMAP	110186-3	P05110186324B4383		5/25/2011	2011	SC	Atlantic Ocean		32.26	-79.04	661	553	625	3394	Otolith	Dry	Chevron trap	South
Cmi-0229	MARMAP	110187-1	P05110187324B4381		5/25/2011	2011	SC	Atlantic Ocean		32.25	-79.03	567	455	534	2028	Otolith	Dry	Chevron trap	South
Cmi-0230	MARMAP	110187-2	P05110187324B4382		5/25/2011	2011	SC	Atlantic Ocean		32.25	-79.03	557	462	524	2012	Otolith	Dry	Chevron trap	South
Cmi-0231	MARMAP	110188-2	P05110188324B4382		5/25/2011	2011	SC	Atlantic Ocean		32.25	-79.04	653	539	613	3510	Otolith	Dry	Chevron trap	South
Cmi-0232	MARMAP	110360-1	P05110360061B4381		7/14/2011	2011	SC	Atlantic Ocean		32.63	-78.32	630	513	593	2413	Otolith	Dry	Longline	South
Cmi-0233	MARMAP	110409-1	P05110409061B4381		8/2/2011	2011	SC	Atlantic Ocean		32.84	-77.98	616	501	582	2674	Otolith	Dry	Longline	South
Cmi-0234	MARMAP	110409-2	P05110409061B4382		8/2/2011	2011	SC	Atlantic Ocean		32.84	-77.98	654	540	614	2993	Otolith	Dry	Longline	South
Cmi-0235	MARMAP	110409-3	P05110409061B4383		8/2/2011	2011	SC	Atlantic Ocean		32.84	-77.98	490	397	457	1422	Otolith	Dry	Longline	South
Cmi-0236	MARMAP	110409-4	P05110409061B4384		8/2/2011	2011	SC	Atlantic Ocean		32.84	-77.98	553	451	522	1922	Otolith	Dry	Longline	South
Cmi-0237	MARMAP	110411-1	P05110411061B4381		8/2/2011	2011	SC	Atlantic Ocean		32.84	-77.99	652	536	619	3200	Otolith	Dry	Longline	South
Cmi-0238	MARMAP	110411-2	P05110411061B4382		8/2/2011	2011	SC	Atlantic Ocean		32.84	-77.99	634	518	603	2767	Otolith	Dry	Longline	South
Cmi-0239	MARMAP	110412-1	P05110412061B4381		8/2/2011	2011	SC	Atlantic Ocean		32.85	-78	576	464	546	2101	Otolith	Dry	Longline	South
Cmi-0240	MARMAP	120198-1	P05120198324B4381		6/20/2012	2012	SC	Atlantic Ocean		33.77	-76.62	497	405	467	1200	Otolith	Dry	Chevron trap	South
Cmi-0241	MARMAP	120325-1	P05120325061B4381		7/15/2012	2012	SC	Atlantic Ocean		32.73	-78.1	620	530	589	2700	Otolith	Dry	Longline	South
Cmi-0242	MARMAP	120331-1	P05120331061B4381		7/15/2012	2012	SC	Atlantic Ocean		32.72	-78.12	563	450		1700	Otolith	Dry	Longline	South
Cmi-0243	MARMAP	120333-1	P05120333061B4381		7/15/2012	2012	SC	Atlantic Ocean		32.71	-78.12	586	491	543	2100	Otolith	Dry	Longline	South
Cmi-0244	MARMAP	120334-1	P05120334061B4381		7/15/2012	2012	SC	Atlantic Ocean		32.71	-78.13	560	455	533	2250	Otolith	Dry	Longline	South
Cmi-0245	MARMAP	120401-1	P05120401324B4381		8/2/2012	2012	SC	Atlantic Ocean		32.26	-79.03	550	454	520	1820	Otolith	Dry	Chevron trap	South
Cmi-0246	MARMAP	120401-2	P05120401324B4382		8/2/2012	2012	SC	Atlantic Ocean		32.26	-79.03	497	400	464	1494	Otolith	Dry	Chevron trap	South
Cmi-0247	MARMAP	120401-3	P05120401324B4383		8/2/2012	2012	SC	Atlantic Ocean		32.26	-79.03	645	533	614	2959	Otolith	Dry	Chevron trap	South
Cmi-0248	MARMAP	120401-4	P05120401324B4384		8/2/2012	2012	SC	Atlantic Ocean		32.26	-79.03	499	416	469	1292	Otolith	Dry	Chevron trap	South
Cmi-0249	MARMAP	120402-1	P05120402324B4381		8/2/2012	2012	SC	Atlantic Ocean		32.26	-79.03	586	483	556	2213	Otolith	Dry	Chevron trap	South
Cmi-0250	MARMAP	120402-2	P05120402324B4382		8/2/2012	2012	SC	Atlantic Ocean		32.26	-79.03	666	554	633	3538	Otolith	Dry	Chevron trap	South
Cmi-0251	MARMAP	120402-3	P05120402324B4383		8/2/2012	2012	SC	Atlantic Ocean		32.26	-79.03	603	504	576	2747	Otolith	Dry	Chevron trap	South
Cmi-0252	MARMAP	120404-1	P05120404324B4381		8/2/2012	2012	SC	Atlantic Ocean		32.25	-79.03	610	506	578	2647	Otolith	Dry	Chevron trap	South
Cmi-0253	MARMAP	120503-1	P05120503061B4381		8/30/2012	2012	SC	Atlantic Ocean		32.83	-78.07	615	501	574	2655	Otolith	Dry	Longline	South
Cmi-0254	MARMAP	120505-1	P05120505061B4381		8/30/2012	2012	SC	Atlantic Ocean		32.83	-78.08	590	490	566	2530	Otolith	Dry	Longline	South
Cmi-0255	MARMAP	120507-1	P05120507061B4381		8/30/2012	2012	SC	Atlantic Ocean		32.84	-78.07	596	480	563	2404	Otolith	Dry	Longline	South
Cmi-0256	MARMAP	120507-2	P05120507061B4382		8/30/2012	2012	SC	Atlantic Ocean		32.84	-78.07	554	453	530	2024	Otolith	Dry	Longline	South
Cmi-0257	MARMAP	120517-1	P05120517061B4381		8/30/2012	2012	SC	Atlantic Ocean		32.77	-78.18	657	549	618	3246	Otolith	Dry	Longline	South
Cmi-0259	MARMAP	113394-1	T60113394324B4381		7/28/2011	2011	GA	Atlantic Ocean		31.48	-79.73	567	475	539	2116	Otolith	Dry	Chevron trap	South
Cmi-0260	MARMAP	123151-1	T60123151324B4381		4/30/2012	2012	GA	Atlantic Ocean		31.49	-79.73	717	595	680	4236	Otolith	Dry	Chevron trap	South
Cmi-0261	MARMAP	123155-1	T60123155324B4381		4/30/2012	2012	GA	Atlantic Ocean		31.5	-79.72	710	588	676	4386	Otolith	Dry	Chevron trap	South
Cmi-0262	MARMAP	123564-1	T60123564324B4381		8/29/2012	2012	FL	Atlantic Ocean		29.66	-80.25	655	543	625	3310	Otolith	Dry	Chevron trap	South
Cmi-0263	MARMAP	128311-1	T60128311324B4381		8/19/2012	2012	NC	Atlantic Ocean		34.48	-75.87	681	555	633	3290	Otolith	Dry	Chevron trap	South
Cmi-0264	MARMAP	128312-1	T60128312324B4381		8/19/2012	2012	NC	Atlantic Ocean		34.49	-75.87	653	563	625	3220	Otolith	Dry	Chevron trap	South
Cmi-0265	MARMAP	128330-1	T60128330324B4381		8/20/2012	2012	NC	Atlantic Ocean		34.48	-75.87	583	495	556	2440	Otolith	Dry	Chevron trap	South
Cmi-0266	MARMAP	128330-2	T60128330324B4382		8/20/2012	2012	NC	Atlantic Ocean		34.48	-75.87	623	525	597	3130	Otolith	Dry	Chevron trap	South
Cmi-0267	MARMAP	128330-3	T60128330324B4383		8/20/2012	2012	NC	Atlantic Ocean		34.48	-75.87	675	576	651	3890	Otolith	Dry	Chevron trap	South
Cmi-0268	MARMAP	128330-4	T60128330324B4384		8/20/2012	2012	NC	Atlantic Ocean		34.48	-75.87	538	460	510	1910	Otolith	Dry	Chevron trap	South
Cmi-0269	MARMAP	128331-1	T60128331324B4381		8/20/2012	2012	NC	Atlantic Ocean		34.48	-75.88	678	575	650	3520	Otolith	Dry	Chevron trap	South
Cmi-0270	MARMAP	128331-2	T60128331324B4382		8/20/2012	2012	NC	Atlantic Ocean		34.48	-75.88	680	604	662	3800	Otolith	Dry	Chevron trap	South
Cmi-0271	MARMAP	128332-2	T60128332324B4382		8/20/2012	2012	NC	Atlantic Ocean		34.47	-75.88	595	500	563	2520	Otolith	Dry	Chevron trap	South

Cmi-0272	MARMAP	128332-3	T60128332324B4383	8/20/2012	2012	NC	Atlantic Ocean	34.47	-75.88	607	506	581	2670	Otolith	Dry	Chevron trap	South
Cmi-0273	MARMAP	128333-1	T60128333324B4381	8/20/2012	2012	NC	Atlantic Ocean	34.47	-75.89	721	610	685	3950	Otolith	Dry	Chevron trap	South
Cmi-0274	MARMAP	128333-2	T60128333324B4382	8/20/2012	2012	NC	Atlantic Ocean	34.47	-75.89	622	531	601	2930	Otolith	Dry	Chevron trap	South
Cmi-0275	MARMAP	128333-3	T60128333324B4383	8/20/2012	2012	NC	Atlantic Ocean	34.47	-75.89	676	555	639	3470	Otolith	Dry	Chevron trap	South
Cmi-0276	MARMAP	128334-1	T60128334324B4381	8/20/2012	2012	NC	Atlantic Ocean	34.46	-75.9	700	610	668	3910	Otolith	Dry	Chevron trap	South
Cmi-0277	MARMAP	128334-2	T60128334324B4382	8/20/2012	2012	NC	Atlantic Ocean	34.46	-75.9	690	586	662	3840	Otolith	Dry	Chevron trap	South
Cmi-0278	MARMAP	128335-1	T60128335324B4381	8/20/2012	2012	NC	Atlantic Ocean	34.46	-75.9	610	524	581	2650	Otolith	Dry	Chevron trap	South
Cmi-0279	MARMAP	128335-2	T60128335324B4382	8/20/2012	2012	NC	Atlantic Ocean	34.46	-75.9	689	587	661	4240	Otolith	Dry	Chevron trap	South