Semi-Annual Progress Report		
Submitted to:		Mr. Derek Orner Chair, Chesapeake Bay Stock Assessment Committee NOAA Chesapeake Bay Office 410 Severn Avenue Annapolis, MD 21401
Submitted by:		Dr. Thomas Miller, Dr. Edward Houde Chesapeake Biological Laboratory University of Maryland Center for Environmental Science P. O. Box 38 Solomons, MD

Objectives

The work proposed to and funded by CBSAC had six core objectives that each focused on the collection or analysis of multispecies fisheries data in different regions of Chesapeake Bay. When completed, the data and information gained under each task will provide a substantial database that will assist greatly in meeting the new Chesapeake Bay Agreement commitment to implement multispecies fisheries management in Chesapeake Bay by 2005. The six objectives are identified below.

Objective 1. Conduct a baywide survey of the bentho-pelagic fish community, focusing on young (juveniles, and yearling) fishes in the mainstem of Chesapeake Bay.

We proposed to continue a multispecies fishery-independent survey of the bentho-pelagic fishery resources that has been conducted by UMCES staff since 1995. The survey has been conducted during April, July, October in each of the past six years. Surveys have been conducted consistently using a midwater trawls (18-m^2 mouth opening, 6-mm codend mesh) throughout the program's duration. We proposedto continue the survey to ensure the continuing availability of this fishery-independent data source to help launch a CBSAC multispecies effort.

Objective 2. Design and implement a complementary survey of the bentho-pelagic fish community in the extensive shoal habitats (< 5 m depth) in the mainstem of Chesapeake Bay.

Survey work proposed to meet Objective 1 was limited to the mainstem of the bay and to water depths $4.5 m. Because of the concentration of juveniles in shallow areas, a significant level of species interactions may take place in these areas. Hence, it is important that such shoal areas be sampled. Therefore we proposed to expand the survey into shallow waters to collect data analogous to those outlined in **Objective 1.**

Objective 3. Conduct pilot surveys of the pelagic fish community in key tributaries and in the mainstem to generate sampling statistics that will of use in subsequent design improvements.

Development of an optimal survey design requires knowledge of the fine scale temporal and spatial distribution of fish in order to define the sample size required to achieve study objectives, and to allocate sampling effort in time or space so that the information content of the samples is maximized for a fixed survey cost. Typcially, such designs are very efficient for common species with broad distributions. They are less efficient for rarer species with more aggregated distributions. We proposed to develop adaptive sampling schemes that will permit us to respond to the abundance patterns in individual hauls of the midwater trawl thereby increasing the efficiency of the overall design.

Objective 4. Determine trophic interactions among key components of the pelagic fish community, and examine the implication of the relationships uncovered in empirical studies

using bioenergetic modeling.

Because biological interactions are a factor motivating the development of multispecies approaches, it is important that we understand the pattern and consequences of such interactions. To do this, we proposed to conduct analyses of the diets of species commonly caught in the core survey. These analyzes will permit us to estimate regional and baywide estimates of daily ration, weight-specific consumption and to empirically determine the major trophic links and overlaps.

Objective 5. Conduct statistical analyses of existing and new data to optimize the complemented pelagic survey with respect to consistency and accuracy of key parameters.

Work under this task sought to determine the utility of multivariate spatial modeling for describing species composition throughout the bay. Such a model would describe the current results and may include not only data collected from sampling but also the stomach contents information where appropriate.

Objective 6. Conduct statistical analyses to facilitate the integration of information from the complemented pelagic survey and existing fishery-independent surveys.

An important component of this proposal is to combine the data collected under **Objectives 1-4** with data that was collected under previous surveys such as TIES, the VIMS year-round trawls, the Maryland summer surveys and the Chesapeake Bay Stock Assessment program. We intend to develop the methodology required to combine data from such disparate sources and collected for such disparate reasons into one coherent model of the economically important component of the bay ecosystem for pelagic fishes.

Progress Report

Work conducted as a part of CHESFIMSS has involved contributions from all PI's, and has been a fully collaborative venture. We have made sound progress against objectives 1-5 over the last 6 moths. We are on schedule to complete all the proposed field sampling. Additionally, we have made a good start on analyzing the existing data both to assist with the development of survey designs (Objective 3) and to assess the validity of existing inferences (Objective 5).

Project Management.

We have held four PI meetings since the project began to coordinate activities. At these meetings we finalized specifications for the sampling gear, determined cruise dates, agreed on sampling strategies and reviewed existing data. We have appointed two research associates to assist with work on objectives 1 and 2. Additionally, two graduate students have been assigned to the project. One is supported fully off of CHESFIMSS and will work on multivariate spatial modeling of the distribution and abundance of species. The second student is supported by a CBL graduate studentship in 2001-2002 and will work on the analysis of trophic relationships in Chesapeake Bay.

Progress Toward Objective 1.

We have conducted two bay wide, broad scale surveys of the bentho-pelagic fish community in Chesapeake Bay. The first cruise, CF0101, was conducted from 30 April 2001 – 5 May 2001 aboard the R/V Aquarius. Cruise objectives were to sample 31 stations distributed throughout the main stem of Chesapeake Bay using an 18 m^2 midwater trawl. All cruise objectives were met, collecting 1,452 fish (67 kg) from 28 different taxonomic categories. A full cruise report is included as Attachment 1.

A second bay wide, broad scale survey. CF0102, was conducted from Jul 16 -24, 2001. Data have yet to summarized, but initial reports indicate that all objectives were met on this cruise as well. A cruise report will be submitted when it is completed.

We have begun to analyze the data collected during CF0101 in comparison to spring time catches in earlier TIES cruises.

Progress Toward Objective 2.

For the shoal habitat sampling, we developed a survey design that takes advantage of the yearly blue crab trawl survey at fixed stations in the shallows dating back to the late 1970's. While not complete, the blue crab otter trawl survey does collect basis catch per unit effort data on juvenile fish that can be used in conjunction with the shoal survey. For example, croaker and weakfish indices for Maryland are developed using the blue crab trawl survey data.

The first shoal habitat survey was conducted from May 11 through June 6 2001, immediately after the completion of the Chesapeake Bay mainstem survey. A total of 103 stations were sampled in shallow waters (depth < 5 m (~17 ft)), using a16 foot bottom trawl. Six minute tows were conducted at each station. We used the same trawl and trawling procedure as for the blue crab trawl survey for compatibility. All fish and crabs in the catch were identified by species, counted, measured and weighted. Environmental data such as air temperature, surface and bottom water temperature, salinity, dissolved oxygen, water clarity and wind conditions were recorded. A second shoal survey is currently underway.

The survey area included shallow waters (< 5 m) from the MD line (approximately 37.5°N) to 38.5°N (below the mouth of the Choptank River). This area covers a significant part of the shallow waters within the MD section of the bay, and includes two regions that are covered by the MD DNR blue crab survey (Tangier Sound with 5 fixed stations and Pocomoke Sound with 8 fixed stations). In addition, three fixed transects of the CHESFIMS mainstem survey are located within the north-south borders of the shoal habitat survey. The results of both shallow water and mainstem surveys will be integrated at a later stage, using information from the gear comparison studies. The strata for the pilot study were chosen to minimize travel time, and thus support the collection of data from a fairly large number of stations for the fixed budget.

Stations were selected randomly within each of four geographical strata:

- Stratum 1: Calvert Cliffs Area. Initially stratum 1 was defined as a stretch along the

western shore between the north side of the mouth of the Potomac River and the south side of the mouth of the Patuxent River with depth < 5 m, with total area less than 30.4 km^2. However, trawling in stratum 1 was abandoned because of significant problems due to rocky bottom - two trawls were torn. We redefined stratum 1 as a stretch from the mouth of the Patuxent River to N 38.25'16"; 6 stations were sampled in redefined stratum 1, using restricted random sampling. The stratum was divided into six equal length sections, and one station were randomly selected in each longitudinal section.

- Stratum 2: Shallow waters along the eastern shore, between 37.54°N (below Smith Island) and 38.03°N (above Smith Island). The mainstem survey includes one fixed transect within this north-south boundary. The area also includes the Pocomoke Sound blue crab survey stations. Total stratum area 346.2 km^2; 33 stations sampled.

- Stratum 3: Along the eastern shore, between 38.03°N and approximately 38.22°N (the north side of the Patuxent R. mouth). This region includes a transect from the mainstem survey and the Tangier Sound blue crab stations. Total stratum area 617 km^2; 56 stations sampled.

- Stratum 4: Along the eastern shore between 38.22°N and 38.32°N (below the mouth of the Choptank R.) This region does not include a transect but it is above the Patuxent and Potomac R. and below the Choptank R. Total stratum area 64.4 km^2; 8 stations sampled.

In strata 2, 3, and 4 we allocated stations proportional to area with a total number of stations of 97. The stations were selected randomly within confined geographic areas and between selected depths using a program maintained by the MD DNR.

The sample processing protocol was similar to the protocol used in the mainstem survey, but was adapted to accommodate for logistical difficulties related to the boat size (Appendix II). Weighing of fish onboard the small vessel was problematic, and hence a sub-sample from each catch was brought onshore for weigh-length measurements. The total weight of the catch by species for each haul will be determined from length-weight keys.

Results indicate differences in the catch rates among strata. Catches were dominated by bay anchovy, blue crab and hogchoker. Additional analyses are being conducted currently.

Progress Against Objective 4.

All samples collected during the CF0101 cruise have been defrost and the stomachs and otoliths dissected out. Otoliths have been stored for subsequent age analysis should this be needed. The stomach samples were preserved in Ethanol for subsequent analysis.

To date stomachs from all the striped bass, croaker and white perch collected during CF0101 have been further analyzed to identify the individual diets. Stomachs were weighed, and assigned a value on a 1-5 arbitrary scale of gut fullness. All prey contents were then removed and indentified to the lowest taxonomic level possible. Data are currently being entered into the project database and will be available for analysis by mid-August.

Progress Against Objective 5

The fixed transect design employed for Objective 1 primarily supports the effective estimation of temporal trends in biomass and species composition. Randomly located transects parallel to the fixed transects were added to support areal estimates of catch per unit effort, biomass, and population characteristics (e.g., size distribution by species). Ten transects were fixed from prior surveys and an additional 8 randomly located transects were added to the summer cruise.

For the fixed location transects, the number of stations ranged from 2 to 5 depending on the length of the transect. Three trawl stations were allocated along each new randomly sited transect using restricted random sampling. Each transect was divided into three equal length sections, and one station was randomly selected within each. The random transect component of the mainstem survey is a form of multi-stage sampling. In the first stage, a transect (cluster) is randomly selected, and in the second stage, a sub-sample (3 stations) is collected randomly from each transect.

We will use estimators that take into account the variable cluster size (length of transects) (e.g., Cochran 1977, chapter 11).

Future Work

We have one more broad-scale and one more shoal survey scheduled for later in the year. We will continue to work against all six objectives.

Appendix I

CF0101 Cruise Report

CHESFIMS 2001-01 Cruise Report

Cruise Dates: 30 April 2001 – 5 May 2001

Research Vessel: R/V Aquarius

Principal Investigators: T.J. Miller and E.D. Houde

Chief Scientist: C.J. Heyer
Phone Number: (410) 326-7420
Fax Number: (410) 326-7318
E-mail: heyer@cbl.umces.edu

Participating Scientists:

	Name	Affiliation	Joined Ship (month/day)	Left Ship (month/day)
1.	C.J. Heyer	CBL	4/30	5/5
2.	M.A. Chenery	CBL	4/30	5/5
3.	H.A. Abeels	CBL	4/30	5/5
4.	T.J. Miller	CBL	4/30	5/1
5.	B. Pearson	CBL	4/30	5/5

Objectives: Measure the spatial distributions, abundances and biological interactions of juvenile/yearling fishes in the Chesapeake Bay. Collect and preserve a sub-sample of the catch for dietary analysis.

Area of Operation: Seaward of the Bay Bridge Tunnel (37^{o} 00' N Latitude) to the head of the Bay (39^{o} 25' N Latitude).

Type of Operations: Conducted CTD casts and 20 minute mid-water trawl tows at 31 stations in the Chesapeake Bay (Fig. 1 and Table 1).

Data / Specimens Collected: Completed 31 CTD casts. Collected 1,452 fish (67 kg) from 28 different taxonomic categories. (Table 2 provides a summary of fish caught). Preserved (frozen or EtOH) samples from each station where fish were caught (21 Jars and 41 Bags).

Damage to Gear: Tore one mid-water trawl net at station 6 on first deployment. T.J. Miller and D. Craige repaired the net on 3 May 2001.

CHESFIMS 2001-01 Cruise Report

Cruise Summary:

We left Chesapeake Biological Laboratory in Solomons, MD at 1900 on 30 April 2001 and returned at 0200 on 5 May 2001. Weather conditions for the cruise were very favorable. No time was lost to bad weather. Wind and seas were calm throughout the sampling. The order in which stations were occupied was altered from the cruise plan to reduce steaming times and allow us to finish ahead of schedule on the nights of 3-4 May 2001. The station log (Table 1) can be used as a guide in planning future CHESFIMS cruises that will incorporate the stations sampled by CHESFIMS 2001-01.

Overall, the cruise was successful. All of the objectives of the original cruise plan were met. We collected fish at all but two of the 31 stations sampled. The average catch per station was 51± 81.7 fish (mean ± SD, range 1 – 304). In total, 1473 fish were caught with a total catch weight of about 67 kg. Bay anchovy (*Anchoa mitchilli*) and spotted hake (*Urophycis regia*) were common in catches throughout the bay. Hogchoker (*Trinectes maculates*) were also collected throughout the bay, but were more abundant in the upper bay (North of 39^{o} 00' N). Catches in the upper bay were dominated by american eel (*Anguilla rostrata*), white perch (*Morone americana*) and striped bass (*Morone saxatilis*). The most commonly caught species in the lower bay (South of 38^{o} 20' N) were croaker (*Micropogonias undulatus*), sculpin (Triglidae) and tongue sole (*Symphyrus plagiusa*) (Table 2). A summary of the characteristics of the more common species is provided in Table 3.

Physical oceanographic conditions varied over the sampling grid as expected. There was evidence of stratification over the sampling grid. Salinities varied from a maximum surface salinity of 26.3 ‰ at the bay mouth to 0.1 ‰ at the head of the bay. Surface dissolved oxygen (DO) was 5.69 mg/L at the bay mouth, peaked at 11.46 mg/L near Chesapeake Beach (Station 23), and was 8.00 mg/L at the head of the bay. Conversely, bottom DO was relatively uniform over the stations, ranging from 6.01 mg/L at the bay mouth to 7.53 at the head of the bay. Notably, a low bottom DO of 2.93 mg/L was observed near Chesapeake Beach (Station 22), and a high bottom DO of 11.01 mg/L was observed near Rock Hall (Station 26). Surface temperatures varied from 15.2 ^{o}C – 19.6 ^{o}C over the grid.

Figure 1. CHESFIMS 2001-01 Station Map.

CHESFIMS 2001-01 Cruise Report

Problems Encountered:

Upon retrieval of the first tow (Station 6) we discovered that the net had torn down one of the wing ropes and wings. This net became unusable until it was repaired on 3 May 2001. It is unclear what we either struck or picked-up that caused the tear.

We had great difficulty in fishing the back-up net we brought with us. By the third station (Station 5) the net began balling up and diving straight to the bottom. After several tows it became evident that this was due to the bridle twisting up. A swivel was added between the bridle and the cable for the fourth attempt at a tow at Station 5. Once the swivel was added, the net deployed and fished well at the next three stations. .

By Station 3 we began having problems with the 4:1 scope we were using. The net began hitting bottom before half the tow was completed. The scope was adjusted to 3:1 to avoiding this problem. However, this did not fully solve the problem. We began to suspect problems with the bridle we were using because one door continually came out of the water before the other upon retrieval, and with the speed at which we were paying out the cable. Adjustments were made to cable payout speed and we began using the fleet bridle. These changes in protocol and gear appeared to eliminate all problems.

We ran into some problems at Station 25 with the net continually hitting bottom, or something, and coming up with mud bags. In one tow attempt the depth was 10 m and after paying out only 8 m of cable we struck bottom and pulled up a mud bag. It was decided that problems at this station were due to the numerous hazards on the North side of the Bay Bridge, so the station was moved slightly north. It should be noted that Station 25 is also very close to the Bay Bridge and a restricted cable area. Subsequent discussions between the Aquarius captain and the captain of the R/V Henlopen which had conducted the previous TIES cruises, uncovered the fact that the Henlopen captain had adjusted the location of these stations during TIES cruises due to similar issues. We now have the positions of the stations actually fished during TIES.

Recommended Improvements:

1) Use a swivel between the bridle and the cable at all times while fishing the mid-water trawl from the R/V Aquarius.
2) Check condition of existing bridles and confirm symmetry. Consider having new bridles made that may fish better.
3) Reserve the mid-water trawl net with the twist in the headline as a back up only. The twist in the headline of this net appears to have been accidentally manufactured into the net during production. It is suspected that this is part of the reason why this net has a tendency to ball up and go straight to the bottom.
4) Consider moving Stations 25 and 24 North of the Bay Bridge more in line with Station 26. This should put the station outside of the hazards found near the Bay Bridge and out of the restricted area.

CHESFIMS 2001-01 Cruise Report

Table 1. CHESFIMS 2001-01 Station Log: Time in Eastern Daylight Time, coordinates in degrees and minutes.

Date	Transect	Station	Time	LAT/LONG	Activities
4/30/01			1900		Depart Port
	5	6	2310	37 20.016 / 76 05.989	CTD, MWT
5/1/01		7	0135	37 19.975 / 76 11.978	CTD, MWT
	3	5	0313	37 09.966 / 76 11.982	CTD, MWT
		4	0422	37 10.015 / 76 04.991	CTD, MWT
			0830		Arrive Port
			1900		Depart Port
	1	1	2001	36 58.016 / 76 03.997	CTD, MWT
		2	2056	37 01.007 / 76 01.997	CTD, MWT
		3	2144	37 02.993 / 76 01.990	CTD, MWT
5/2/01	7	8	0025	37 30.020 / 76 01.005	CTD, MWT
		9	0205	37 30.021 / 76 07.000	CTD, MWT
		10	0258	37 30.005 / 76 13.022	CTD, MWT
	9	13	0416	37 40.025 / 76 08.963	CTD, MWT
		14	0530	37 40.003 / 76 12.489	CTD, MWT
			0645		Arrive Port
			1900		Depart Port
		12	1948	37 40.023 / 76 05.522	CTD, MWT
		11	2103	37 40.016 / 75 58.969	CTD, MWT
	31	30	2222	37 49.998 / 75 55.507	CTD, MWT
		31	2333	37 59.984 / 75 55.017	CTD, MWT
5/3/01	13	15	0049	37 59.993 / 76 07.009	CTD, MWT
		16	0135	38 00.006 / 76 11.007	CTD, MWT
		17	0219	37 59.991 / 76 14.994	CTD, MWT
		18	0308	38 00.009 / 76 18.955	CTD, MWT
			0500		Arrive Port
			1900		Depart Port
	17	21	1932	38 19.998 / 76 21.965	CTD, MWT
		20	2014	38 20.000 / 76 19.967	CTD, MWT
		19	2059	38 19.996 / 76 18.471	CTD, MWT
	21	22	2254	38 40.018 / 76 24.990	CTD, MWT
		23	2350	38 39.985 / 76 27.922	CTD, MWT
5/4/01	25	24	0141	39 00.075 / 76 22.476	CTD, MWT
		25	0223	39 00.034 / 76 23.361	CTD, MWT
			0445		Arrive Port

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			1645		Depart Port
	30	29	1908	39 24.998 / 76 01.707	CTD, MWT
		28	2025	39 19.002 / 76 12.941	CTD, MWT
		27	2123	39 13.014 / 76 14.987	CTD, MWT
		26	2231	39 06.997 / 76 19.023	CTD, MWT
5/5/01			0200		Arrive Port

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CHESFIMS 2001-01 Cruise Report

Table 2. CHESIMS 2001-01 Catch Log: Table continues onto next page. Total weight of each species in grams (g). No fish caught for stations 2 and 10.

Species Index	Scientific Name		Station																												
			01	03	04	05	06	07	08	09	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
320	Anguilla rostrata	Count																									2	3	28		
		Total Wt.																									239	162	1273		
380	Ophidion marginatum	Count														1															
		Total Wt.														1															
410	Clupeidae	Count					1						1	4						1											1
		Total Wt.												2						14											
410	Clupeidae (larval)	Count					22																							256	2
		Total Wt.																													
455	Alosa sp.	Count			26								1								1				8	1	1				
		Total Wt.			166								8								170				1024	165	135				
460	Brevoortia tyrannus	Count						1													2				1	1					
		Total Wt.						100													12				164	400					
520	Anchoa mitchilli	Count		3	186	36	10	40	17	2 2 3			85	1 8 3		1	8 1 5	4	1		6				2					27	23
		Total Wt.		6		62		83	37	5 5 5			170	1 2 8 1		2	22 8 1	1			15				5					51	43
930	Ictalurus nebulosus	Count																									5				
		Total Wt.																									69				
940	Ictalurus punctatus	Count																									2				
		Total Wt.																									650				
1520	Morone americana	Count																			1				11	18	161				
		Total Wt.																			13 4				1273	2409	20227				
1530	Morone saxatilis	Count																						1	1	1	22				
		Total Wt.																					1273	4	180	7182					
1550	Centropristis striata	Count							1																						
		Total Wt.							5																						
1740	Bairdiella chrysura	Count	1					1																							
		Total Wt.	56					74																							
1760	Cynoscion regalis	Count	3					4	1				1				1														4
		Total Wt.	191					325	80				123				47														550
1770	Leiostomus xanthurus	Count		1			1			2				1			1														
		Total Wt.		48						1 4 8				4 1			6 5														
1800	Micropogonias undulatus	Count					4	19		2 7			56				2		1												
		Total Wt.						3955		6 0 9 1			13182				500		2 3 5												

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1930 Peprilus triacanthus	Count	1																							
	Total Wt.	197																							
1940 Triglidae	Count		1	2	6	8	1	2	1	1	7	1	4	1											
	Total Wt.		2					3	3	4	15	7	9	71											
												1													
2003 Scophthalmus aquosus	Count	1	1																						
	Total Wt.	9	7																						
2003 Bothidae	Count		1																						
	Total Wt.		160																						
2003 Paralichthys lethostigma	Count		2		2																				
	Total Wt.																								
2005 Paralichthys dentatus	Count					1																			
	Total Wt.																								
2040 Trinectes maculatus	Count					1	7					1					1				2	11	85		
	Total Wt.						156					3					2				37	180	1182		
												6					3								
2070 Symphyrus plagiusa	Count				1	6	3	1		2															
	Total Wt.				21		94	23		6															
										3															
2120 Sphaeroides maculatus	Count	1																							
	Total Wt.	145																							
4010 Callinectes sapidus	Count					2		1			1	1	1		1	3		1		5	2	2			6
	Total Wt.																								
4015 Callinectes sp.	Count			1	1																				
	Total Wt.																								
4100 Loligo sp.	Count					1																			
	Total Wt.																								
9004 Urophycis regia	Count	2	4			1		1		2	1		2	2	1	6			23		1			1	1
	Total Wt.	58	63					10		5	18		17	25	1	8			300		8			12	43
										0					8	0									

Table 3. Biological characteristics of the common species collected during CHESFIMS 2001-01.

Species	Mean TL (mm)	SD	Range (mm)
Bay anchovy (Anchoa mitchelli)	70	7.3	33-94
Spotted hake (*Urophysis regia)*	116	19.0	48-165
Hogchoker (*Trinectes maculates*)	83	23.0	29-152
American eel (*Anguilla rostrata*)	262	42.2	190-417
White perch (*Morone Americana*)	192	30.4	67-297
Striped bass (*Morone saxatilis*)	302	85.8	77-487
Croaker (*Micopogonias undulatus*)	261	23.7	203-324
Sculpin	54	10.5	38-76
Tongue sole (*Symphyrus plagiusa*)	147	10.3	134-172

Appendix II

Shaol Survey Sampling Protocol

1). Environmental data collection. Measure and record wind direction, air and water temperature, salinity, dissolved oxygen.

2). Record start time and GPS location.

2). Deploy and fish bottom trawl for two minutes.

3) Retrieve bottom trawl and dump the catch into a bin.

4). Record end time and location.

5). Process catch.

Sort the catch by species.
Take total weight by species
Take randomly subsample of each species (n=30-100)
Measure each individual fish in subsample
Weigh subsample
Preserve in jars with ethanol X fish for each species of interest