Fine Scale Genetic Population Structure of Monkfish

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Progress Report: 5

Title of Project: Fine Scale Genetic Population Structure of Monkfish

Project Summary:

The monkfish (*Lophius americanus*) fishery has been assessed and managed as two distinct units, a northern and southern stock, since the inception of its fishery management plan in 1999, although the fundamental management approach (Days at Sea (DAS) and trip limits) has been the same in both areas (NEFSC, 2010). The boundary between the two management units is currently Georges Bank although biological data supporting this division is largely lacking (MPDT, 2011). In recent years, further indirect and direct evidence on monkfish stock structure has begun to accumulate and still there remain many uncertainties (MPDT, 2011). This project will use a sensitive genetic approach, microsatellite DNA analysis, to empirically determine if monkfish constitute single or multiple stocks over their coastwide distribution from Newfoundland to North Carolina and to determine if there is migrational mixing between management areas. In our previous one-year Research Set Aside (RSA) study, we found that monkfish constitute two and maybe three genetic stocks across their coastwide distribution, but these do not correspond to the stock delineation currently used in their management (Hasbrouck and Wirgin, 2014). In this new project, we will build on our previous results by further defining the fine-scale stock structure of monkfish by focusing our attention on areas where spatial discontinuities in microsatellite allelic frequencies were observed in our initial RSA monkfish project. Additionally, we will empirically evaluate the temporal stability of diagnostic microsatellite DNA genotypes within and across sampling years thus ensuring that defined spatial genetic variability exceeds that of temporal genetic variability. Our genetic results will address a major void in the data needed to most effectively manage this resource: the identification of its stock structure.

Goal and Objectives:

Our overall objective is to use a DNA-based approach, microsatellite DNA analysis, to sensitively define the migrational boundaries of monkfish stocks coastwide and to evaluate the temporal stability of these stocks both within and between collection years. This study will build on our earlier successful RSA-funded genetic study in accurately defining the coastwide stock structure of monkfish and in providing a model with which to accurately determine the biological characteristics (age and growth, longevity, reproduction, natural mortality) of individual stocks.

Goal 1: Re-establish and extend our collaborative and comprehensive sampling and analysis program that encompasses the entire range of monkfish in order to test the hypotheses presented below.

Goal 2: Determine how many genetic stocks of monkfish occur within its coastwide distribution and sensitively define their spatial boundaries.
Hypotheses:
H0- There are two genetic stocks of monkfish in U.S. waters that correspond to the management model now in effect; one north of Georges Bank and one south of Georges Bank.
H1- There is only a single stock of monkfish in U.S. waters and coastwide.
H2- There are two or more stocks of monkfish in U.S. waters and coastwide but their boundary does not occur at Georges Bank.

Goal 3: Determine if the extent of temporal variation in microsatellite allelic frequencies among stocks is greater than the extent of spatial variation.
Hypotheses:
H0- Allelic frequencies are temporally stable between seasons and over several collection years within individual genetic stocks.
H1- There are significant differences in microsatellite allelic frequencies among different collection years within individual genetic stocks.
H2- There are significant differences in microsatellite allelic frequencies between seasons within individual genetic stocks.

Goal 4: Form an Advisory Committee of stock assessment scientists, fisherman, and resource managers to effectively communicate the project results and conduct a workshop on integrating project results into management and monkfish stock assessment activities.

Activities:

The following project activities were performed for this reporting period 05/01/2018 – 10/31/18.

Permits:

CCE staff remained in contact with Greater Atlantic Regional Fisheries Office's (GARFO), Fishery Management Specialist, Cynthia Hanson and GARFO's Cooperative Research Liaison, Ryan Silva throughout this reporting period to update the associated project Federal Exempted Fishing Permit (EFP) for compensation harvest (use of RSA Days at Sea). As of October 31, 2018, we have 40 vessels listed on the 2017 EFP that was revised by GARFO on September 26, 2018. During this reporting period, CCE added two vessels and one vessel was removed. CCE was notified of an issue with a fisherman last reporting period. An investigation was completed by NOAA's Office of Law Enforcement and the vessel was officially removed from all project EFPs in May 2018. Please see Problems Encountered Section for further details.

In June of this reporting period, CCE submitted a formal request to NOAA to increase the possession limit associated with an RSA DAS. In 2016 RSA days were allocated 3,552 pounds of whole monkfish per day. The possession limit allocated per RSA day in the past has equalled a double limit of a regular monkfish day at-sea. Since that time the monkfish possession limit for a regular monkfish day-at-sea has increased. Currently the daily limit is 2,037 pounds of whole monkfish per regular monkfish day-at-sea. A double limit would equal 4,074 pounds of whole monkfish per RSA day-at-sea. CCE requested an increased possession limit on June 8, 2018

relative to the increased allocation of a regular monkfish day-at-sea. After submission and review a possession limit for an RSA DAS increase was granted by NOAA on July 12, 2018. The new possession limit is 4,074 lbs. Even with this increase, demand for RSA DAS has remained very low. See also Problems Encountered section.

Monkfish Network Activities:

During this reporting period networking continued in person, by phone and email with commercial fishermen, dealers, wholesalers, processors and scientists in ports across the Mid-Atlantic and New England regions. CCE has remained in contact with network participants for both sampling opportunities and monkfish RSA DAS purchase. Partnerships established previously during this project have continued in ports of New Bedford, MA, Pt. Judith, RI, Montauk and Shinnecock, NY.

CCE has also coordinated with the following scientists and fisheries staff: NMFS- Northeast Fisheries Science Center (NEFSC) – Spring 2018 bottom trawl survey, 2018 Scallop Survey; NFMS-NEFSC, Woods Hole staff for age and growth samples from study fleet vessels; Virginia Institute of Marine Sciences (VIMS)-Northeast Area Monitoring and Assessment Program (NEAMAP)- Spring 2017 inshore trawl survey; VIMS – Scallop Survey and Assessment; Virginia Marine Fisheries Commission; North Carolina Division of Marine Fisheries; New Jersey offshore bottom-trawl survey This network has allowed CCE to target monkfish from more specific project areas. Proper training was given to all participants to ensure data precision.

Field Work:

Due to reduced industry demand for monkfish DAS and thus reduced program income, field work was curtailed during this reporting period. Most activites on this project were thus suspended as of August, 2018. Please see Problems Encountered section.

Sampling Strata and Procedure

To date a total of 1,992 monkfish fin clip samples have been collected. The following is a breakdown of the known samples collected in each project area: 317 samples in 2C, 201 samples in 2D, 346 samples in 3A, 168 samples in 3B, 118 samples in 3C, 152 samples in 3D, 178 samples in 4A, 228 samples in 4B, 45 samples in 4C, 0 samples in 4D, 51 samples in 5A, 15 samples in 5B, 10 samples in 5C, 0 samples in 5D, 133 samples in 6A, 27 samples in 6B. Sample area 4B has been added into the collection of sample areas. During this reporting period, a number of samples were collected on CCE's behalf by the NMFS Spring Bottom Trawl Survey and by the Virginia Institute of Marine Science's Spring Scallop Survey. These samples have been received by CCE and will be catalogued and organized.

All data was processed by CCE staff to validate the location and project area of each monkfish sample collected. Samples taken by commercial fishermen required a VTR to document the exact project area fished during sampling. Latitude and longitude coordinates were used to pinpoint the origins of each sample. All sample vials were topped off with ethanol to secure proper preservation during shipping. CCE staff made certain all vials were appropriately sealed and packaged for shipment to New York University (NYU). Shipment confirmation was made with Ike Wirgin of NYU to ensure the integrity of each sample was maintained.

During this reporting period CCE continued limited dockside sampling activities in the ports of Shinnecock, NY, Pt. Judith, RI and New Bedford, MA. The NY samples were collected directly from fishing vessels. The RI and MA sampling was attempted at Town Dock, Inc in Pt. Judith

and Nebula, Inc in New Bedford but there was no monkfish on site. CCE staff also coordinated the pickup of collected samples and provided additional sampling kits to any network partners when necessary.

Limited monkfish sampling kits were sent out during this reporting period.

- 1 kit sent to Jamie Wescott in Virginia in May
- 1 kit dropped off at Red's Best in New Bedford, MA in May
- 1 kit dropped off for Bill McCann in New Bedford, MA

During this reporting period CCE staff made two trips to New England and visited New Bedford and Woods Hole, MA to collect Monkfish fin clip samples. CCE stopped in Woods Hole, MA after coordinating with Jakub Kircun and Nancy McHugh from NEFSC. CCE staff collected frozen monkfish fin clip samples that were collected from the NEFSC 2018 Bottom Trawl Survey and the 2018 Scallop Survey. In May, staff traveled to New Bedford, Massachusetts, to attend and present at a Monkfish RSA Meeting coordinated by SMAST. CCE staff discussed our Monkfish RSA Program results and contributed to discussions about some of the challenges faced executing the Monkfish RSA Program. In attendance were representatives from NOAA, SMAST, UMass Dartmouth, GMRI, Northeastern University and Monkfish Industry members.

Blackfin Monkfish

During our previous project review it was suggested that we add blackfin monkfish (*Lophius gastrophysus*) to our sampling effort and outreach for this current project. Species identification is critical to project success and specific attention to detail is being paid to this area of sampling and training. In a previous reporting period CCE staff created a project species identification fact sheet for all project partners to reference during sample collection. All samples collected directly by CCE personnel are verified *Lophius americanus,* particularly in the more southern collection areas. Discrimination of a subset of American monkfish versus blackfin monkfish will be further addressed on the molecular level. We have also identified this sampling need to NEAMAP and NMFS-NEFSC bottom trawl surveys. To date we have three confirmed blackfin monkfish samples, three samples have been collected from the NMFS-NEFSC bottom trawl surveys We will continue to pursue blackfin monkfish samples throughout its southern range. One Blackfin monkfish samples was collected during this reporting period.

Database Development

In this reporting period, CCE continued to maintain multiple project databases to target, track, and verify relevant project data and information. These databases apply to to all project samples collected, RSA DAS purchase and usage, sample kit dissemination, and data request information. Coordination and tracking of sampling targets continues to be done on a weekly basis, ensuring that project goals are met. All samples collected were received by CCE. Each individual sample has been logged, visually inspected, and organized and arranged for shipment so as to undergo DNA analysis. An updated sample database has been included with each sample mailing to NYU.

CCE staff continued to perform sample validation and verification in an effort to maintain the highest standards of quality control. The sample collection database continues to be routinely audited. The VTR number associated with each particular sample has been used to verify the fishermen and the details of the trip and area of harvest. Latitude and longitude from the VTR

has been used to determine exact location of the boat during fishing activities and thus the location of the sample.

During this reporting period CCE staff continued to monitor RSA DAS purchase and usage using two separate spreadsheets. One spreadsheet lists all fishermen allocated RSA DAS and payment received. The other spreadsheet is coordinated with NMFS and tracks the RSA DAS usage and pounds landed. These spreadsheets are reorganized and updated as RSA DAS are allocated, paid for, and used.

A sample kit spreadsheet has been created to list all sample vial numbers contained in each kit and to whom the kit was assigned. This spreadsheet is updated as kits are disseminated.

Multiple spreadsheets containing data request information have been utilized by authorized individuals to coordinate industry contact and sampling opportunities. The data provided by NMFS has allowed an increase in focused efforts in expanding the network.

Outreach Program

The comprehensive outreach program continues to remain a useful tool in circulating information to scientists and industry members up and down the coast. The project website is still active and continuously updated allowing us to broadcast our project activities and provide up-to-date information to new recruits. CCE continues to use the sampling instruction video that was created for the previous monkfish RSA project. This video is on the project website to aid new participants in the sample collection procedure. The instructional video along with current maps and charts can be found at http://ccesuffolk.org/Monkfish.

CCE continues to actively market this monkfish RSA project to the fishing industry and its infrastructure. This effort provides project participants and industry members with a better understanding of this monkfish RSA project. The outreach program remains a key component in targeting specific monkfish samples with the use of information sharing, real time communication and dedication from all participants and new recruits. In addition, contact with fishermen while monitoring monkfish RSA DAS provides an additional platform to perform outreach for this project.

In September of this reporting period CCE staff drafted a letter to recruit fishermen to participate in purchasing Monkfish RSA DAS. The request letter was sent to 150 federal monkfish license holders. We have received very little response to this letter.

DNA Analysis at NYU

To date CCE has sent 997 monkfish fin clip samples to Isaac Wirgin of the NYU School of Environmental Medicine. The following is a breakdown of the samples sent to NYU by project area: 84 samples from 2C, 50 samples from 2D, 111 samples from 3A, 133 samples from 3B, 112 samples from 3C, 105 samples from 3D, 92 samples from 4A, 100 samples from 4B, 43 samples from 4B, 42 samples from 5A, 7 samples from 5B, 7 samples from 5C, 0 samples from 5D, 94 samples from 6A, 17 samples from 6B. No results are available at this time. Due to reduced industry demand for monkfish DAS and thus reduced program income, all activity on this project by NYU was suspended in June 2018. See Problems Encountered section.

RSA Days at Sea And Compensation Harvest:

CCE was awarded 250 RSA DAS for 2106 and 300 RSA DAS for 2017. To date, CCE staff has allocated to our fishing industry partners for compensation harvest 250 RSA DAS for 2016 and 163 RSA DAS for 2017. Monkfish RSA DAS were offered industry-wide to fishermen of all gear types holding active monkfish permits. CCE staff coordinated with participating compensation harvesters to sign a CCE RSA DAS purchase contract, adding participating vessels to the EFP, distributing the EFP and NMFS RSA DAS reporting instructions to all participants purchasing RSA DAS. CCE updates and tracks usage of monkfish RSA DAS by coordinating with the involved fishermen and Cynthia Hanson from NMFS-GARFO. According to the final update received from NOAA on June 27, 2018, project EFP # 16066 for 2016 RSA DAS used 146.85 days out of the 250 2016 days allocated to our fishing partners for compensation harvest. Thus only 58.74% of the 2016 RSA DAS were actually used by our industry partners. Associated with these 146.85 DAS, 639,704 lbs were landed out of a total of 888,000 lbs awarded to our industry partners. Thus only 72.04% of the available 2016 poundage associated with the 2016 DAS were actually landed. EFP # 16066 for 2016 RSA DAS expired April 30, 2018 so there will not be any additional catch for those 2016 RSA DAS. Also, CCE is still owed monies from fishermen who contracted to purchase a certain amount of RSA DAS but then did not use them. According to a summary received on October 31, 2018, Project EFP # 17027 for 2017 RSA DAS has used only 21.89 days out of 300 awarded and landed 124,699 lbs out of the 1,222,200 awarded. Due to low industry demand for RSA DAS, we have only been able to allocate 163 2017 RSA DAS to our industry partners for compensation harvest. This is 54% of the 300 RSA DAS awarded to us, and this is at the reduced rate we are charging for RSA DAS (see below). Since these DAS expire April 30, 2019 we anticipate only around 50% or less income from the awared 2017 RSA DAS. Please see problems Encountered section.

Problems Encountered:

Generating funds from the sale of RSA DAS has been a challenge during this project. We were able to allocate to our industry partners for compensation harvest RSA DAS awarded for Project #16066 (2016 DAS). But as reported above, fishermen could not efficiently use the RSA DAS and left over 25% of the quota awarded un-used. CCE is also finding some difficulty collecting all the money agreed to for the 2016 RSA DAS. Fishing industry feedback reports that issues with weather, market prices, Northern management Area unlimited possession and the skate closure have made paying for and using RSA DAS costly and not viable. A reduction in price per RSA DAS was requested by industry. The reduction in ex-vessel price during this project has particulary had a large negative impact on the demand and use of RSA DAS. The ex-vessel price of monkfish has gone from around $3.00/lb at the start of our project to approximately $1.00/lb in 2018. This drop in price has not only reduced demand for RSA DAS but has also forced some monkfish fishermen to persue other species during part or all of the year. An additional contributing factor was that last year fishermen received 15% more normally allocated monkfish DAS with a 15% increase in pounds per DAS. The RSA DAS poundage parity was resolved with NMFS (as stated above) but the 15% increase in normally allocated DAS continued to reduce demand. Despite our increased effort to market RSA DAS to the fishing industry we still have approximately 140 unsold RSA DAS which will expired on April 30, 2019. CCE staff struggled over funds generated from the sale of RSA DAS. It was eventually determined that a price reduction was necessary to try to effectively sell as many 2017 RSA DAS as possible.

Due to the above-described issues and the impact they potentially have on this project, P.I. Hasbrouck met with Cheryl Corbett, Cooperative Programs Specilist, at her office at the NEFSC. The problems associated with reduced program income, and the reasons why this occurred, were thoroughly discussed.

As a result of this meeting, Hasbrouck informed Corbett of the following changes for this RSA project:

- CCE will be lowering the price to industry for our 2017 RSA DAS to $400/DAS
- Since current project expenditures greatly exceed program income, and since there has been little demand for RSA DAS, CCE has suspended work on this project including tasks to be carried out by NYU.
- CCE and NYU will not be able to resume activity on this project until we can cover existing expenses and generate funds to continue the project
- We will thus have to reduce our scope of work on the project but will not be able to determine the reduction in project scope until we see if there is industry demand for RSA DAS
- It is hoped that by lowering the price of 2017 DAS coupled with the recent NMFS actions that increased poundage associated with RSA DAS, we can generate interest in the fishing industry to purchase additional DAS.

An issue with a fisherman was resolved during this reporting period. CCE staff was notified that a reporting issue with a fisherman on the project EFP was persisting and that fisherman was to be removed from the EFP after investigation was completed by NOAA's Office of Law Enforcement. The removal of this fishereman from the CCE project EFP's was finalized May 15, 2018.

Future Activities:

CCE will continue to market RSA DAS sales to fully utilize the award allocation and generate the appropriate funds to complete the research. CCE staff continue the open conversation with NEFSC staff about RSA DAS issues. CCE will maintain coordination with fishermen and replenish sampling kits as needed. We will remain in contact with NMFS to track monkfish RSA DAS usage. CCE will continue to work with NMFS/GARFO with any vessel additions or subtractions on the EFP for this project. CCE will continue to coordinate with NMFS/GARFO to file data requests and analyze all monkfish fishery specific data provided to assure the success of this project. Project partners will continue to communicate through email and conference calls. CCE and NYU will coordinate the project progress and data analysis. CCE will coordinate and complete the final report for submission.

Figure 1. Total monkfish samples from known areas.

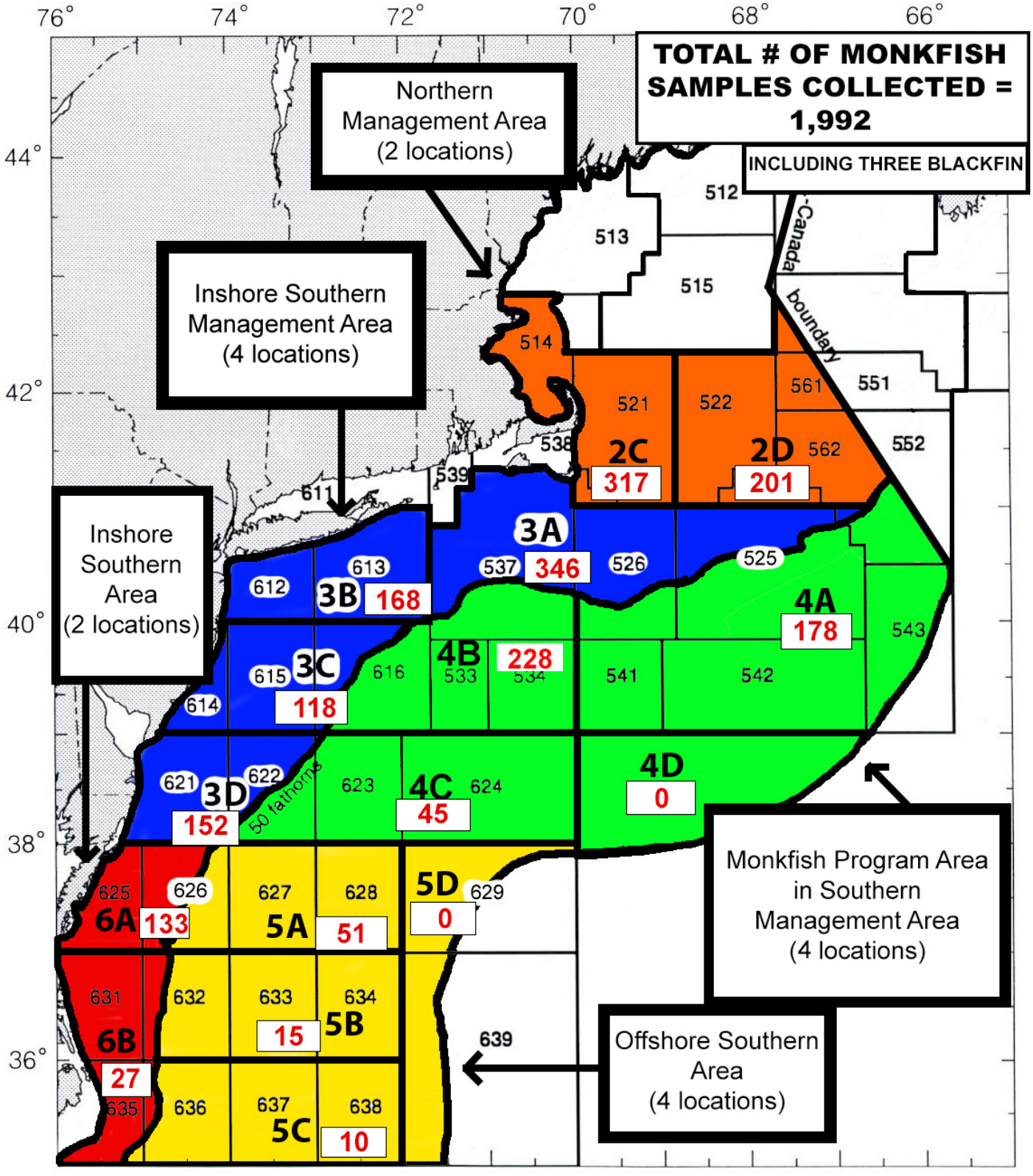

Fig. 3. USA/NEFSC Statistical Areas.

Monkfish RSA Network Participants

Cornell Monkfish Network Participants		
Fisherman	**Vessel**	**State**
William McCann	Pilgrim & Shamrock	Massachusetts
Melon Fisheries	SS Melon	Massachusetts
Nebula Inc		Massachusetts
Reds Best		Massachusetts
Charles Borden	Drake	Massachusetts
Phillip Powell	Foxy Lady	Massachusetts
Ted Platz	Louise	Rhode Island
John Stoltsgif	Martha Porter	Rhode Island
Todd Sutton	Sweet Misery	Rhode Island
Town Dock Inc	Lightning Bay	Rhode Island
Town Dock Inc	Excalibur	Rhode Island
Town Dock Inc	Determination	Rhode Island
Town Dock Inc	Rebecca Mary	Rhode Island
Town Dock Inc	Stephanie Bryan	Rhode Island
Jim Fox	Rayda Cheramie	Rhode Island
Scott Dudley	Atlantic Pearl	Rhode Island
Malcolm McClintock	Rhonda Denise	Rhode Island
Chris Roebuck	Karen Elizabeth	Rhode Island
Aaron Gerwitz	Nancy Beth	Rhode Island
Tim Froelich	Liberty & Miss Independence	New York
Richard Larocca Jr	Double Vision, Doubled Vision & Morgan Gabriella	New York
Vincent Damm	Lady K	New York
Charles Etzel	Clover	New York
Rick Stevenson	Sea Smoke	New York
William Grimm	Perception	New York
Chris Scola	Rock and Roll	New York
Kevin Wark	Dana Christine	New Jersey
Viking Village Inc		New Jersey
Atlantic Capes Seafood		New Jersey
Chris Walker	Krists~Caleb~Morgan	Virginia
Randall Morgan	Miss Dolores	Virginia
Chincoteague Fisheries		Virginia
Jamie Westcott	Risky Business	Virginia
John Shertenlieb	Patty L	Virginia
Wanchese Fish Co		Virginia
L D Amory & Co		Virginia
Old Point Packing Inc		Virginia

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