

Northeast Consortium Cooperative Research Mid-Year Progress Report, December 2006

Project Title: Genetic Identification of Atlantic Cod Spawning Stocks in U.S. Waters using Microsatellite and SNP DNA Markers

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Project Objectives: Our research objectives are to identify the spatial and temporal stock structure of Atlantic Cod (*Gadus morhua*) in US waters, using genetic analyses. Specifically, our aim is to identify and sample major spawning aggregations throughout the Gulf of Maine (GOM), Georges Bank, and areas south of Georges Bank, and to determine if these aggregates are genetically unique stocks.

Major Accomplishments: To date, we have identified spawning aggregates and collected 681 samples from the following locations: Northeast Georges Bank (n=158, winter-spawning), Massachusetts Bay (n=98, winter-spawning, and n=35 spring-spawning), Ipswich Bay (n=121, spring-spawning), Stellwagen Bank (n=61, spring-spawning), Nantucket Shoals (n= 107, winter-spawning), and Platts Bank, offshore Maine (n=85, summer, reproductive, nonspawning). In addition, we have collected nonspawning fish from Long Island (n=16, winter) and Jeffreys Ledge (n=55, fall). Additional sample collection is ongoing (e.g., we are collecting samples from winter-spawning fish in Ipswich Bay at the time of writing this report). Genetic analyses of these samples are currently in progress. To date, DNA has been isolated from all samples in hand. 544 samples have been genotyped at 3 microsatellite and 5 single nucleotide (SNP) DNA loci. We will continue analysis of these and additional sample collections at 6-10 additional loci, in the upcoming months.

In preliminary analyses (based on 3 genetic marker loci), we focused on comparing 2 of the new sample collections (Massachusetts Bay and Jeffreys Ledge) to the populations studied in 2005 (funded via a previous NEC development grant). We found that a sample of 65 spawning adult females from Massachusetts Bay, collected in December 2005-January 2006, were genetically distinct from our previously sampled populations in Georges Bank, Long Island and Ipswich Bay (spring-spawning). We also detected marginally significant differentiation with Ipswich Bay (winter-spawning) and Chatham populations. These preliminary findings suggest that the cod that are currently spawning in Massachusetts Bay might be a distinct population from those spawning in Ipswich Bay. We emphasize that these findings are preliminary, as they

are based on a limited number of genetic markers and samples. In addition, there was a temporal difference of 3 years in the sampling of the Ipswich and Massachusetts Bay populations for this comparison. We are currently continuing analysis of these populations with additional markers and the additional sample collections to further investigate this and other relationships of cod spawning stocks. For the fish sampled on Jeffreys Ledge (in the WGoMAC), we found that these 55 nonspawning adults were genetically distinct from the Massachusetts Bay and Long Island samples, but not from our previously collected Georges Bank, Ipswich Bay (neither spring nor winter-spawning), Chatham or Stellwagen samples. The latter findings suggest that cod found on Jeffreys Ledge do not spawn there, and they appear to be a mix of fish from different populations. Interestingly, this mix did not appear to include fish from the nearby, inshore Massachusetts Bay population. Further research with additional markers and samples are needed to resolve the identity of Jeffreys Ledge cod.

Unexpected difficulties: The key to the success of our project is identifying the spawning aggregates; nonetheless, we feel that our progress to date is encouraging. The major difficulty we face is that, for some previously identified (historic) populations, spawning aggregates might no longer exist, e.g. coastal Maine and downeast Maine. Although we sampled reproductive fish from offshore Maine in August, they were not actively spawning. Furthermore, in the last few winters cod have not been aggregating in Ipswich Bay, as they did back in 2003. It is possible that the structure of cod populations is more fluid and complex than previously anticipated. If so, this too will be a very interesting finding.

Tasks for the next 6 months: We will continue genotyping of the 681 samples collected to date in 2006; we anticipate to genotype at a total of 10 –15 genetic marker loci. We will also continue our collaboration with fisherman to identify and sample cod from spawning aggregations. Our intent is to collect additional samples, if available, from winter-spawning fish in Ipswich Bay, additional sites on Georges Bank, southern coastal Maine, and downeast Maine, and to increase our samples from the southern range (Long Island and Block Island areas). Ultimately, we will test for genetic differentiation among these samples and make comparisons with our previous findings, in order to identify the stock structure of Atlantic cod in the Gulf of Maine, Georges Bank and south of Georges Bank. We will also compare samples collected from the same locations in different years, to test for temporal stability of stocks.

Impacts: Our research involves collaboration between scientific researchers, managers and commercial fisherman. We have been working closely with our steering committee members in sample collection and also communication of our preliminary findings. The results of our previously funded NEC development grant are in press for publication in the Transactions of the American Fisheries Society. Recently, we have presented our preliminary results at several seminars and meetings. Our project is generating much interest and we anticipate that our findings will be incorporated into the scientific information used to develop fisheries management plans.