NORTHEAST CONSORTIUM
2010 Progress Report

Project Title: Spawning movements and habitat use of winter flounder in the southern GOM.
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Principal Investigator:
Elizabeth A. Fairchild, Assistant Research Professor
University of New Hampshire, Dept. of Biological Sciences
Spaulding Hall G47, Durham, NH 03824
Ph: 603-862-1244; Fax: 603-862-3784; E-Mail: elizabeth.fairchild@unh.edu

Other Project Participants:
W. Huntting Howell, Professor of Biological Sciences
University of New Hampshire, Durham, NH 03824
Ph: 603-862-2109; E-mail: whh@cisunix.unh.edu

David Goethel, Commercial Fisherman
23 Ridgeview Terrace, Hampton, NH 03842
Ph: 603-926-2165; E-mail: egoethel@comcast.net

Carl Bouchard, Commercial Fisherman
Epping Road, Exeter, NH 03833
Ph: 603-772-5047; Fax: 603-772-5370; Email: cpbouch@aol.com

Charles Felch Sr., Commercial Fisherman
118 Centennial St., Seabrook, NH 03874
Ph: 603-474-7342; E-mail: boat1151@aol.com

Michael Armstrong, Program Manager
Recreational and Anadromous Fisheries, Annisquam River Marine Fisheries Station
Massachusetts Division of Marine Fisheries, 30 Emerson Avenue, Gloucester, MA 01930
Ph: (978) 282-0308 ext. 109; E-mail: michael.armstrong@state.ma.us

Laughlin Siceloff, Technician, Dept. of Biological Sciences
University of New Hampshire, Durham, NH 03824
Ph: 603-862-4153; E-mail: laughlin.siceloff@unh.edu

Bill Hoffman, Technician
Massachusetts Division of Marine Fisheries, 30 Emerson Avenue, Gloucester, MA 01930
Ph: (978) 282-0308; E-mail: bill.hoffman@state.ma.us

Hypothesis: Winter flounder in the Gulf of Maine spawn in coastal and offshore waters rather than in estuaries.

To test this hypothesis, we proposed the following objectives:

1. Acoustically tag 40 pre-spawning adult winter flounder (20 males, 20 females) in our selected study area in February 2009.
2. Track these fish over the next three months to determine their spatial distribution and movements.
3. Sample the adult population of winter flounder in our study site from February to May 2009 to quantify how the reproductive status of these fish changes over time in this offshore area.
4. Determine how the spatial distribution of spawning fish relates to attributes of the spawning habitat.

Major Accomplishments and Milestones:

General Summary: During this reporting period, the remaining sea days were used to remove all the receivers thus completing the field work, and data analyses began in earnest.
A total of 397 winter flounder were caught in 92 tows made by industry partners in March-June 2009. Fish size ranged from 17 – 46.5 cm TL (mean = 31.3 cm, S.E.=0.26). Females typically were larger than males: females ranged from 25 – 46.5 cm (mean = 33.8 cm, S.E.=0.29), while males were 22 – 37 cm (mean = 29.8 cm, S.E.=0.58). Mature fish of indeterminate sex were 28 – 41.5 cm (mean = 31.7 cm, S.E.=0.38), while immature fish were 17 – 27.5 cm (mean = 24.1 cm, S.E.=0.31). The mean numbers of ripe/developing females and ripe males caught per tow increased over time in March and April and peaked in late April and early May, while the number of spent females peaked slightly later, in early and late May. By late May, the majority of flounder caught per tow showed no signs of spawning and sex was not identifiable externally (see Fig. 1). Most fish caught at sea (94%) were equipped with disc or spaghetti tags (n=336) or acoustic transmitters (n=40). Twenty-one fish were not tagged: 17 were considered too small, and four were in poor condition. In addition, 9 tows were made in the Hampton-Seabrook Estuary (HSE) in which an additional 21 winter flounder were disc tagged. Gonad biopsies were successfully taken from 87 females and their eggs were counted and measured. Mean egg diameters varied from 0.60 – 0.95 (mm). Seven of these egg samples spanning a range of mean egg sizes (0.6 – 0.91 mm) were further analyzed, and histology verified that all seven females were in “ripe” reproductive condition.

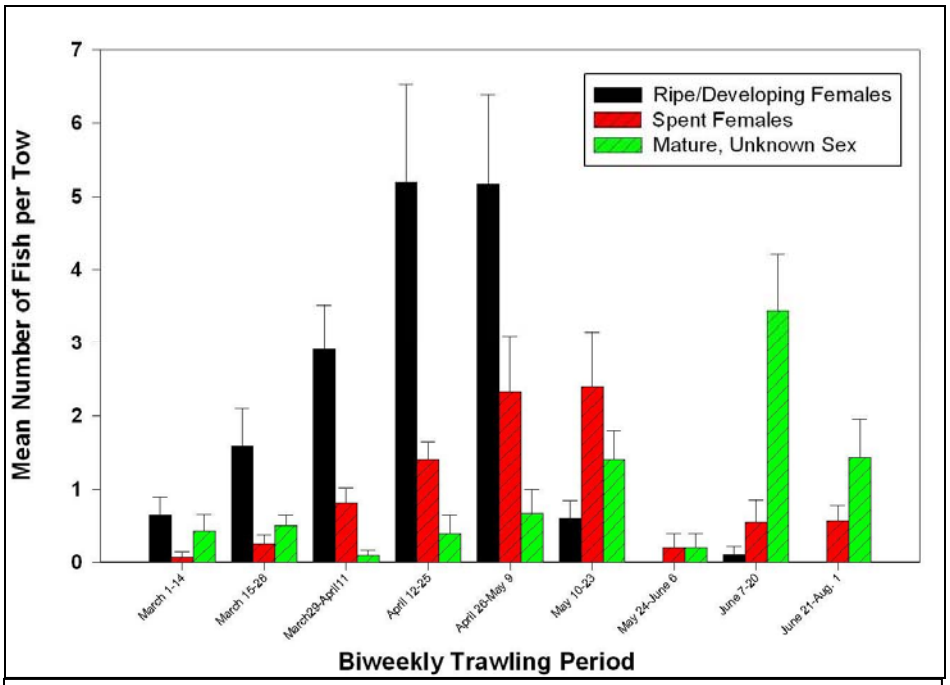

Figure 1. Condition of adult female winter flounder caught by trawl surveys in Ipswich Bay from March to August 2009.

Recaptured Fish: As of Dec. 31, 2009, 15 tagged flounder were recaptured and reported by fishermen (4% return rate; Fig. 2). One flounder was tagged in the HSE and recaptured ~350 m from its release site inside the estuary after 36 d at liberty. The rest were tagged at sea, and most were recaptured in Ipswich Bay (n=11). Ocean-released fish were recaptured ~ 2 – 57 km from their tagging sites with a mean of 18 km (net displacement), and were recaptured in depths of 6 – 75 m. Recaptured fish were at liberty for 33 –230 days after tagging with an average of 109 days. Two fish recaptured in November, 5 to 7 months after tagging, were only 2 to 7 km from their release sites.

Three flounder (8%), all females, were relocated south of the Ipswich Bay study area by receiver arrays deployed by Massachusetts Division of Marine Fisheries. They were detected along the southern coast of Cape Ann in Massachusetts Bay, and the southern edge of Jeffreys Ledge.

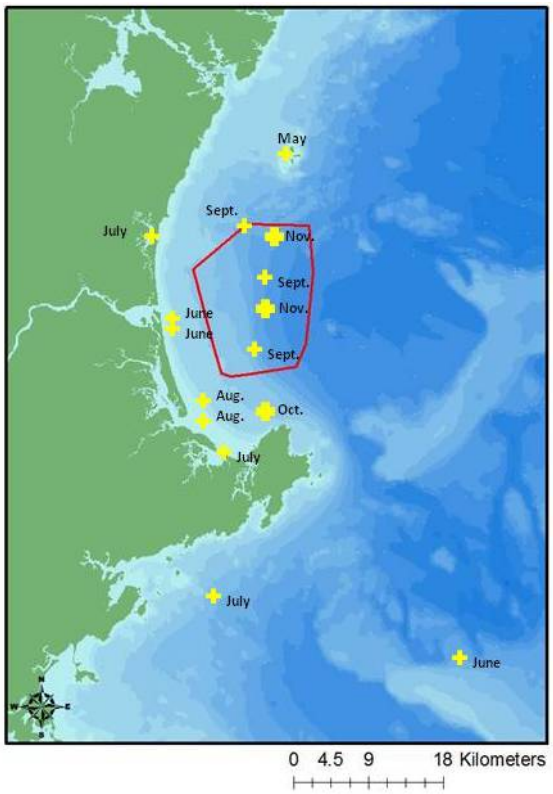

Figure 2. Locations and months of recaptured tagged winter flounder in 2009 as denoted by the yellow crosses. The red polygon shows trawl and disc tagging area used March to July 2009. All recaptured fish were tagged within the red area except for the fish captured in the Hampton-Seabrook Estuary in July which was tagged in that estuary in June.

Estuarine Movements: Six fish (15%) were detected entering estuaries between April and August 2009. One fish entered the Hampton estuary, two entered the Merrimack, two entered Plum Island Sound, and one entered Essex Bay. No fish were detected in the Piscataqua / Little Harbor area or the Annisquam River. Interestingly, the two fish found in the Merrimack were male, while the rest were female. The majority of fish (n=4) entered and left the estuaries at night. There was no obvious relationship between tidal cycle and estuary movements for the group as a whole. One fish (tag 711) that entered Plum Island Sound, continued to be heard by UMASS receivers until mid-Nov. when the receivers were hauled out.

Movement Trends: Preliminary analyses indicate a relationship between time of day and fish activity patterns. Most horizontal movement (migration) occurred at night (8pm - 6am), and was particularly clear when a fish moved within an array or line of receivers. Despite patchy depth data, 66% of acoustically tagged fish (n=25) were confirmed to have made one or more vertical ascents at least 10 m off the bottom, according to available bathymetric data. All of these confirmed off-bottom ascents occurred at night. Eighteen percent of these fish (n=7) made one or more ascents 20 to 45 m above the seafloor. Vertical ascents off-bottom were not only associated with nocturnal periods, but horizontal migration as well. Almost all fish showed a pronounced depth decrease just prior to making nocturnal exits out of the array. In some cases, this depth shift corresponded to inshore movement up slopes, but 55% of fish (n=21) were confirmed to have been > 10 m above the seafloor just prior to moving out of the receiver range, indicating that these flounder often rose significantly in the water column during nocturnal migratory movements. Similarly, when fish entered a receiver array at night, usually

they were above the seafloor, and made a gradual descent as daylight approached. The highest ascent was believed to be 45 m above the seafloor (27 m below the surface) as fish 701 moved southeast out of the original array with a southward current in late April. This fish was later relocated in June on southern Jeffreys Ledge. It is possible that its migration was facilitated by the ascent coupled with selective tidal transport.

Spawning Habitat: Because the majority of the acoustically tagged fish (85%) did not enter estuaries during the spawning season, there appear to be several reproductive strategies that winter flounder use; our study suggests that a large proportion of these fish are spawning outside of estuaries in the southern Gulf of Maine. Further analyses of the movements and habitat occupied by these tagged fish will clarify this behavior.

Unexpected difficulties and project alterations:

There were no unexpected difficulties or project alterations during this reporting period. A minor setback was the loss of six receivers (4 from off-shore and 2 from estuarine areas). Some tagged fish detection data likely were lost from those areas.

Next steps, tasks for next 6 months:

During the next six months, data analyses will be completed and manuscripts will be prepared.

Impacts of the project to fishermen/fishing community and scientist/science community:

This study contributes to a broader understanding of winter flounder spawning habitat, especially for those populations north of Cape Cod. Given that the long-term viability of marine resources depend on protection of their habitat, and that the Sustainable Fisheries Act requires regional fishery management councils to describe, identify, protect, conserve and enhance essential fish habitats (EFH), studies of winter flounder spawning habitat are necessary. Results of the research will be useful to fisheries managers. For example, there is good evidence that southern winter flounder populations return to the same spawning area each year (Saila 1961a; Phelan 1992), and this may be true in the GOM as well. In addition, it appears that the northern populations do not undertake long migrations (Howe and Coates 1975). Therefore localized spawning areas, such as those we are identifying, are probably critical to local populations, and the fishery that depends on them. Clearly it is important to study and understand the essential spawning habitat associated with this area. State and federal fisheries managers and regulators will be able to use the data to identify, conserve and enhance the essential habitat for winter flounder.

Elizabeth Fairchild
January 15, 2010