Identifying offshore spawning grounds of Gulf of Maine winter flounder

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New England Fishery Management Council

NEFMC Research Steering Committee Meeting 3/23/17
GOM Winter Flounder Life History

ESTUARINE \(\rightarrow\) IN-SHORE \(\rightarrow\) SUBADULT

OFF-SHORE
Typical Inshore Movements of Ipswich Bay Fish

Final depths = 8 - 68 m

Spawning season peak = April

SPAWNING NOT ESTUARINE DEPENDENT

Plymouth Bay, MA Fish

- 2 spawning groups:
  - Coastal
  - Estuarine

- Most fish remained outside of estuary

- Estuarine use greatest in late spring/early summer (post-spawning)

Mature winter flounder

March - June 2004 - 2007

30-minute tows

Data from Hoffman et al., 2006

Are winter flounder spawning offshore too?
Possible Offshore Spawning Sites

1. Identify offshore sites based on industry knowledge

2. Measure relative abundance of winter flounder during the spawning season (mid-March – May)

3. Examine sex and reproductive stage of mature fish

4. Characterize habitat
Possible Offshore Spawning Sites

Jeffreys:
- 53 – 70 m; sandy
- 13 km to shore
- 5 trips; 25 tows

Bigear:
- 91 – 183 m; muddy
- 5.5 – 6.6 °C
- 25 km to shore
- 5 trips; 25 tows

Stellwagen:
- 27 – 41, 82 m; sandy
- 5.4 – 6.9 °C
- 44 km to shore
- 4 trips; 21 tows

14 March – 15 May 2016
2016 Spring Sampling: 1,384 winter flounder caught in 71 tows
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Sex Composition

**Proportion Caught**

**Week**

**Jeffreys**
- Females: 83%
- Males: 74%
- Unknown Sex: 71%
- Immature: 23%
- Mature: 6%

**Stellwagen**
- Females: 176%
- Males: 166%
- Unknown Sex: 147%
- Immature: 187%

**Bigear**
- Females: 69%
- Males: 160%
- Unknown Sex: 152%
- Immature: 70%
- Mature: 6%

**Sex Verification**
- 22 Females
- 25 Mature
- 25 Unknown

**Sex**

- 5% Males: N = 74 fish
- 19% Unknown Sex: N = 264
- 2% Immature: <28 cm TL; N = 27 fish
- 17% Mature: >28 cm TL; N = 237 fish

Total fish: 1,045
Sex Composition

**Jeffreys**

- Proportion Caught
- Week 2: 83% Females, 71% Unknown Sex, 23% Males
- Week 4: 74% Females, 71% Unknown Sex, 6% Males
- Week 6: 71% Females, 6% Unknown Sex, 23% Males
- Week 8: 23% Females, 6% Unknown Sex, 71% Males
- Week 10: 6% Females, 6% Unknown Sex, 83% Males

**Stellwagen**

- Proportion Caught
- Week 2: 176% Females, 166% Unknown Sex, 147% Males
- Week 4: 166% Females, 147% Unknown Sex, 187% Males
- Week 6: 166% Females, 147% Unknown Sex, 187% Males
- Week 8: 147% Females, 187% Unknown Sex, 166% Males
- Week 10: 187% Females, 166% Unknown Sex, 147% Males

**Adjustments based on groundtruthing:**

- Females: 4%
- Males: 4%
- Unknown Mature Fish: 82% female, 18% male
Adjusted Sex Composition

**Adjusted Sex Composition**

![Bar Chart](Bar Chart Image)

**Proportion Caught**

- **Jeffreys**
  - 2: 83% (f), 74% (m), 71% (unknown mature)
  - 4: 23% (f), 6% (m), 17% (unknown Immature)

- **Stellwagen**
  - 2: 176% (f), 166% (m), 147% (unknown Immature)
  - 4: 187% (f), 147% (m), 166% (unknown Immature)

**Unknown Immature**

**Females**: 4%  
**Males**: 4%  
**Unknown Mature Fish**: 82% female 18% male

**Adjustments based on groundtruthing:**
Female Reproductive Stage

Reproductive Stages:
- Immature
- Resting
- Spent
- Running Ripe
- ripe
- Developing

Maturation:
- Immature → Resting
- Resting → Developing
- Developing → ripe
- ripe → Ripe
- Ripe → Spent
- Spent → Running ripe
- Running ripe → Running Ripe
- Running Ripe → Developing
Female Reproductive Stage

Reproductive Stages
- Immature
- Resting
- Spent
- Running Ripe
- Ripe
- Developing

Stage Verification:
- **22 Females**
- **20 Mature Unknown**

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Winter flounder maturity classes

Slide courtesy of Rich McBride
### Observed reproductive stages

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### Adjustments needed to data:
- Increase Developing by 20%
- Decrease Ripe by 20%
- Decrease Resting by 29%

42 Females >28 cm TL
Female Reproductive Stage

Adjustments based on groundtruthing:
- Immature
- Resting 29%
- Spent
- Running Ripe 20%
- Ripe
- Developing 20%
Adjusted Female Reproductive Stage

**Proportion Caught**

**Jeffreys**
- Immature: 75%
- Resting: 29%
- Spent: 19%
- Developing: 4%
- Ripe: 20%

**Stellwagen**
- Immature: 163%
- Resting: 156%
- Spent: 130%
- Developing: 180%

**Bigear**
- Immature: 66%
- Resting: 148%
- Spent: 143%
- Developing: 65%

**Adjustments based on groundtruthing:**
- Immature
- Resting: 29%
- Spent
- Running Ripe: 20%
- Ripe
- Developing: 20%

*Shallowest to deepest:*
- Sandy: 13 km to shore
- Mud: 25 km to shore
- Sandy: 44 km to shore

Maturation:
- Immature
  - Resting
  - Developing
  - Running ripe
  - Ripe
Adjusted Female Reproductive Stage

Adjustments based on groundtruthing:
- Immature
- Resting 29%
- Spent
- Running
- Ripe 20%
- Developing 20%

Jeffreys
- Week 2: Immature 75%
- Week 4: Resting 67%
- Week 6: Spent 65%
- Week 8: Running 19%
- Week 10: Ripe 4%

Bigear
- Week 2: Immature 66%
- Week 4: Resting 148%
- Week 6: Spent 143%
- Week 8: Ripe 65%

Stellwagen
- Week 2: Immature 163%
- Week 4: Resting 156%
- Week 6: Spent 130%
- Week 8: Ripe 180%

Sandy 13 km to shore
- Deepest muddy 25 km to shore
- Shallowest sandy 44 km to shore

Maturation:
- Immature
- Resting
- Developing
- Running
- Ripe
- Spent
Summary of Observations:

• **Winter flounder do spawn offshore:**
  • More pre-spawning females earlier in the sampling period, and more post-spawning females later.
  • **RUNNING RIPE** fish caught at Jeffreys and Stellwagen.

• Jeffreys: Abundance decreased towards May, indicating that while fish may be spawning there, they are not remaining there after spawning, and are moving elsewhere (inshore).

• Bigear: Mostly pre-spawning, developing females, but abundance dropped significantly by early May, suggesting that winter flounder are moving through on the way to a nearby spawning area (perhaps adjacent rocky bottom?).

• Stellwagen: Abundance remained constant and high, relative to the other two areas, and all reproductive stages were caught. Fish spawn and remain there. Earlier and longer spawning season compared to other more northerly sites.
Summary of Observations:

Why Stellwagen?

• **Likely habitat related.**
• Shallow and sandy, typical of inshore spawning areas... but 44 km from shore.
• However....

Limitations of this study:

• Minimal documentation of habitat
• Not possible to compare between sites
• Relatively short (<3 month) study
Winter flounder spawning areas extend further from shore than previously documented in the GOM.

**IMPLICATIONS:**
1. Is an EFH re-evaluation warranted?
2. What are movements of adults in these offshore spawning areas?
3. Are winter flounder still spawning in estuarine waters in southern GOM?
4. Are dredge windows relevant?

**Recaptured Fish (1.3%)**

N = 17 (12 plotted here) of 1,337

After spawning season, most recaptured fish had moved inshore.

Some Stellwagen Bank fish stayed put.
Thank you!

**Industry Collaborators:** Captains Jim Ford, David Goethel, and Neil Pike, and all their crew

**Field Assistance:** Erik Berghahn, Katie Butler, Liz Groover, Hunt Howell, Schuyler Mace, Megan Owings, Jenna Rackovan, Steph Sykes, and John Taylor

**GIS Figures:** Tiffany Rodenbaugh

**Scientific Support:** Hunt Howell and Rich McBride

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