

Project Title:

Sex and Length of Summer Flounder Discards in the Recreational Fishery, NJ to RI

Funding Provided By: Science Center for Marine Fisheries (SCeMFiS)



Save the Summer Flounder Fisher Fund (SSFFF)



Jersey Coast Anglers Association (JCAA)



Award Period: 01/01/2016 - 12/31/2016

Reporting Period: 01/01/2016 – 10/01/2016

Project PI: Daphne Munroe, Haskin Shellfish Lab, Rutgers University

Graduate Student Investigators: Jason Morson, Haskin Shellfish Lab, Rutgers University

Undergraduate Investigators: Ryan Harner, Stockton University

Rachel Marshall, University of Rhode Island

Project Collaborators: Cornell Cooperative Extension of Suffolk County

Project Data Report, October 2016



Sex and Length of Summer Flounder Discards in the Recreational Fishery, NJ to RI

Summary

Previous research has shown that summer flounder (*Paralichthys dentatus*) recreational landings are composed of 95% females, in contrast to the commercial fishery which maintains a more even ratio of male to female landings. The sexually dimorphic nature of the species is potentially underrepresented in current recreational fishery management plans and, unlike in the commercial fishery, sufficient data proxies (i.e. trawl surveys) are not available to estimate the sex ratio of discarded (<46 cm) fish. To address this gap in available data, discard-sized fish were measured throughout the 2016 summer flounder recreational fishing season aboard for-hire recreational fishing vessels. A subset, based on length and fishing depth, of those discarded fish were brought back to the laboratory for dissection and further analysis. Results indicate a clear relationship between sex ratio and fish length, with males more frequently observed at shorter lengths, giving way to a predominantly female sex ratio as length increased. In addition to length, latitudinal and seasonal trends were found to have a significant effect on sex ratio in discard-sized fish in the summer flounder recreational fishery.



Project team members, Ryan Harner (left) and Rachel Marshall (center) collect data on fishing vessels and perform dissections and data collection in the lab.

Introduction

A recent stock assessment review of summer flounder (*Paralichthys dentatus*) identified the need to account for sex-specific fishing mortality in the assessment model. However, sex-specific models of population dynamics can be data-intensive and require some knowledge or assumptions about the sex ratio of the population and catch (landings and discards). Sex-specific information for the population is collected annually by the National Marine Fisheries Service's (NMFS-NEFSC) trawl survey. Sex composition of the catch, however, is limited and *no information* is available on sex composition of discards from either fishery.

Female summer flounder grow faster (Morson et al., 2012; Poole, 1961) and have a lower natural mortality (Maunder and Wong, 2011) than males. Previous studies (Morson et al., 2012, 2015) demonstrated that summer flounder landings in the recreational fishery have been composed primarily of females (95%). Furthermore, while sex-at-length of fish landed in the commercial fishery is well described by data from the NMFS-NEFSC survey, in the recreational fishery, a significantly higher fraction of landed fish at a given length are female (Morson et al., 2015). Thus, sex-at-length keys generated from the NMFS-NEFSC survey are not appropriate proxies for estimating sex ratio of landed and discarded fish in recreational fishery. The absence of information on the sex composition of recreationally discarded summer flounder remains a key need for development of a sex-specific stock assessment model (Figure 1).

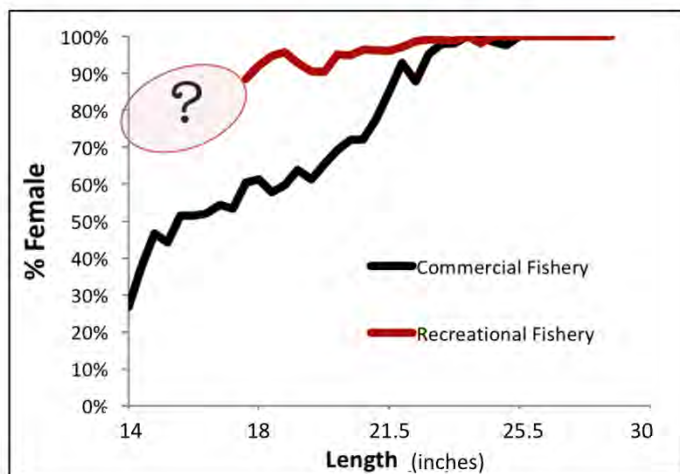


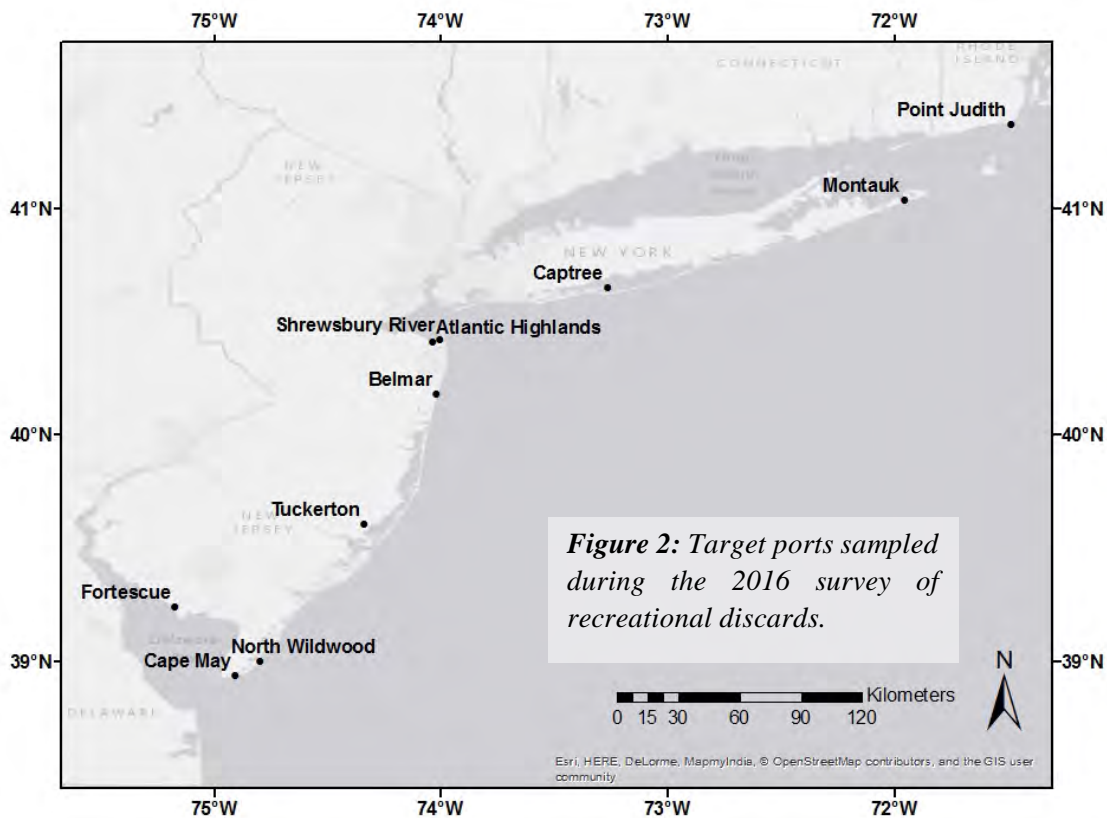
Figure 1: A gap in the existing data concerning sex ratios of discarded fish in the recreational fishery is the motivation for this program. Our primary aim is to fill this gap and provide regional and seasonal data about sex ratios of recreational discards.

The goal of this project was to determine the sex ratio of sublegal summer flounder caught and discarded in the recreational fishery from New Jersey, New York, and Rhode Island and to evaluate seasonal and spatial (depth and latitude) trends in discard sex ratio. Efforts are underway by other investigators to develop a sex-specific assessment model and the data collected during this project have been provided to the assessment modeling team for incorporation into their model.

Materials and Methods

Sample Collection

Data collection spanned the 2016 summer flounder recreational season beginning when the season opened on May 23, 2016 and continuing through September 16, 2016. Samples were collected aboard for-hire recreational fishing vessels from selected ports (Figure 2) in New Jersey, New York, and Rhode Island. Sampling ports were selected based on previous studies (Morson et al., 2012; Morson et al., 2015). The six main ports (Cape May, Fortescue, Atlantic Highlands, Captree, Montauk, and Point Judith) were supplemented with additional back bay (shallow water) sampling trips to North Wildwood, Tuckerton, and Shrewsbury River as opportunity allowed, in order to document fish from shallower locations not represented by samples collected on larger for-hire vessels. Each main port was sampled every two weeks beginning at the opening of the fishing season and continuing through the close of the season (note: weather and other factors lead to missed sampling on rare occasions).



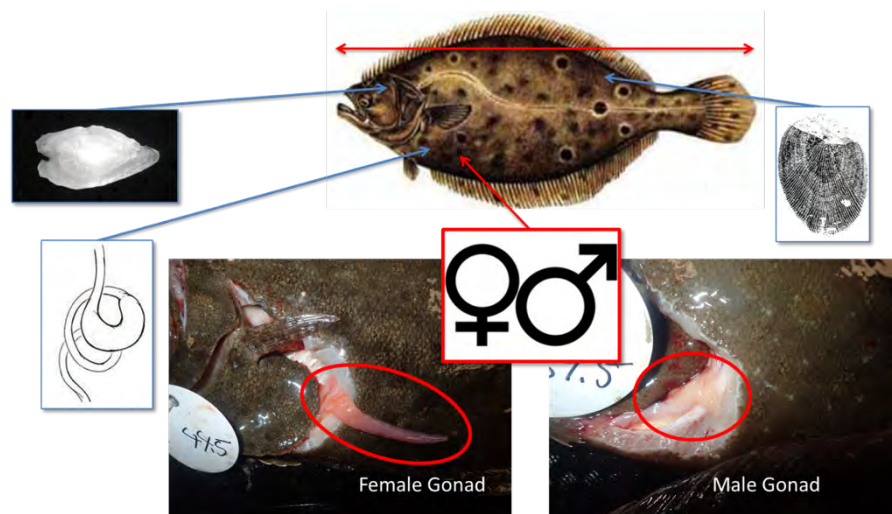
On each trip, data and sample collection occurred on each drift according to predetermined length bins and depth categories. Depth was assigned four categories: 0-25, 26-50, 51-75, and >75 feet. Fish length bins included 20-25, 26-30, 31-35, 36-40, and 40-45 cm categories. For each depth category, a maximum of 10 fish were collected in each size bin for laboratory analysis, while any additional fish were measured to the nearest cm and returned to the water alive. Retained fish were tagged with their respective drift number and length and placed on ice until return to the laboratory. Date, port, drift, length, latitude, longitude, time, and depth were recorded for each

discard-sized fish whether retained or released. Upon the completion of each trip, length and sex were recorded for all landed fish.

Laboratory Analysis

Discard-sized fish that were retained for laboratory analysis were processed fresh within 24 hours of the trip. Dissections were performed to determine sex. In addition, samples and data were gathered for future research opportunities (Figure 3). These included stomach and scale samples collected from all retained discards from the New Jersey ports as well as otoliths taken from one male and female fish per size bin per drift where possible. Scale samples were taken from one male and one female fish per size bin per drift from the retained New York and Rhode Island discards.

Figure 3: Data collected for each discarded fish includes length, sex, stomach sample (archived), and scale sample (archived). Otoliths were also archived for a subset of sampled fish.



Results

Samples were collected from stations ranging in depth from 5 to 95 feet and spanning a latitudinal range from off the coast of Delaware to the coast of Rhode Island (Figure 4). The number of discarded fish per trip ranged from zero to 147 (Table 1), and sex-at-length data was collected for a total of 2,243 discard-sized fish and 842 legal-sized fish. On average, across all ports and sample dates, the sex composition of discard-sized fish was 45% female, whereas the landings were 87% female. A per trip summary of fish collected and sex ratios is provided in Appendix 1.

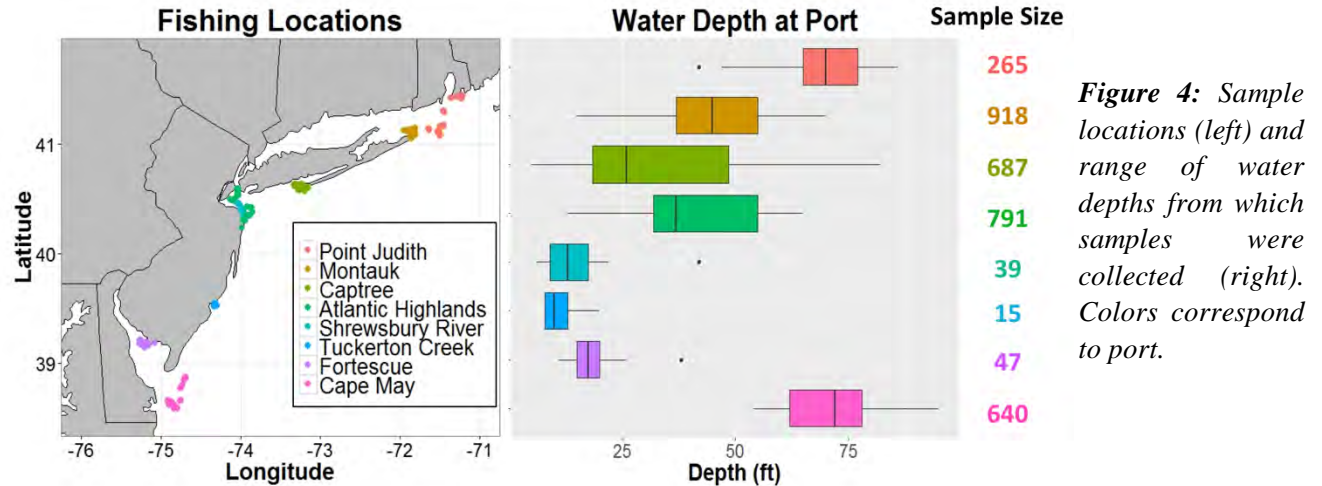


Table 1: Summary of sampling schedule and number of discards (with number of landed fish in parentheses) observed on each sampling trip. Trips that are masked in grey are those for which some data errors may be present – efforts are underway to correct those errors. Trips indicated with -- are those that were cancelled due to captain’s choice (weather, too few clients, or too few fish).

| | Week 1/2 May 23 - June 6 | Week 3/4 June 6 – June 20 | Week 5/6 June 20 - July 4 | Week 7/8 July 4 - July18 | Week 9/10 July 18 - Aug 1 | Week 11/12 Aug 1 - Aug 15 | Week 13/14 Aug 15 – Aug 29 | Week 15/16 Aug 19- Sept 5 | Week 17/18 Sept 5- Sept 19 |
|---------------------------------|-----------------------------------|------------------------------------|------------------------------------|-----------------------------------|------------------------------------|------------------------------------|-------------------------------------|------------------------------------|-------------------------------------|
| <i>Primary Ports</i> | | | | | | | | | |
| Point Judith | 35 (24) | 118 (31) | 41 (15) | 54 (51) | 7 (7) | 25 (22) | 41 (43) | 6 (14) | 34 (10) |
| Montauk | 74 (16) | 112 (16) | 116 (31) | 147 (19) | 113 (11) | 49 (28) | 53 (10) | 7 (9) | 41 (47) |
| Captree | 70 (4) | 79 (20) | 76 (22) | 80 (7) | 33 (7) | 111 (15) | 79 (14) | 38 (12) | 17 (3) |
| Atlantic Hlds | 42 (6) | 45 (17) | -- | 147 (47) | 122 (54) | 88 (57) | 112 (15) | 27 (12) | -- |
| Cape May | -- | 43 (10) | 144 (22) | 54 (14) | 63 (6) | 26 (9) | 92 (19) | 40 (4) | 81 (13) |
| Fortescue | -- | 0 (0) | 11 (0) | 14 (3) | 4 (3) | 5 (6) | 0 (0) | -- | -- |
| <i>Additional Backbay Ports</i> | | | | | | | | | |
| Shrewsbury River | | 30 (9) | | | | | | | |
| Tuckerton Creek | | 12 (3) | | | | | | | |
| NorthWildwood | | | | | | 2 (0) | | | |

The median length of all discarded fish was 38 cm, and over half of those (55%) were male. The sex ratio of discarded fish nears 50:50 at approximately 39 cm, and below that, for a given length, males outnumber females, while above that, females outnumber males (Figure 5). A trend with water depth is evident as well. A greater number of large males were caught in deeper stations (Figure 6). Holding depth constant, a significant latitudinal ($p=0.02$) and

seasonal ($p=0.05$) trend also exists such that a greater proportion of females are found among the largest discards (lengths 40 – 45 cm only) in the south (Cape May) and earlier in the season (Figure 7).

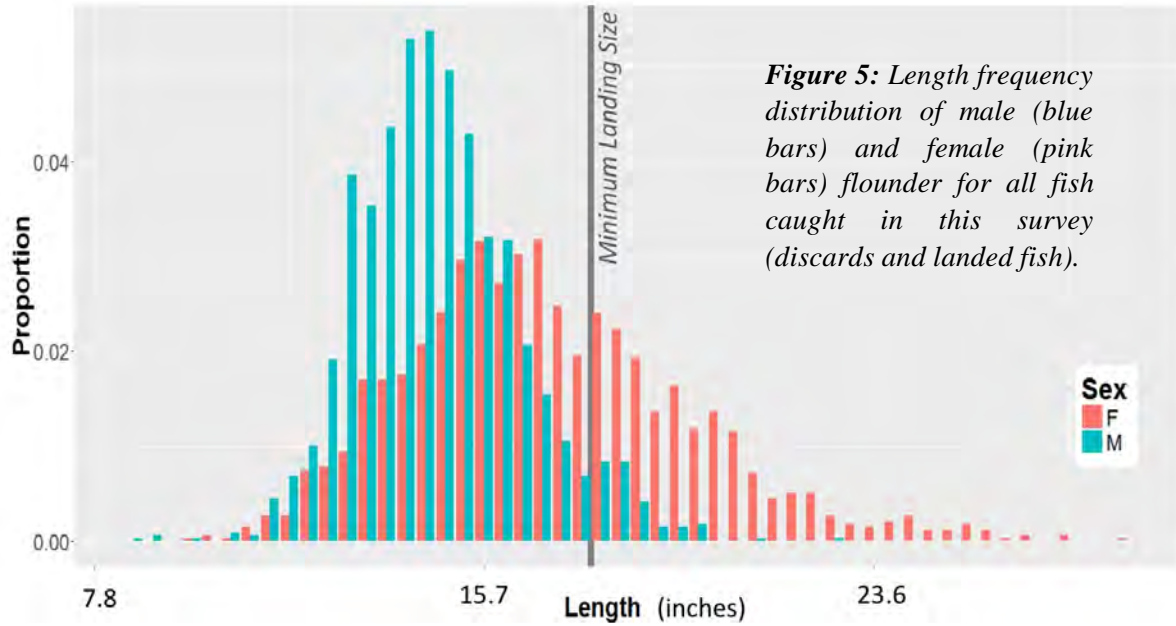


Figure 5: Length frequency distribution of male (blue bars) and female (pink bars) flounder for all fish caught in this survey (discards and landed fish).

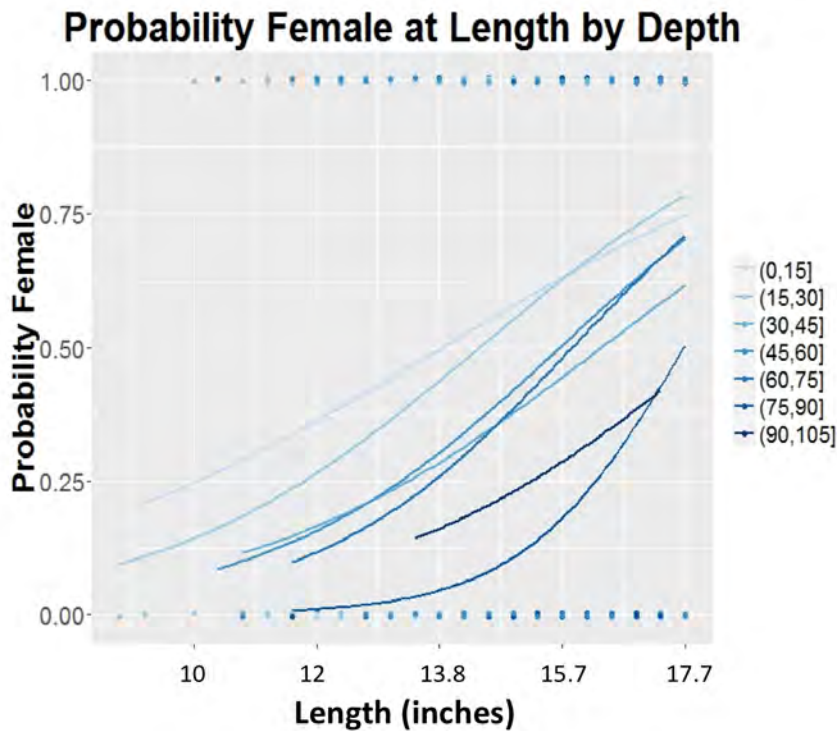
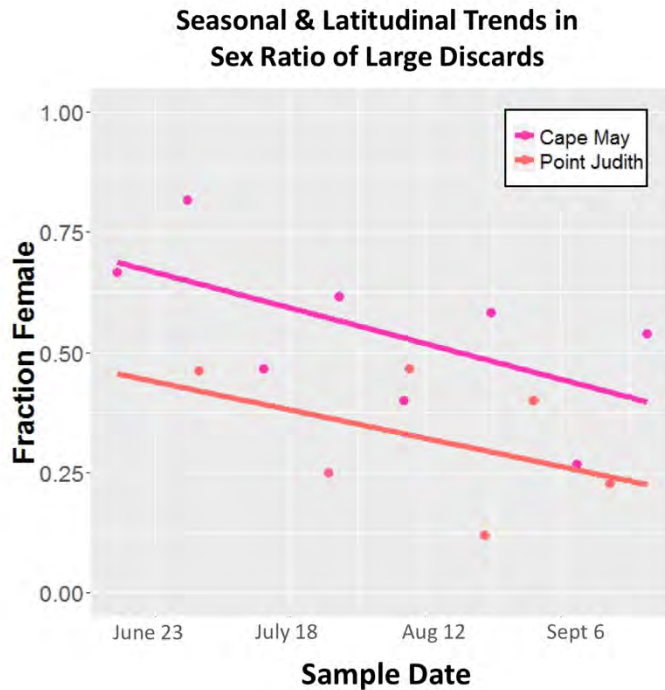


Figure 6: Logistic regression fits to the probability female by size and depth (color scaled by depth bin). There tends to be more small females at shallow stations, and larger males in deeper water.

Figure 7: Fraction female over time for large discard fish (40-45 cm) at two ports fishing in similarly deep water (~70 feet). Linear regression indicates that southern discards (Cape May) tend to contain more females, and the fraction of females in the large discards decreases through the fishing season.

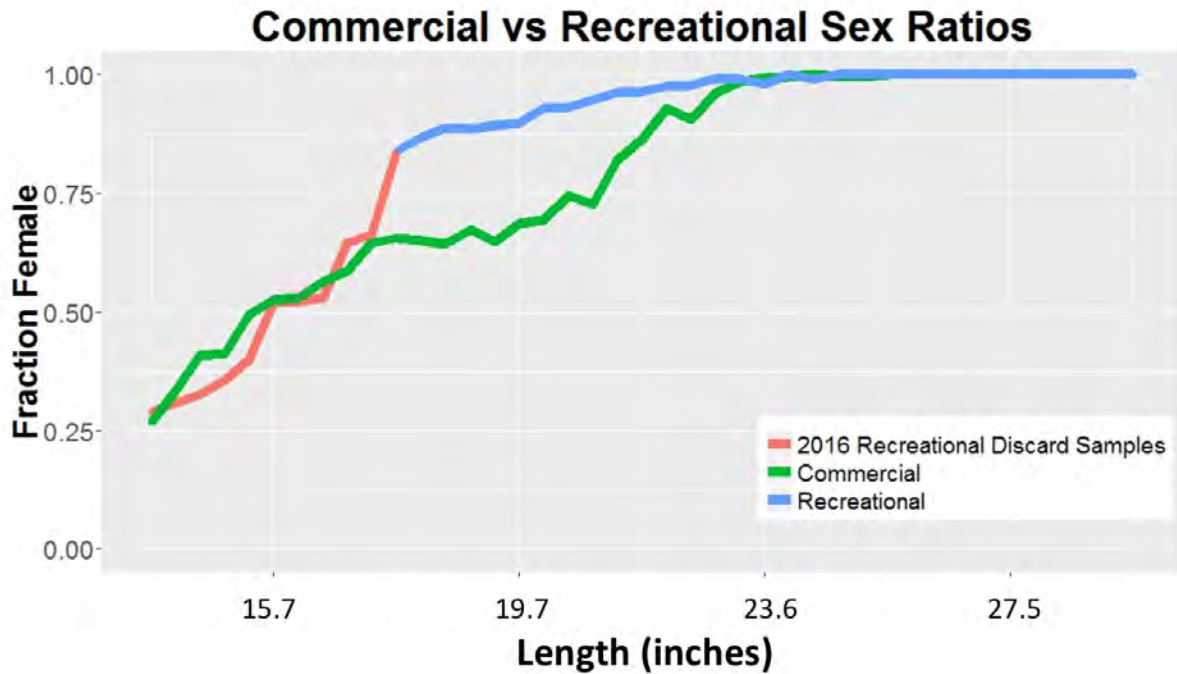


Conclusions

These results confirm prior observations (Morson et al., 2012, 2015) that female summer flounder dominate the recreational catch; however, we demonstrate that this does not hold below the legal size limit. Fish smaller than the legal limit are predominately male. On average, across all ports, dates and depths, the sex ratio approximates 50:50 at 39 cm, with males dominant in the size classes less than 39 cm and females dominant above 39 cm. This trend varies by depth, with larger males being caught in deeper water. Considering only the largest discards (lengths 40-45 cm), and holding depth constant, we show that female fish are more prominent at a given length at southern ports. In addition, the proportion female decreases over the fishing season.

The data reported here provide important insights for possible management strategies in this fishery. One of those is the potential for a slot limit fishery (Bochenek et al., 2010) to distribute the fishing mortality more evenly across both sexes. This could be achieved by allocating some of the allowable catch to smaller size classes where males are more dominant. The data provided in this study could be used to help identify an appropriate slot limit size, or in management strategy evaluations to compare various slot limit options.

In addition to providing a better understanding of the general biology of this species, another potentially important management application is in parameterization of sex-specific assessment models. Sex composition of recreationally discarded summer flounder remains a key need for development of a sex-specific stock assessment model, and the data generated in this study will be shared directly with the team developing that model (P. Sullivan, *pers. comm.*).



References:

- Bochenek, E.A., E.N. Powell, and J. DePersenaire. 2010. Evaluating catch, effort, and bag limits on summer flounder directed trips in the recreational summer flounder party boat fishery. *Marine and Coastal Fisheries* 2(1):412 - 423.
- Maunder, M.N., and R.A. Wong. 2011. Approaches for estimating natural mortality: application to summer flounder (*Paralichthys dentatus*) in the U.S. mid-Atlantic. *Fisheries Research* 111:92-99.
- Morson, J.M., E.A. Bochenek, E.N. Powell, and J.E. Gius. 2012. Sex at length of summer flounder landed in the New Jersey recreational party boat fishery. *North American Journal of Fisheries Management* 32:1201-1210.
- Morson, J.M., E.A. Bochenek, E.N. Powell, E.C. Hasbrouck, J.E. Gius, C.F. Cotton, K. Gerbino, and T. Froehlich. 2015. Estimating the sex composition of the summer flounder catch using fishery-independent data. *Marine and Coastal Fisheries* 7:393-408.
- Poole, J.C. 1961. Age and growth of the fluke in Great South Bay and their significance to the sport fishery. *New York Fish and Game Journal* 8:1-18.

APPENDIX 1

Summary table of per trip data including numbers of discard-sized fish for which sex and other samples were obtained, number of discarded fish for which only length was obtained, and number of landed fish. Proportion female of the discards and catch per trip is also summarized. Trips that are masked in grey are those for which some data errors may be present – efforts are underway to correct those errors.

| Trip Date | Trip Number | Port | # Discards Sexed | # Discards Measured (but not sexed) | % Female Discards | # Landed Fish | % Female Landings |
|-----------|-------------|--------------|------------------|-------------------------------------|-------------------|---------------|-------------------|
| 3-Jun | 1 | Point Judith | 35 | 0 | 17% | 24 | 83% |
| 16-Jun | 2 | Point Judith | 112 | 6 | 33% | 31 | 90% |
| 1-Jul | 3 | Point Judith | 41 | 0 | 34% | 15 | 73% |
| 11-Jul | 4 | Point Judith | 54 | 0 | 56% | 51 | 86% |
| 25-Jul | 5 | Point Judith | 7 | 0 | 29% | 7 | 71% |
| 9-Aug | 6 | Point Judith | 25 | 0 | 40% | 22 | 68% |
| 23-Aug | 7 | Point Judith | 41 | 0 | 10% | 43 | 65% |
| 1-Sep | 8 | Point Judith | 6 | 0 | 33% | 14 | 29% |
| 15-Sep | 9 | Point Judith | 34 | 0 | 15% | 10 | 50% |
| 1-Jun | 1 | Montauk | 74 | 0 | 43% | 16 | 81% |
| 14-Jun | 2 | Montauk | 110 | 2 | 40% | 16 | 94% |
| 28-Jun | 3 | Montauk | 105 | 11 | 31% | 31 | 77% |
| 11-Jul | 4 | Montauk | 140 | 7 | 55% | 19 | 89% |
| 22-Jul | 5.1 | Montauk | 14 | 0 | 14% | 5 | 100% |
| 27-Jul | 5 | Montauk | 96 | 17 | 14% | 11 | 64% |
| 4-Aug | 6 | Montauk | 49 | 0 | 47% | 28 | 93% |
| 17-Aug | 7 | Montauk | 53 | 0 | 23% | 10 | 80% |
| 30-Aug | 8 | Montauk | 7 | 0 | 71% | 9 | 100% |
| 13-Sep | 9 | Montauk | 41 | 0 | 44% | 47 | 98% |
| 31-May | 1 | Captree | 70 | 0 | 41% | 4 | 100% |
| 10-Jun | 2 | Captree | 79 | 0 | 44% | 20 | 60% |
| 23-Jun | 3 | Captree | 76 | 0 | 45% | 22 | 91% |

Munroe – Summer Founder Project Data Report, October 2016

| | | | | | | | |
|--------|---|--------------------|-----|-----|------|----|------|
| 6-Jul | 4 | Captree | 80 | 0 | 40% | 7 | 100% |
| 19-Jul | 5 | Captree | 33 | 0 | 67% | 7 | 100% |
| 2-Aug | 6 | Captree | 111 | 0 | 40% | 15 | 87% |
| 17-Aug | 7 | Captree | 79 | 0 | 47% | 14 | 79% |
| 31-Aug | 8 | Captree | 38 | 0 | 47% | 12 | 92% |
| 11-Sep | 9 | Captree | 17 | 0 | 59% | 3 | 100% |
| 1-Jun | 1 | Atlantic Highlands | 31 | 11 | 61% | 6 | 100% |
| 13-Jun | 2 | Atlantic Highlands | 45 | 0 | 40% | 17 | 82% |
| 7-Jul | 4 | Atlantic Highlands | 33 | 114 | 39% | 47 | 83% |
| 21-Jul | 5 | Atlantic Highlands | 61 | 61 | 36% | 54 | 98% |
| 4-Aug | 6 | Atlantic Highlands | 57 | 31 | 56% | 57 | 88% |
| 17-Aug | 7 | Atlantic Highlands | 48 | 64 | 40% | 15 | 100% |
| 31-Aug | 8 | Atlantic Highlands | 27 | 0 | 22% | 12 | 67% |
| 16-Jun | 2 | Cape May | 28 | 15 | 32% | 10 | 100% |
| 29-Jun | 3 | Cape May | 30 | 114 | 50% | 22 | 95% |
| 13-Jul | 4 | Cape May | 31 | 23 | 29% | 14 | 100% |
| 27-Jul | 5 | Cape May | 32 | 31 | 31% | 6 | 100% |
| 8-Aug | 6 | Cape May | 22 | 4 | 14% | 9 | 100% |
| 24-Aug | 7 | Cape May | 30 | 62 | 27% | 19 | 100% |
| 9-Sep | 8 | Cape May | 29 | 11 | 21% | 4 | 75% |
| 22-Sep | 9 | Cape May | 34 | 47 | 47% | 13 | 85% |
| 10-Jun | 2 | Fortescue | 0 | 0 | NA | 0 | NA |
| 24-Jun | 3 | Fortescue | 11 | 0 | 100% | 0 | NA |
| 11-Jul | 4 | Fortescue | 14 | 0 | 86% | 3 | 100% |
| 25-Jul | 5 | Fortescue | 4 | 0 | 100% | 3 | 100% |
| 15-Aug | 6 | Fortescue | 5 | 0 | 100% | 6 | 100% |
| 22-Aug | 7 | Fortescue | 0 | 0 | NA | 0 | NA |
| 2-Aug | 6 | North Wildwood | 2 | 0 | 100% | 0 | NA |
| 11-Jun | 2 | Shrewsbury River | 30 | 0 | 60% | 9 | 100% |
| 18-Jun | 2 | Tuckerton Creek | 12 | 0 | 75% | 3 | 100% |

Project Title:

Sex and Length of Summer Flounder Discards in the Recreational Fishery, NJ to RI

Funding Provided By: Science Center for Marine Fisheries (SCeMFiS)



Save the Summer Flounder Fisher Fund (SSFFF)



Jersey Coast Anglers Association (JCAA)



Award Period: 01/01/2016 - 12/31/2016

Reporting Period: 01/01/2016 – 10/01/2016

Project PI: Daphne Munroe, Haskin Shellfish Lab, Rutgers University

Graduate Student Investigators: Jason Morson, Haskin Shellfish Lab, Rutgers University

Undergraduate Investigators: Ryan Harner, Stockton University

Rachel Marshall, University of Rhode Island

Project Collaborators: Cornell Cooperative Extension of Suffolk County

Project Data Report, October 2016



Sex and Length of Summer Flounder Discards in the Recreational Fishery, NJ to RI

Summary

Previous research has shown that summer flounder (*Paralichthys dentatus*) recreational landings are composed of 95% females, in contrast to the commercial fishery which maintains a more even ratio of male to female landings. The sexually dimorphic nature of the species is potentially underrepresented in current recreational fishery management plans and, unlike in the commercial fishery, sufficient data proxies (i.e. trawl surveys) are not available to estimate the sex ratio of discarded (<46 cm) fish. To address this gap in available data, discard-sized fish were measured throughout the 2016 summer flounder recreational fishing season aboard for-hire recreational fishing vessels. A subset, based on length and fishing depth, of those discarded fish were brought back to the laboratory for dissection and further analysis. Results indicate a clear relationship between sex ratio and fish length, with males more frequently observed at shorter lengths, giving way to a predominantly female sex ratio as length increased. In addition to length, latitudinal and seasonal trends were found to have a significant effect on sex ratio in discard-sized fish in the summer flounder recreational fishery.



Project team members, Ryan Harner (left) and Rachel Marshall (center) collect data on fishing vessels and perform dissections and data collection in the lab.

Introduction

A recent stock assessment review of summer flounder (*Paralichthys dentatus*) identified the need to account for sex-specific fishing mortality in the assessment model. However, sex-specific models of population dynamics can be data-intensive and require some knowledge or assumptions about the sex ratio of the population and catch (landings and discards). Sex-specific information for the population is collected annually by the National Marine Fisheries Service's (NMFS-NEFSC) trawl survey. Sex composition of the catch, however, is limited and *no information* is available on sex composition of discards from either fishery.

Female summer flounder grow faster (Morson et al., 2012; Poole, 1961) and have a lower natural mortality (Maunder and Wong, 2011) than males. Previous studies (Morson et al., 2012, 2015) demonstrated that summer flounder landings in the recreational fishery have been composed primarily of females (95%). Furthermore, while sex-at-length of fish landed in the commercial fishery is well described by data from the NMFS-NEFSC survey, in the recreational fishery, a significantly higher fraction of landed fish at a given length are female (Morson et al., 2015). Thus, sex-at-length keys generated from the NMFS-NEFSC survey are not appropriate proxies for estimating sex ratio of landed and discarded fish in recreational fishery. The absence of information on the sex composition of recreationally discarded summer flounder remains a key need for development of a sex-specific stock assessment model (Figure 1).

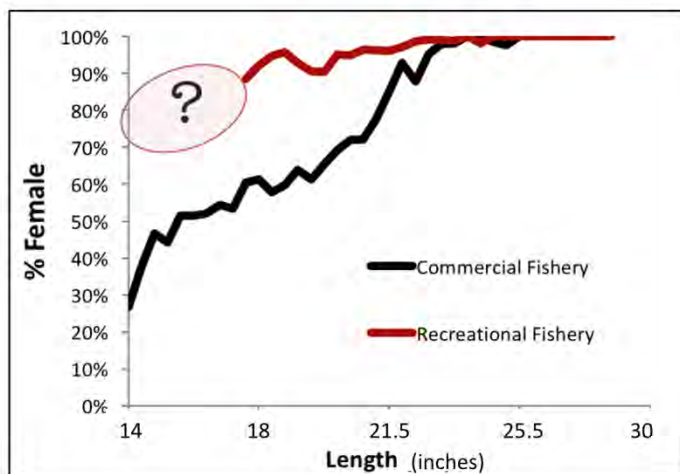


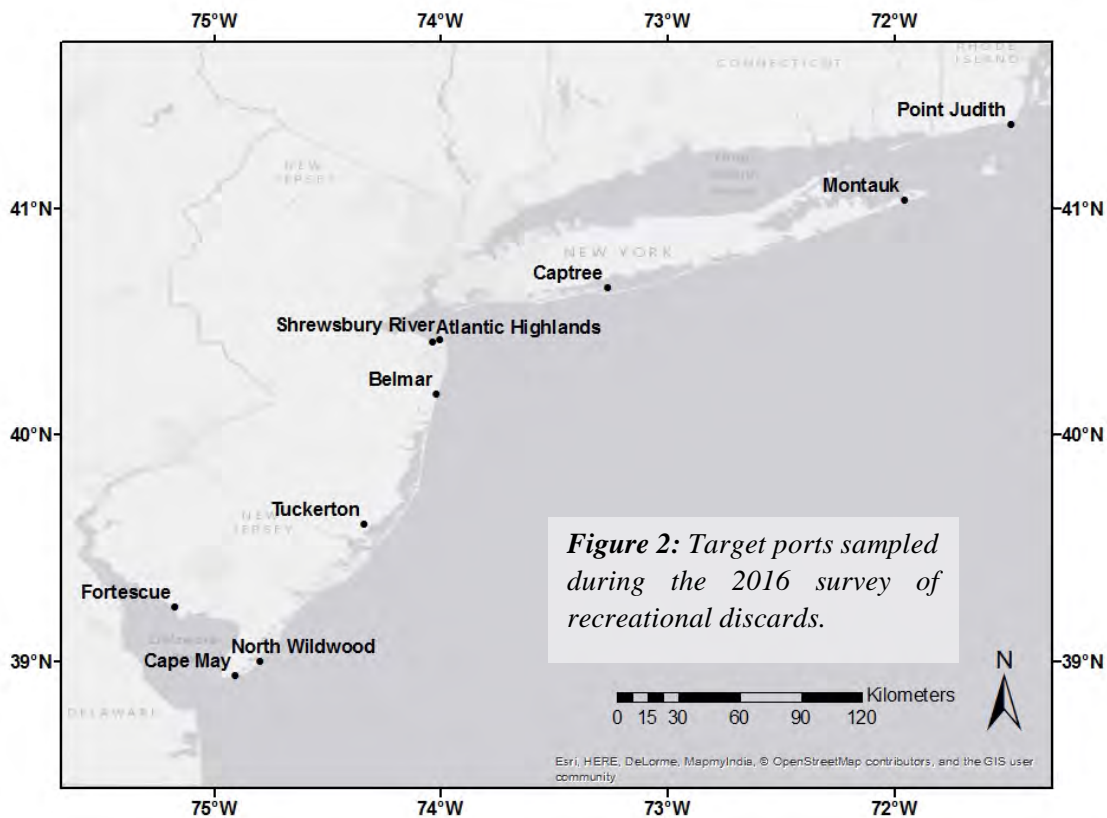
Figure 1: A gap in the existing data concerning sex ratios of discarded fish in the recreational fishery is the motivation for this program. Our primary aim is to fill this gap and provide regional and seasonal data about sex ratios of recreational discards.

The goal of this project was to determine the sex ratio of sublegal summer flounder caught and discarded in the recreational fishery from New Jersey, New York, and Rhode Island and to evaluate seasonal and spatial (depth and latitude) trends in discard sex ratio. Efforts are underway by other investigators to develop a sex-specific assessment model and the data collected during this project have been provided to the assessment modeling team for incorporation into their model.

Materials and Methods

Sample Collection

Data collection spanned the 2016 summer flounder recreational season beginning when the season opened on May 23, 2016 and continuing through September 16, 2016. Samples were collected aboard for-hire recreational fishing vessels from selected ports (Figure 2) in New Jersey, New York, and Rhode Island. Sampling ports were selected based on previous studies (Morson et al., 2012; Morson et al., 2015). The six main ports (Cape May, Fortescue, Atlantic Highlands, Captree, Montauk, and Point Judith) were supplemented with additional back bay (shallow water) sampling trips to North Wildwood, Tuckerton, and Shrewsbury River as opportunity allowed, in order to document fish from shallower locations not represented by samples collected on larger for-hire vessels. Each main port was sampled every two weeks beginning at the opening of the fishing season and continuing through the close of the season (note: weather and other factors lead to missed sampling on rare occasions).



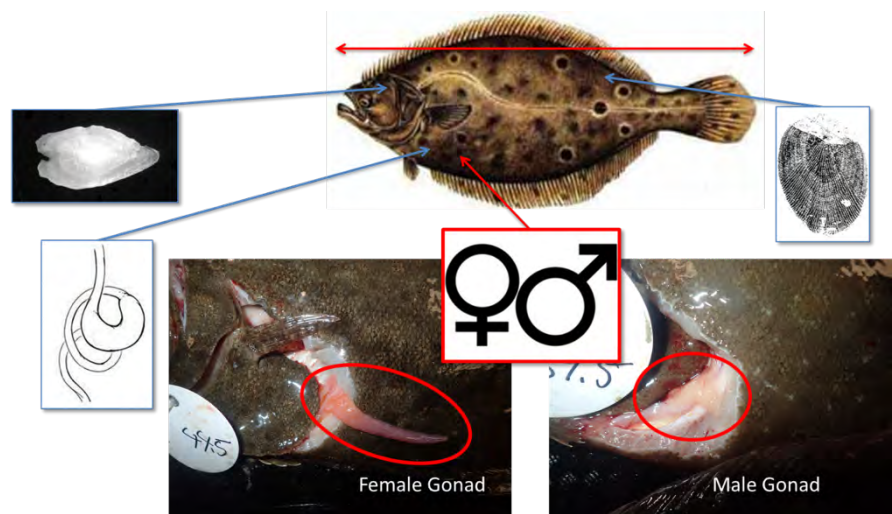
On each trip, data and sample collection occurred on each drift according to predetermined length bins and depth categories. Depth was assigned four categories: 0-25, 26-50, 51-75, and >75 feet. Fish length bins included 20-25, 26-30, 31-35, 36-40, and 40-45 cm categories. For each depth category, a maximum of 10 fish were collected in each size bin for laboratory analysis, while any additional fish were measured to the nearest cm and returned to the water alive. Retained fish were tagged with their respective drift number and length and placed on ice until return to the laboratory. Date, port, drift, length, latitude, longitude, time, and depth were recorded for each

discard-sized fish whether retained or released. Upon the completion of each trip, length and sex were recorded for all landed fish.

Laboratory Analysis

Discard-sized fish that were retained for laboratory analysis were processed fresh within 24 hours of the trip. Dissections were performed to determine sex. In addition, samples and data were gathered for future research opportunities (Figure 3). These included stomach and scale samples collected from all retained discards from the New Jersey ports as well as otoliths taken from one male and female fish per size bin per drift where possible. Scale samples were taken from one male and one female fish per size bin per drift from the retained New York and Rhode Island discards.

Figure 3: Data collected for each discarded fish includes length, sex, stomach sample (archived), and scale sample (archived). Otoliths were also archived for a subset of sampled fish.



Results

Samples were collected from stations ranging in depth from 5 to 95 feet and spanning a latitudinal range from off the coast of Delaware to the coast of Rhode Island (Figure 4). The number of discarded fish per trip ranged from zero to 147 (Table 1), and sex-at-length data was collected for a total of 2,243 discard-sized fish and 842 legal-sized fish. On average, across all ports and sample dates, the sex composition of discard-sized fish was 45% female, whereas the landings were 87% female. A per trip summary of fish collected and sex ratios is provided in Appendix 1.

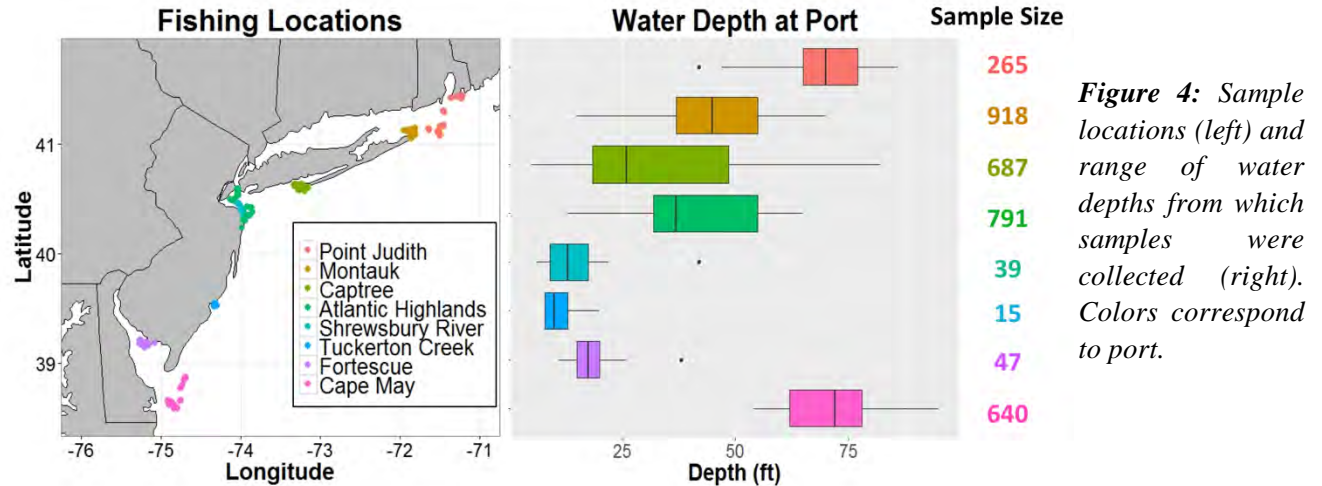


Figure 4: Sample locations (left) and range of water depths from which samples were collected (right). Colors correspond to port.

Table 1: Summary of sampling schedule and number of discards (with number of landed fish in parentheses) observed on each sampling trip. Trips that are masked in grey are those for which some data errors may be present – efforts are underway to correct those errors. Trips indicated with -- are those that were cancelled due to captain’s choice (weather, too few clients, or too few fish).

| | Week 1/2 May 23 - June 6 | Week 3/4 June 6 – June 20 | Week 5/6 June 20 - July 4 | Week 7/8 July 4 - July18 | Week 9/10 July 18 - Aug 1 | Week 11/12 Aug 1 - Aug 15 | Week 13/14 Aug 15 – Aug 29 | Week 15/16 Aug 19- Sept 5 | Week 17/18 Sept 5- Sept 19 |
|---------------------------------|-----------------------------------|------------------------------------|------------------------------------|-----------------------------------|------------------------------------|------------------------------------|-------------------------------------|------------------------------------|-------------------------------------|
| <i>Primary Ports</i> | | | | | | | | | |
| Point Judith | 35 (24) | 118 (31) | 41 (15) | 54 (51) | 7 (7) | 25 (22) | 41 (43) | 6 (14) | 34 (10) |
| Montauk | 74 (16) | 112 (16) | 116 (31) | 147 (19) | 113 (11) | 49 (28) | 53 (10) | 7 (9) | 41 (47) |
| Captree | 70 (4) | 79 (20) | 76 (22) | 80 (7) | 33 (7) | 111 (15) | 79 (14) | 38 (12) | 17 (3) |
| Atlantic Hlds | 42 (6) | 45 (17) | -- | 147 (47) | 122 (54) | 88 (57) | 112 (15) | 27 (12) | -- |
| Cape May | -- | 43 (10) | 144 (22) | 54 (14) | 63 (6) | 26 (9) | 92 (19) | 40 (4) | 81 (13) |
| Fortescue | -- | 0 (0) | 11 (0) | 14 (3) | 4 (3) | 5 (6) | 0 (0) | -- | -- |
| <i>Additional Backbay Ports</i> | | | | | | | | | |
| Shrewsbury River | | 30 (9) | | | | | | | |
| Tuckerton Creek | | 12 (3) | | | | | | | |
| NorthWildwood | | | | | | 2 (0) | | | |

The median length of all discarded fish was 38 cm, and over half of those (55%) were male. The sex ratio of discarded fish nears 50:50 at approximately 39 cm, and below that, for a given length, males outnumber females, while above that, females outnumber males (Figure 5). A trend with water depth is evident as well. A greater number of large males were caught in deeper stations (Figure 6). Holding depth constant, a significant latitudinal ($p=0.02$) and

seasonal ($p=0.05$) trend also exists such that a greater proportion of females are found among the largest discards (lengths 40 – 45 cm only) in the south (Cape May) and earlier in the season (Figure 7).

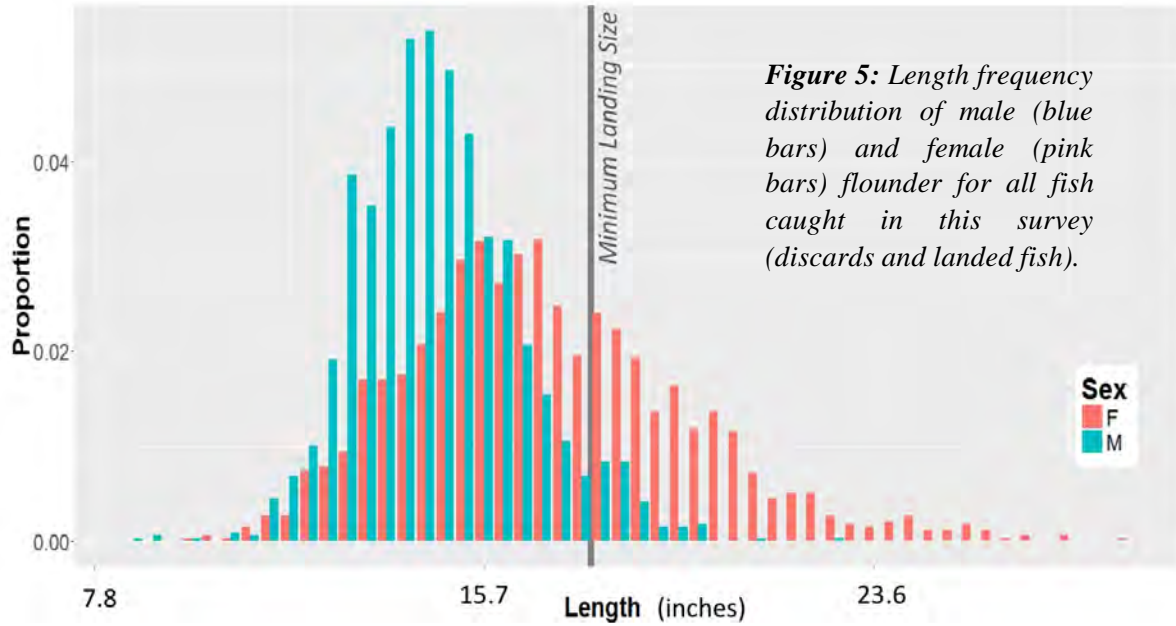


Figure 5: Length frequency distribution of male (blue bars) and female (pink bars) flounder for all fish caught in this survey (discards and landed fish).

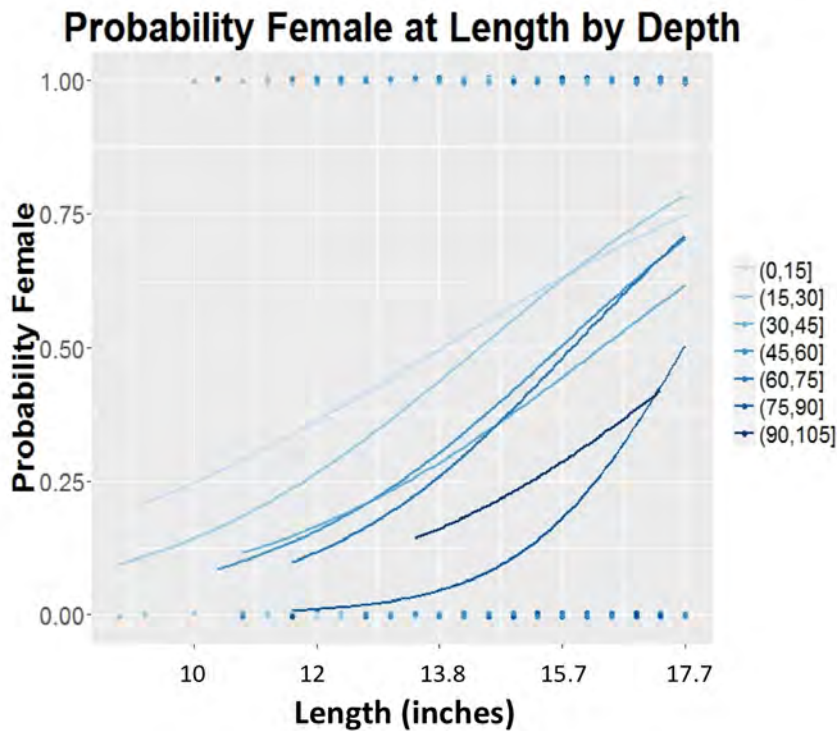
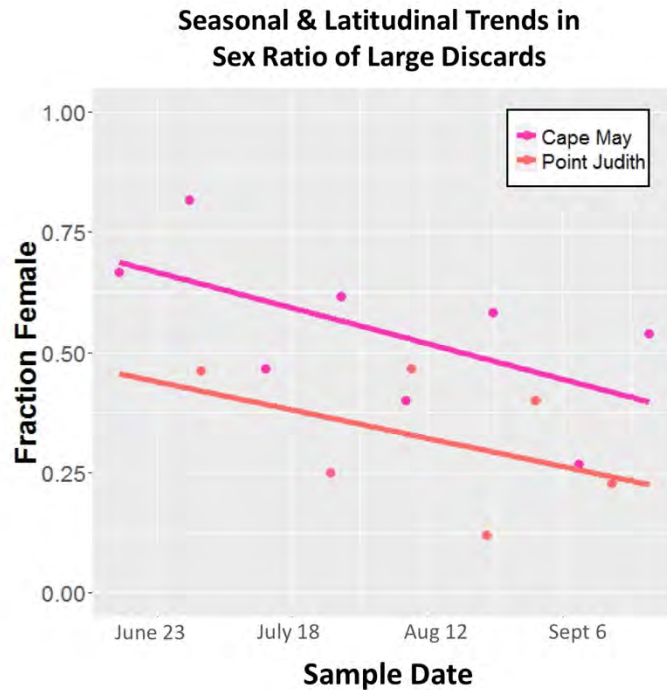


Figure 6: Logistic regression fits to the probability female by size and depth (color scaled by depth bin). There tends to be more small females at shallow stations, and larger males in deeper water.

Figure 7: Fraction female over time for large discard fish (40-45 cm) at two ports fishing in similarly deep water (~70 feet). Linear regression indicates that southern discards (Cape May) tend to contain more females, and the fraction of females in the large discards decreases through the fishing season.

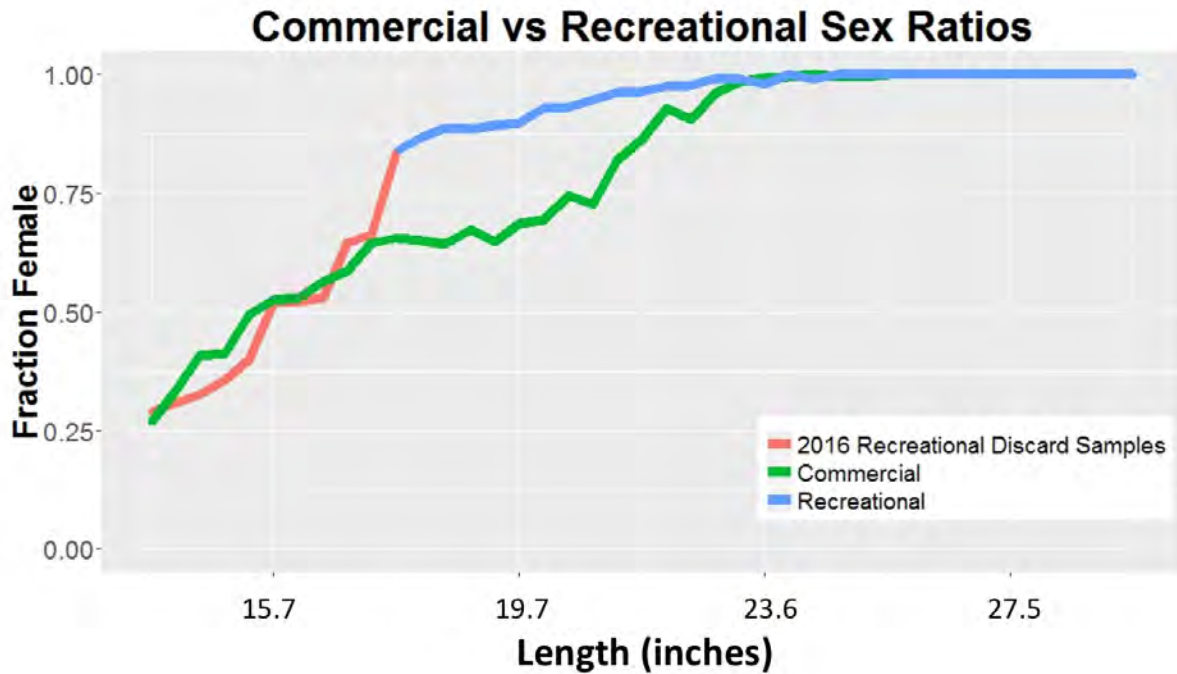


Conclusions

These results confirm prior observations (Morson et al., 2012, 2015) that female summer flounder dominate the recreational catch; however, we demonstrate that this does not hold below the legal size limit. Fish smaller than the legal limit are predominately male. On average, across all ports, dates and depths, the sex ratio approximates 50:50 at 39 cm, with males dominant in the size classes less than 39 cm and females dominant above 39 cm. This trend varies by depth, with larger males being caught in deeper water. Considering only the largest discards (lengths 40-45 cm), and holding depth constant, we show that female fish are more prominent at a given length at southern ports. In addition, the proportion female decreases over the fishing season.

The data reported here provide important insights for possible management strategies in this fishery. One of those is the potential for a slot limit fishery (Bochenek et al., 2010) to distribute the fishing mortality more evenly across both sexes. This could be achieved by allocating some of the allowable catch to smaller size classes where males are more dominant. The data provided in this study could be used to help identify an appropriate slot limit size, or in management strategy evaluations to compare various slot limit options.

In addition to providing a better understanding of the general biology of this species, another potentially important management application is in parameterization of sex-specific assessment models. Sex composition of recreationally discarded summer flounder remains a key need for development of a sex-specific stock assessment model, and the data generated in this study will be shared directly with the team developing that model (P. Sullivan, *pers. comm.*).



References:

- Bochenek, E.A., E.N. Powell, and J. DePersenaire. 2010. Evaluating catch, effort, and bag limits on summer flounder directed trips in the recreational summer flounder party boat fishery. *Marine and Coastal Fisheries* 2(1):412 - 423.
- Maunder, M.N., and R.A. Wong. 2011. Approaches for estimating natural mortality: application to summer flounder (*Paralichthys dentatus*) in the U.S. mid-Atlantic. *Fisheries Research* 111:92-99.
- Morson, J.M., E.A. Bochenek, E.N. Powell, and J.E. Gius. 2012. Sex at length of summer flounder landed in the New Jersey recreational party boat fishery. *North American Journal of Fisheries Management* 32:1201-1210.
- Morson, J.M., E.A. Bochenek, E.N. Powell, E.C. Hasbrouck, J.E. Gius, C.F. Cotton, K. Gerbino, and T. Froehlich. 2015. Estimating the sex composition of the summer flounder catch using fishery-independent data. *Marine and Coastal Fisheries* 7:393-408.
- Poole, J.C. 1961. Age and growth of the fluke in Great South Bay and their significance to the sport fishery. *New York Fish and Game Journal* 8:1-18.

APPENDIX 1

Summary table of per trip data including numbers of discard-sized fish for which sex and other samples were obtained, number of discarded fish for which only length was obtained, and number of landed fish. Proportion female of the discards and catch per trip is also summarized. Trips that are masked in grey are those for which some data errors may be present – efforts are underway to correct those errors.

| Trip Date | Trip Number | Port | # Discards Sexed | # Discards Measured (but not sexed) | % Female Discards | # Landed Fish | % Female Landings |
|-----------|-------------|--------------|------------------|-------------------------------------|-------------------|---------------|-------------------|
| 3-Jun | 1 | Point Judith | 35 | 0 | 17% | 24 | 83% |
| 16-Jun | 2 | Point Judith | 112 | 6 | 33% | 31 | 90% |
| 1-Jul | 3 | Point Judith | 41 | 0 | 34% | 15 | 73% |
| 11-Jul | 4 | Point Judith | 54 | 0 | 56% | 51 | 86% |
| 25-Jul | 5 | Point Judith | 7 | 0 | 29% | 7 | 71% |
| 9-Aug | 6 | Point Judith | 25 | 0 | 40% | 22 | 68% |
| 23-Aug | 7 | Point Judith | 41 | 0 | 10% | 43 | 65% |
| 1-Sep | 8 | Point Judith | 6 | 0 | 33% | 14 | 29% |
| 15-Sep | 9 | Point Judith | 34 | 0 | 15% | 10 | 50% |
| 1-Jun | 1 | Montauk | 74 | 0 | 43% | 16 | 81% |
| 14-Jun | 2 | Montauk | 110 | 2 | 40% | 16 | 94% |
| 28-Jun | 3 | Montauk | 105 | 11 | 31% | 31 | 77% |
| 11-Jul | 4 | Montauk | 140 | 7 | 55% | 19 | 89% |
| 22-Jul | 5.1 | Montauk | 14 | 0 | 14% | 5 | 100% |
| 27-Jul | 5 | Montauk | 96 | 17 | 14% | 11 | 64% |
| 4-Aug | 6 | Montauk | 49 | 0 | 47% | 28 | 93% |
| 17-Aug | 7 | Montauk | 53 | 0 | 23% | 10 | 80% |
| 30-Aug | 8 | Montauk | 7 | 0 | 71% | 9 | 100% |
| 13-Sep | 9 | Montauk | 41 | 0 | 44% | 47 | 98% |
| 31-May | 1 | Captree | 70 | 0 | 41% | 4 | 100% |
| 10-Jun | 2 | Captree | 79 | 0 | 44% | 20 | 60% |
| 23-Jun | 3 | Captree | 76 | 0 | 45% | 22 | 91% |

Munroe – Summer Founder Project Data Report, October 2016

| | | | | | | | |
|--------|---|--------------------|-----|-----|------|----|------|
| 6-Jul | 4 | Captree | 80 | 0 | 40% | 7 | 100% |
| 19-Jul | 5 | Captree | 33 | 0 | 67% | 7 | 100% |
| 2-Aug | 6 | Captree | 111 | 0 | 40% | 15 | 87% |
| 17-Aug | 7 | Captree | 79 | 0 | 47% | 14 | 79% |
| 31-Aug | 8 | Captree | 38 | 0 | 47% | 12 | 92% |
| 11-Sep | 9 | Captree | 17 | 0 | 59% | 3 | 100% |
| 1-Jun | 1 | Atlantic Highlands | 31 | 11 | 61% | 6 | 100% |
| 13-Jun | 2 | Atlantic Highlands | 45 | 0 | 40% | 17 | 82% |
| 7-Jul | 4 | Atlantic Highlands | 33 | 114 | 39% | 47 | 83% |
| 21-Jul | 5 | Atlantic Highlands | 61 | 61 | 36% | 54 | 98% |
| 4-Aug | 6 | Atlantic Highlands | 57 | 31 | 56% | 57 | 88% |
| 17-Aug | 7 | Atlantic Highlands | 48 | 64 | 40% | 15 | 100% |
| 31-Aug | 8 | Atlantic Highlands | 27 | 0 | 22% | 12 | 67% |
| 16-Jun | 2 | Cape May | 28 | 15 | 32% | 10 | 100% |
| 29-Jun | 3 | Cape May | 30 | 114 | 50% | 22 | 95% |
| 13-Jul | 4 | Cape May | 31 | 23 | 29% | 14 | 100% |
| 27-Jul | 5 | Cape May | 32 | 31 | 31% | 6 | 100% |
| 8-Aug | 6 | Cape May | 22 | 4 | 14% | 9 | 100% |
| 24-Aug | 7 | Cape May | 30 | 62 | 27% | 19 | 100% |
| 9-Sep | 8 | Cape May | 29 | 11 | 21% | 4 | 75% |
| 22-Sep | 9 | Cape May | 34 | 47 | 47% | 13 | 85% |
| 10-Jun | 2 | Fortescue | 0 | 0 | NA | 0 | NA |
| 24-Jun | 3 | Fortescue | 11 | 0 | 100% | 0 | NA |
| 11-Jul | 4 | Fortescue | 14 | 0 | 86% | 3 | 100% |
| 25-Jul | 5 | Fortescue | 4 | 0 | 100% | 3 | 100% |
| 15-Aug | 6 | Fortescue | 5 | 0 | 100% | 6 | 100% |
| 22-Aug | 7 | Fortescue | 0 | 0 | NA | 0 | NA |
| 2-Aug | 6 | North Wildwood | 2 | 0 | 100% | 0 | NA |
| 11-Jun | 2 | Shrewsbury River | 30 | 0 | 60% | 9 | 100% |
| 18-Jun | 2 | Tuckerton Creek | 12 | 0 | 75% | 3 | 100% |