## SEDAR 63: Gulf Menhaden

## Fishery-Dependent Data Collection at the NMFS Beaufort Laboratory

## NOAA FISHERIES

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## Fishery-Dependent Data for the Gulf Menhaden Fishery

Maintained at the NMFS Beaufort Lab in three large data files:

1. Catch Records: Landings and nominal fishing effort
2. Port Samples: Size and age composition of the catch
3. Captain's Daily Fishing Reports (CDFRs, or logbooks): Itemize set location, catch, distance from shore, etc for each purse-seine set

## Catch Records: Catch/Effort Data

- Since 1964 , the gulf menhaden fishery has reported their daily vessel unload values (= landings), usually on a monthly basis
- In 1960s, industry allowed NMFS biologists access
to company records - back to the 1940s
- able to re-construct monthly/total landings and fishing effort back to 1948
- Daily vessel unloads are in "thousands of standard fish"
- by convention, 1,000 std fish = 670 lbs
- converted to metric tons (x 0.3039)
- In recent years, vessel unloads are reported to the NMFS daily or weekly via spreadsheet attachment to email

Landings reported to the NMFS

- Landings are daily vessel unloads, and in thousands of standard fish
- One hopper dump (22,000 cu. in.) = 1,000 std fish
- One standard fish = $2 / 3 \mathrm{lb}$

- One hopper dump $=670 \mathrm{lb}$ or 0.3039 mt
- J. Kutkuhn ms (1966)



## Older catch records, ~1964-2005



Hand-copied from plant records/ledgers

Key-entered into NMFS Beaufort 'Catch Records' data base

## Company catch records since ~2005 via daily spreadsheets



## Total Reduction Fishery Landings of Gulf Menhaden

- Catch records summed across all plant-months to get:
- Total gulf menhaden landings for the fishing season


Landings in the Gulf Menhaden Fishery, 1955-2017


## Nominal or Observed Fishing Effort

- Catch records do not list active fishing days
- Logbooks placed on gulf vessels in 1960s, but compliance incomplete - program discontinued in late 1960s, but revived in late 1970s as CDFRs
- Nicholson (1971) argued that a vessel-week on the Atlantic coast was satisfactory unit of nominal effort [1 vessel, fishing at least 1 day of a given wk]
- Chapoton (1971) noted that on the Gulf coast, fish catching ability was more related to size of the vessel and its fish hold capacity
- thus, a vessel-ton-week became the preferred measure of nominal effort for the gulf menhaden fishery
- = one vessel, fishing at least one day of a week, times its net tonnage


## Catch and Nominal Effort

for the Gulf Menhaden Fishery, 1948-2017


Figure 4.2 in Report

Gulf Menhaden reduction landings (1000mt) and nominal fishing effort (vtw), 1948-2017.


Figure 4.4 in Report

## The Port Samples:

## Size and Age Composition of the Catch


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## Menhaden Sampling

- Two-stage cluster design:
- First-stage (vessels or sets): Vessels chosen at random
- Top of fish hold assumed to be last set of the trip
- Fishing location received from logbook or crew

- Second-stage (fish from bucket or dip net): Originally, 20 fish randomly chosen from sample for size and age composition and processed for:
- Fork length in mm
- Weight in grams
- and scales removed for ageing
- In 1972, sample size reduced to 10 fish
- Within-sample variation smaller than among-sample




## Methodology for estimating catch in numbers-at-age: Merge catch records with the port samples

- Used consistently over time (Nelson \& Ahrenholz 1986; Vaughan 1987; Vaughan et al. 1996, 2000, 2007)
- Detailed sampling of landings allows biomass to be converted into catch in numbers-at-age
- For each port/week, port sampling provides estimate of mean weight and age distribution of fish caught
- Dividing total landings for given port/week by mean weight of sampled fish allows the numbers of fish landed to be estimated
- Age proportion then allows numbers at age to be estimated
- Sum across all port/weeks to get total numbers-at-age in total landings
- SAS statistical routine (BSO03) re-written by D. Colby in late 1990s better accounts for port/weeks without samples
- Catch-at-age matrix developed at the port/week level provides for considerably greater precision than is typical for most assessments


## Merge catch records (landings) with the port samples on a port/week basis

- Total landings for given port/week are divided by mean weight of sampled fish
- Example:


Merge catch records (landings) with the port samples on a port/week basis

- Total landings for given port/week are divided by mean weight of sampled fish
- Age proportion of port samples then allows numbers-at-age to be estimated
- Example:

| $\begin{gathered} \text { Landings } \\ 9,337,487 \mathrm{~kg} \end{gathered}$ | $\begin{gathered} 88,151,870 \\ \text { fish } \end{gathered}$ | X | 7.5\% age-1 | $=$ | $\begin{gathered} 6,611,390 \\ \text { age-1 } \\ \hline \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | 92.5\% age-2 |  | $\begin{gathered} 81,540,481 \\ \text { age-2 } \end{gathered}$ |
| Avg fish weight $105.9 \mathrm{~g}$ |  |  | 0 age-3 |  | 0 age-3 |

Merge catch records (landings) with the port samples on a port/week basis

- Total landings for given port/week are divided by mean weight of sampled fish
- Age proportion of port samples then allows numbers-at-age to be estimated
- Example:


Sum across all portweeks to get total numbers-at-age in total landings

## Sampled Set Location Incorporated 1970s

- Proportion of catch for given area determined by locations of port samples and applied to landings



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- Landings for port/week/area are divided by mean weight of sampled fish



## Sampled Set Location Incorporated 1970s

- Proportion of catch for given area determined by locations of port samples and applied to landings
- Landings for port/week/area are divided by mean weight of sampled fish
- Numbers-at-age estimated for each area from port sample proportions



## Sampled Set Location Incorporated 1970s

- Proportion of catch for given area determined by locations of port samples and applied to landings
- Landings for port/week/area are divided by mean weight of sampled fish
- Numbers-at-age estimated for each area from port sample proportions

- Sum across all port/week/areas to get total numbers-at-age in total landings

Total numbers Gulf Menhaden caught, 1964-2017

Gulf Menhaden Caught (in millions)


Total numbers of catch-at-age for gulf menhaden, 1964-2017

Gulf Menhaden Catch at Age (in millions)


## Captain's Daily Fishing Report

- The Captain's Daily Fishing Report is a joint Industry, State, and Federal effort
- Began in late 1970s
- Updated to include latitude and longitude in 2009
- Provides effort data for:
- Fishery Management
- Company Records
- From the CDFRs we get:
- Effort estimates (including days not fished)
- Days fishing
- Days not fishing (traveling, maintenance)
- Number, duration, and catch of sets
- Distance from shore
- Use (or not) of spotter pilot
- Environmental variables (air temperature, wind speed and direction, cloud cover)


## Captain's Daily Fishing Report Timeline

- CDFR existed as paper files until $\sim 1992$
- Not used as extensively as today, not routinely key-entered
- In 1992, NMFS Beaufort began saving Gulf CDFRs as dBase files
- In about 1999, collaborated with GSMFC to enter pre-1992 CDFR data sets
- Available electronically to 1983
- Available on DVD from 1979
- In 2009, NMFS Beaufort altered forms to use an optical scanner
- CHANGE: GPS locations of sets recorded from approximately 2004


## Captain's Daily Fishing Report: Old

CAPTAIN'S DAILY FISHING REPORT

| NAME OF VESSEL |  |  |  |  | PLANT |  | DATE $\frac{2 l}{\text { month }} 12 \frac{0}{5}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| IF VESSEL DID NOT LEAVE THE DOCK ON THIS FISHING DAY, CHECK HERE |  |  |  |  | IF VESSEL LEFT THE DOCK AND DID NOT MAKE ANY SETS ON THE FISHING GROUNDS THIS FISHING DAY, CHECK HERE |  |  |  |
| $\begin{aligned} & \text { SET } \\ & \text { NO. } \end{aligned}$ | TIME (Military) |  | $\begin{aligned} & \text { FISH } \\ & (000) \end{aligned}$ | PLANE NO. | FISHING LOCATION |  | $\begin{aligned} & \text { MILES } \\ & \text { TO } \\ & \text { SHORE } \end{aligned}$ | WEATHER CONDITIONS |
|  | START | END |  |  | $\begin{gathered} \text { CDFR } \\ \text { 5-DIGIT } \\ \text { CODE } \end{gathered}$ | $\operatorname{GPS}\left(\underline{\mathrm{dd}}{ }^{0}, \underline{\mathrm{~mm}}{ }^{\prime}, \underline{\underline{s s}}{ }^{\prime \prime}\right)$ |  |  |
|  |  |  |  |  |  | LATITUDE / LONGITUDE |  |  |
| 1 | 0645 | 0720 | 75 | 0 |  |  | $4 N$ | 3-87-8-1 |
| 2 | 0950 | 1020 | 35 | 72 |  |  | $8 \times$ | $3-88-8-1$ |
| 3 | 1755 | 1420 | 40 | 2 |  |  | 5\% | $3-89-4-3$ |
| 4 | 1440 | $15 / 0$ | 25 | 0 |  |  | 51 | 3-89-4i-3 |
| 5 | 16015 | 1710 | 150 | 95 |  |  | $8 \%$ | 3-89-4-3 |
| 6 | 1815 | 1850 | 40 | 0 | - |  | 711 | 3-89-4-3 |
| 7 |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  | ${ }^{0}$ |  |  |
| 10 |  |  |  |  |  | ${ }^{0}+\ldots$ '___ ' / ___ ${ }^{0}$ |  |  |
| 11 |  |  |  |  |  | ${ }^{0} \ldots \ldots$ '___ ' / _ _ ${ }^{0}$ _ _ ' |  |  |
| 12 |  |  |  |  |  |  |  |  |
| PUMP OUT |  | COMMEN <br> DATE / TI | TS | TO DOC |  |  |  | PIAIN'S SIGNAIURE |

## Captain's Daily Fishing Report: Current



## Alternate Estimates of Nominal Fishing Effort

- Traditional:
- From Catch Records:
- From CDFRs:

Vessel-ton-weeks (VTW)
Number of successful fishing trips
Number of purse-seine sets


## Comparison of Normalized Effort



Figure 4.5 in Report

## Comparison of Normalized CPUE



Figure 4.6 in Report

## Questions?



## Menhaden Sampling Time Line

- Samplers were temporary/seasonal Federal employees through ~1994
- ~1994 lost all temporary Federal positions NMFS-wide
- Since $\sim 1995$, company dockside employees at Louisiana fish factories solicited to acquire weekly samples noting date, vessel, fishing location; freeze samples in chest freezers
- Target number of samples per week
- Paid a nominal fee for their services
- QA/QC: Date of sample checked against daily logbooks


## Processing of Menhaden Samples from Louisiana Fish Factories

- ~1995-2003: GSMFC hired independent contractors to process samples from LA for size and age; forward data to NMFS Beaufort
- 2004 to present: GSMFC contracts w/ LDWF to process samples from Empire, Abbeville, and Cameron; forward data to NMFS Beaufort



## Processing of Menhaden Samples From Mississippi Fish Factory

- 1995-2009, an employee of NMFS Pascagoula Lab acquired samples at fish factory in Moss Point, MS, and processed those samples; sent data to NMFS Beaufort
- In recent years, GSMFC has hired an independent contractor to process the samples and forward data to NMFS Beaufort.


| Mean net tonnage of the gulf menhaden fleet by decade since 1970 |  |  |  |
| :---: | :---: | :---: | :---: |
| Fishing <br> Year | Mean net tonnage | No. of vessels in <br> calculation | Range of net <br> tonnages |
| 1970 | 248 | 72 | $80-386$ |
| 1980 | 315 | 79 | $139-453$ |
| 1990 | 317 | 75 | $147-447$ |
| 2000 | 338 | 43 | $197-453$ |
| 2010 | 361 | 32 | $293-453$ |
| 2017 | 354 | 34 | $213-453$ |

Table 4.10 in Report

## Catch at Age 1964-2017



Figure 4.3 in Report

