LOUISIANA FISHERIES FORWARD

# BLACK DRUM & SHEEPSHEAD

## A Report on the Growth, Abundance, and Landings in Louisiana Waters

LOUISIANA FISHERIES FORWARD
Advancing Our Seafood Industry

QUALITY + EDUCATION + SUSTAINABILITY

OCTOBER 2020

Prepared by:
Department of Oceanography and Coastal Sciences
Louisiana State University

**Steve Midway, PhD**
*Assistant Professor*
Louisiana State University
(225) 578-6458, smidway@lsu.edu

**Kenneth Erickson**
*Graduate Research Assistant*
Louisiana State University
kerick6@lsu.edu

# CONTENTS

# BACKGROUND to the STUDY

This report was commissioned in 2019 by Louisiana Fisheries Forward (LFF) in order to have an independent investigation on the growth, abundance, and landings of black drum and sheepshead in the coastal waters of Louisiana. Both species have exhibited varying levelsof harvest both among coastal estuaries as well as over time. Black drum and sheepsheadare both assessed and managed at the state level; however, finer resolution information of estuary specific patterns of growth, relative abundance, and landings may help stakeholders and managers better understand these fisheries. The data presented in this report come exclusively from existing sampling programs run by the Louisiana Department of Wildlife and Fisheries (LDWF). In other words, no data were collected for the explicit purpose of this study. LDWF biological data was used for the growth estimation methods, LDWF fishery- independent sampling was used for the abundance methods, and LDWF trip tickets were used for the catch methods.

Much of this report focuses on comparisons among and between coastal estuaries; for example, we evaluate whether each species grows differently among different basins. Fortunately, LDWF samples both species across coastal waters of the state. And although samples exist outside of the major estuaries, the majority of information and interest in the species takes place in five LDWF coastal study areas (CSAs). This report has adopted (for the most part) the CSAs that LDWF uses and which are described in Table 1.1 (and in Figure 1.1).

Also, throughout this report the terms estuary, basin, and CSA are used interchangeably to refer to these waterbodies.

Table 1.1: LDWF Coastal Study Areas (CSAs) that correspond to coastal estuaries. This report largely adopts the CSA spatial framework.

| CSA | Description |
|---|---|
| 1 | Pontchartrain Basin |
| 3 | Barataria Basin |
| 5 | Terrebonne/Timbalier Basins |
| 6 | Vermillion/Teche/Atchafalaya Basins |
| 7 | Mermentau/Calcasieu/Sabine Basins |

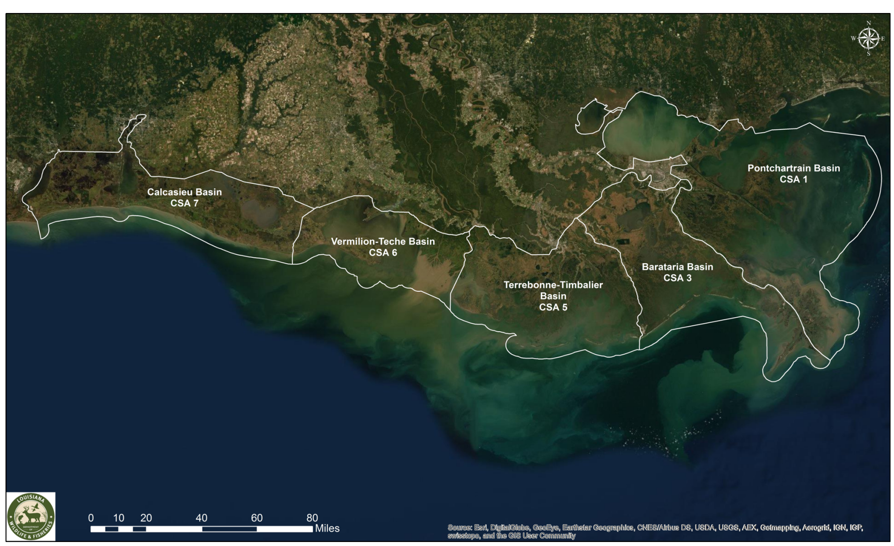


Figure 1.1: Map of LDWF Coastal Study Areas (CSAs) shown in yellow borders.

# PART I:
# BLACK DRUM

# CHAPTER 2

## Growth //

**Question**

**Does growth of black drum (*Pogonias cromis*) vary by coastal estuary? For example, do black drum in different Louisiana estuaries grow at different rates or achieve different maximum average sizes?**

### 2.1 The Data

All black drum growth data were collected and provided by LDWF. In addition to date and location of capture, the primary variables of interest are fork length (FL) measured in millimeters, and age (years), which is estimated by LDWF biologists examining individual otoliths. The full black drum biological data set was unbalanced (i.e., not all data were available for all fish), so the first step we took was to subset the data to include only the useable records.

1. The full data set included n=21,156 fish, which were sampled between 1996 and 2019.
2. We first needed to remove any fish that did not have a recorded fork length or estimated age, because those two variables are required to estimate growth. n=3,179 fish were removed due to no recorded length, and all remaining fish had an estimated age.
3. Next we need to define the geographic areas to compare. Within our data, the length and age samples break down geographically (Table 2.1)
4. The last 3 groups have less than 100 samples and are not particularly areas of interest, so we will drop those groups. We will also drop the first group, which is not really a group, but includes n=11,135 records that do not have a location associated with them. Finally, we also excluded Sabine and Calcasieu because almost no old or large fish were included in those samples, and as such, growth models cannot be fit to these groups.
5. We were left with n=9,936 samples that were complete with fork length, age, and location information required to estimate growth in black drum across Louisiana estuaries.

Table 2.1: Black drum length-at-age samples by coastal location.

| Coastal Location | Records |
|---|---|
| None | 11135 |
| Barataria | 3086 |
| Pontchartrain | 2456 |
| Vermilion-Teche | 1516 |
| Terrebonne/Timbalier | 1121 |
| Calcasieu | 722 |
| Sabine | 526 |
| Mississippi | 509 |
| Atchafalaya | 47 |
| Outside Waters | 34 |
| Mermentau | 4 |

## 2.2 The Model

We were interested in using a growth model to see if black drum grow at different rates and achieve different maximum sizes in different Louisiana estuaries. We enter into the analysis assuming fish in every basin have the same growth characteristics. However, we will use a growth model that is able to detect any differences in growth by location, should those differences occur. It is also worth noting that we have not mentioned anything about males and females at this point. In some fish species, males and females grow differently; however, previous growth modeling of black drum has demonstrated that male and female growth does not statistically differ (Jones and Wells (1998), although in the Chesapeake Bay). Beckman et al. (1990) studied black drum in coastal Louisiana and did find some evidence of sex-specific growth; however, they report that sex-specific differences in growth were largely confined to older ages (> 25 years of age. Based on the weak evidence of sex-specific growth in the literature and lack of effects in younger ages, we combined both sexes into one model. It is also worth noting that using the same data, LDWF does not report much evidence for sex-specific growth.

The model we used was the von Bertalanffy growth model, which is by far the most common growth model used in fisheries. The von Bertalanffy growth model is a non-linear model that is characterized by a steep slope for younger ages (signifying faster growth) and then a leveling off of growth in later years. The two parameters of interest for the von Bertalanffy growth model are (typically) k, which captures the early life growth (technically the rate at which the asymptote is approached) and $L_\infty$, which describes the mean asymptotic fish length, or the largest average size that fish reach (note that individual fish can be larger than the $L_\infty$ estimate).

The model equation follows the form:

$$y_{ij} = L_{\infty j} \; 1 - e(-k_j(t_{ij} - t_{0j})) \; + \; _{ij}$$ (Figure 2.1)

with errors modeled as

$$_{ij} \sim N(0, \sigma^2)$$ (Figure 2.2)

Where *i* represents individual fish and *j* represents the geographic grouping factor. $y_{ij}$ is fork length (mm) and $t_{ij}$ is the estimated age of fish *i* from basin *j*. Note that the full model description and fitting methods can be found in Midway et al. (2015).

## 2.3 Results

### 2.3.1 Maximum Average Sizes

Visual comparisons are useful (Fig 2.1), but to determine statistically significant differences between growth in estuaries, we need to look at the numerical parameter estimates. Fig 2.2 shows the parameter estimates for $L_\infty$, the maximum average size of black drum. Pontchartrain and Vermillion-Teche were found to have the smallest maximum average sizes across coastal Louisiana, while Terrebonne was home to the largest maximum average size.

To further compare these basin-specific estimates of maximum average length (Fig 2.2), we can ran a simple test to see if the ranges of values between basins overlap with each other. Overlapping estimates suggest that the estimate of maximum average size does not differ between locations, or that the two basins have fish that reach approximately the same maximum average size (Table 2.2). Non-overlapping estimates provide strong evidence that fish reach different maximum average sizes in different basins.

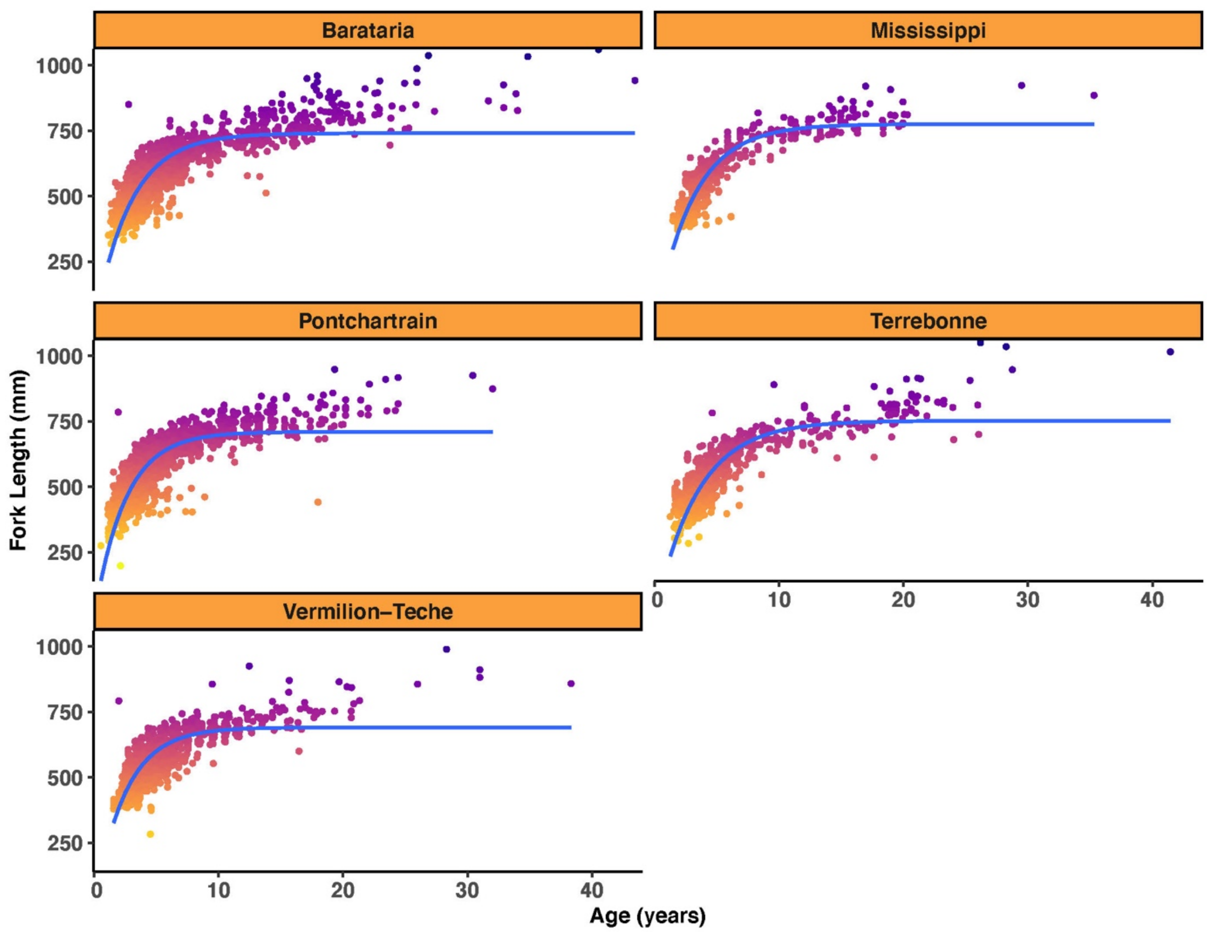


Figure 2.1: Black drum basin-specific age and growth samples (dots) and basin-specific growth model estimates (lines). Colors of dots correspond to fork length and are solely to aid in visualizing the size distribution.

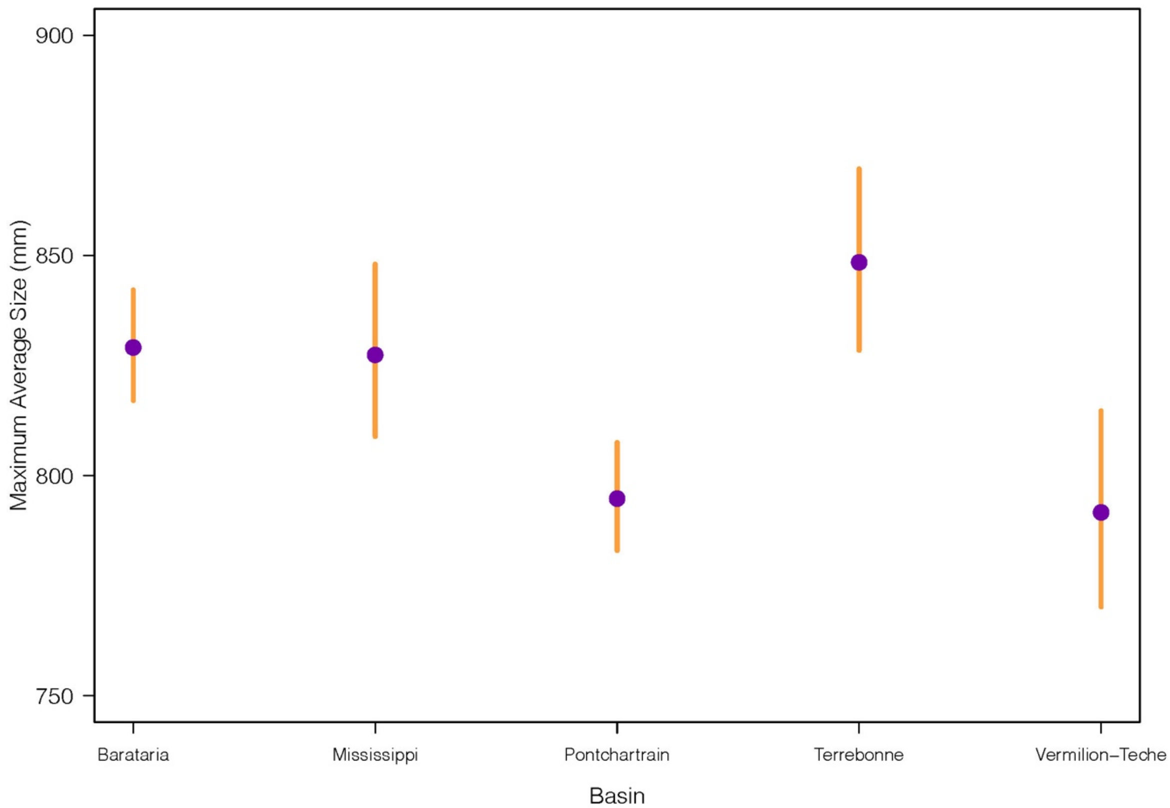


Figure 2.2: Basin-specific estimates of maximum average size of black drum in different Louisiana basins. The dot represents the mean estimate and the lines represent the 95% credible interval (uncertainty) around the estimate.

Table 2.2: Basin-to-basin comparisons of maximum average size. *Same* means that black drum in both basins reach the same maximum average size, while *Different* means that black drum in the two basins reach different maximum average sizes. When black drum in two basins were found to have different maximum average sizes, Fig 2.2 can be referenced to determine which basin reaches larger or smaller sizes.

| Basin | Barataria | Mississippi | Pontchartrain | Terrebonne | Vermilion-Teche |
|---|---|---|---|---|---|
| Barataria | Same | Same | Different | Same | Different |
| Mississippi | Same | Same | Different | Same | Different |
| Pontchartrain | Different | Different | Same | Different | Same |
| Terrebonne | Same | Same | Different | Same | Different |
| Vermilion-Teche | Different | Different | Same | Different | Same |

## 2.32. Growth Rates

Fig 2.3 shows the parameter estimates for *k*, the growth coefficient of black drum. Mississippi and Pontchartrain were found to have the largest growth coefficients across coastal Louisiana, while Terrebonne was home to the smallest growth coefficient.

To further compare these basin-specific estimates of growth (Fig 2.3), we ran a simple test to see if the ranges of *k* values between basins overlap with each other. Overlapping estimates suggest that the growth coefficient estimate does not differ between locations, or that the two basins have fish that increase in size at the same rate. Non-overlapping estimates provide strong evidence that the black drum in each basin grow at different rates.

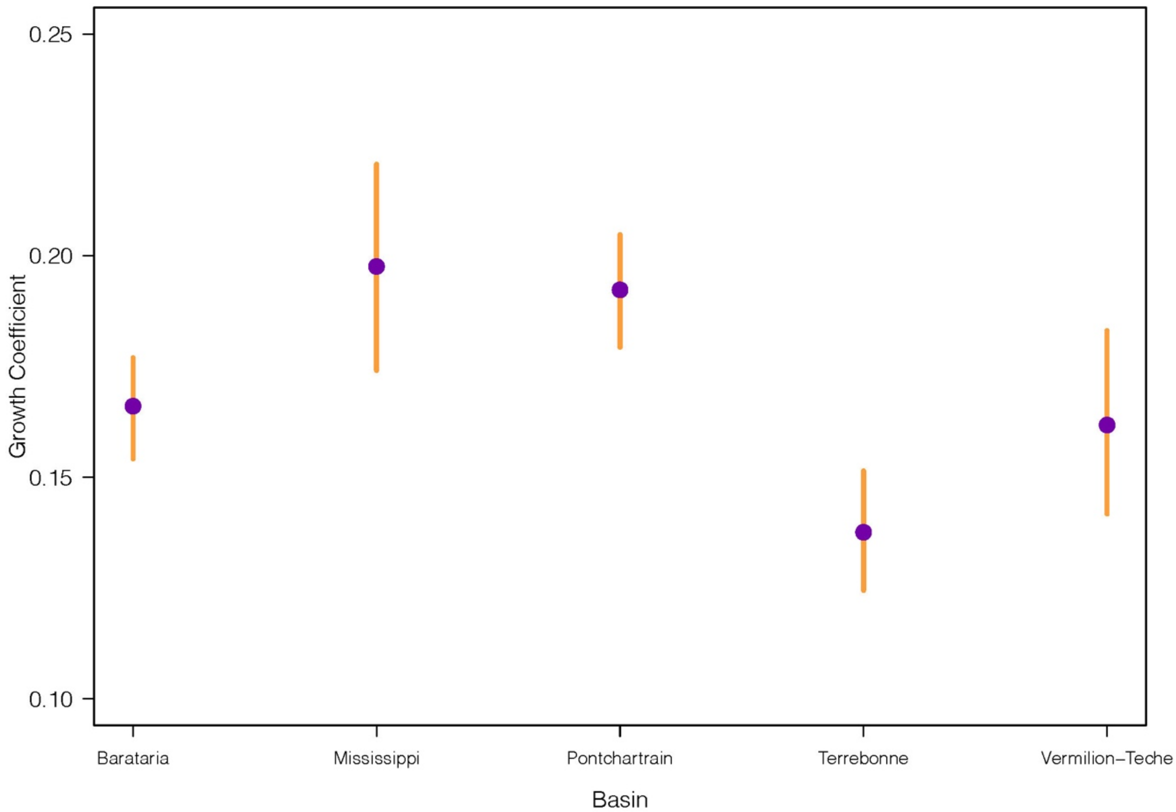


Figure 2.3: Basin-specific estimates of the growth coefficient of black drum in different Louisiana basins. The dot represents the mean estimate and the lines represent the 95% credible interval (uncertainty) around the estimate.

Table 2.3: Basin-to-basin comparisons of black drum growth. Same means that black drum in both basins grow at approximately the same rate, while Different means that black drum in the two basins grow at different rates. When black drum in two basins were found to have different growth coefficients, Fig 2.3 can be referenced to determine which basin exhibits faster or slower growth.

| Basin | Barataria | Mississippi | Pontchartrain | Terrebonne | Vermilion-Teche |
|---|---|---|---|---|---|
| Barataria | Same | Different | Different | Different | Same |
| Mississippi | Different | Same | Same | Different | Different |
| Pontchartrain | Different | Same | Same | Different | Different |
| Terrebonne | Different | Different | Different | Same | Different |
| Vermilion-Teche | Same | Different | Different | Different | Same |

# CHAPTER 3

## Abundance //

**Question**

**What is the relative abundance of black drum in different coastal basins? Do some basins have more or less black drum?**

### 3.1 The Data

For this analysis, we used LDWF's Index of Abundance (IoA, or *indices*) that is developed from fishery-independent trammel net sampling program, and which is fully described in Louisiana Department of Wildlife and Fisheries (2018). From the trammel net sampling, records of catch are calculated relative to effort and the resulting index is assumed to represent relative abundance. Indices are estimated on an annual basis pooling all of coastal Louisiana; however, for the purposes of this report LDWF generously ran estimates of IoA for each coastal estuary (CSA). The estimates we examined for this report include an annual IoA for every year from 1985–2018 for each of five coastal estuaries: Pontchartrain, Barataria, Terrebonne, Vermillion, and Calcasieu.

### 3.2 The Analysis

The first analysis we undertook with the data was to plot the estuary-specific indices over the time series of the data. This allows for a visualization of any synchronous periods of high or low abundance across coastal Louisiana estuaries. In order to quantify the actual synchrony between estuaries, we ran a synchrony analysis using a Pearson correlation that estimated the amount of positive or negative correlation in relative abundance between each of the estuaries. Finally, we calculated the average indices for the last five years and ranked them by estuary, which may serve as a proxy for recent black drum production across coastal Louisiana. (Note that this metric only estimates what the relative abundance might be, and does not reflect any information about landings.)

## 3.3 Results

Indices of abundance varied over time within each basin; however, there appeared to be little synchrony between or among basins (Fig 3.1). This lack of synchrony was further confirmed with very low correlation coefficients (Fig 3.2). Interpretation of correlation coefficients varies, but typically anything less than 0.3–0.4 is considered weakly correlated or not correlated. Our results suggest that perhaps Pontchartrain and Terrebonne have a weak-to-moderate negative correlation, or that Vermillion and Calcasieu have a weak-to-moderate positive correlation, but otherwise virtually no correlation in black drum abundance exists among basins. Further, we do not hypothesize or evaluate any mechanisms for why we see or do not see correlations between basins. Our interest was purely in measuring whether the relative amount of black drum in each coastal basin tends to independent or dependent on other basins.

Our 5-year average index found that recently, relative abundance among basins has been very different. Pontchartrain and Barataria have high relative abundances in recent years, while Vermillion, Terrebonne, and Calcasieu have about half as much relative abundance over the same time.

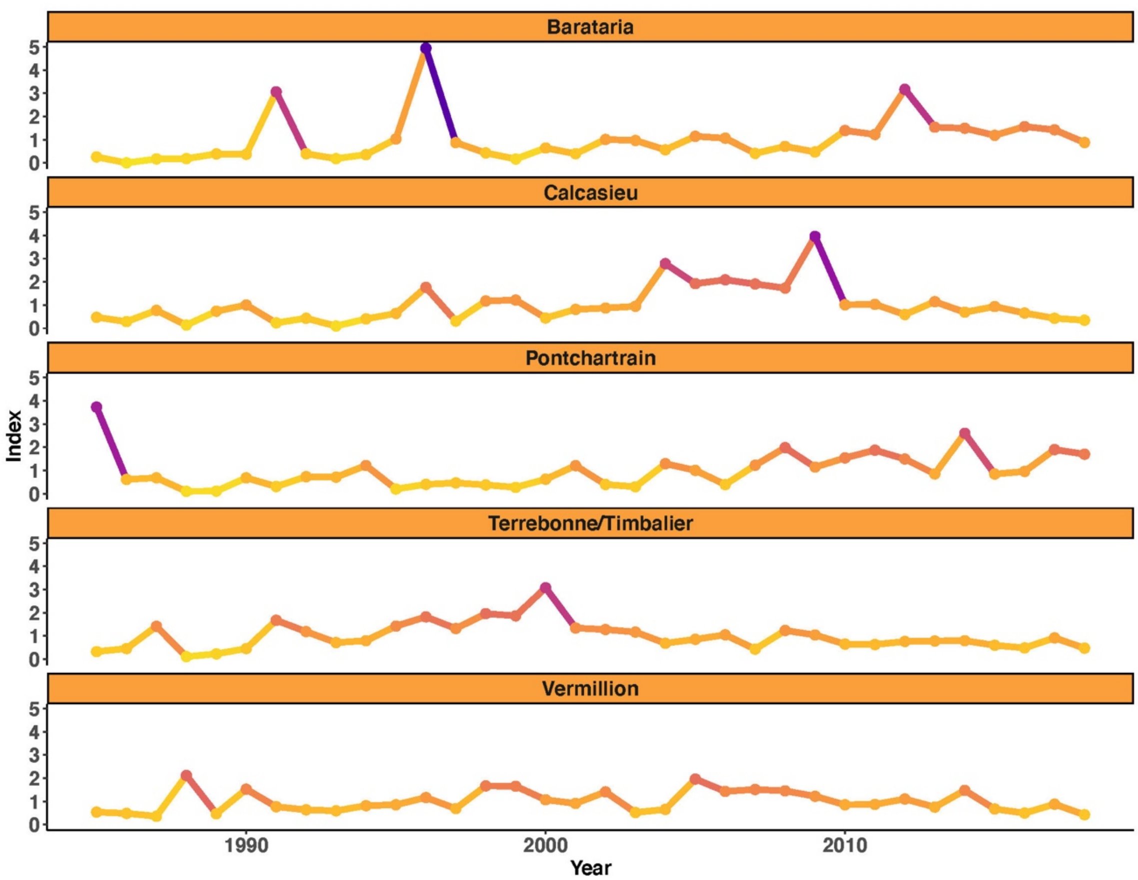


Figure 3.1: Black drum indices of relative abundance for five coastal basins in Louisiana. The time series begins in 1985 and goes to 2018. Darker colors signify higher index values.

Table 3.1: Average index of relative abundance for the last 5 years of data (2013-2018). Longer time series are useful for understanding correlations (see Fig 3.1); however, examining only the most recent years provides a better indicator of recent black drum abundances.

| Basin | 5-Year Average |
|---|---|
| Pontchartrain | 1.603 |
| Barataria | 1.307 |
| Vermillion | 0.790 |
| Terrebonne | 0.654 |
| Calcasieu | 0.613 |

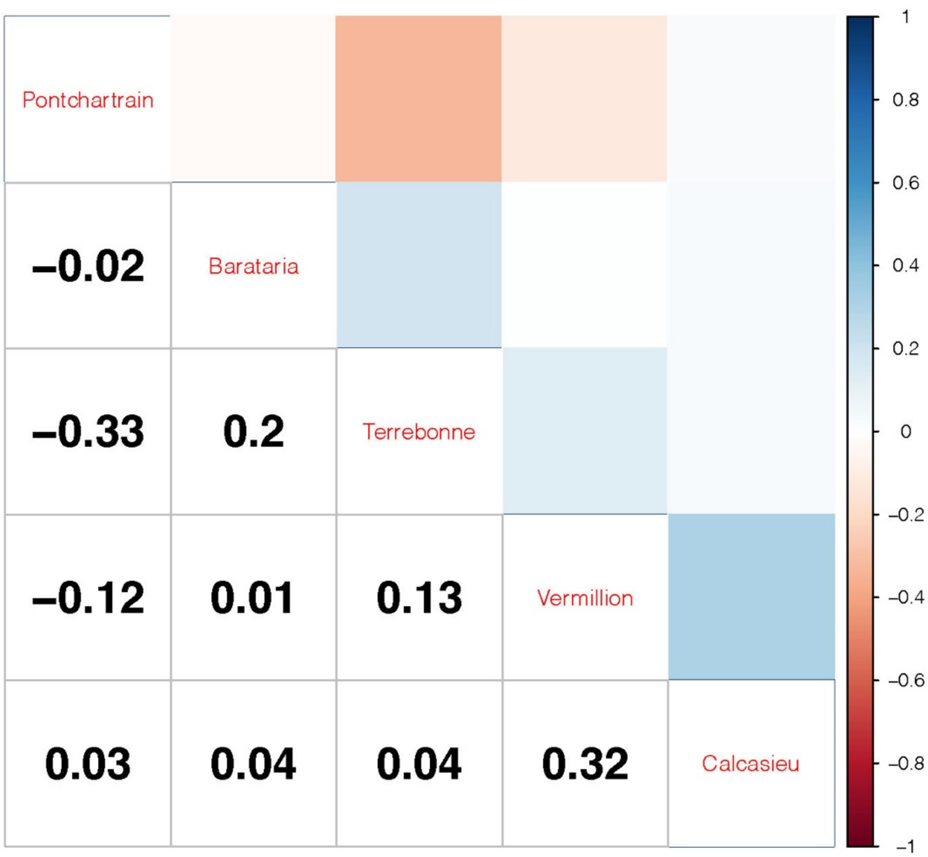


Figure 3.2: Correlation matrix of black drum indices of abundance over time. The lower left portion of the matrix displays the numerical estimates of the correlation between basins, which is described as the basin above and basin to the right of the number. The upper right portion of the matrix is displaying the correlation information using color intensity, which can be referenced in the legend to the right of the matrix.

# CHAPTER 4

## Landings //

**Question**

**What are the annual landings of fish by areas of the state?**

### 4.1 The Data

For this analysis, we used LDWF trip ticket data that dates from 1999–2019. Due to confidentiality rules, not all landings were available for all sites and time periods, and in order to increase the amount of useable data we pooled time into years. Originally, we intended to look time at a finer scale, but ultimately had to look at landings at the annual time interval.

### 4.2 The Analysis

We used descriptive analyses to understand black drum landings. Trip ticket landings of black drum were plotted over time to visualize any trends in landings.

### 4.3 Results

Black drum landings (Fig 4.1) over time were highest in Vermillion, although landings have declined in Vermillion in recent years. Barataria had higher landings earlier in the time series (around 2000–2010), while Pontchartrain has had higher recent landings (roughly 2010–2018).

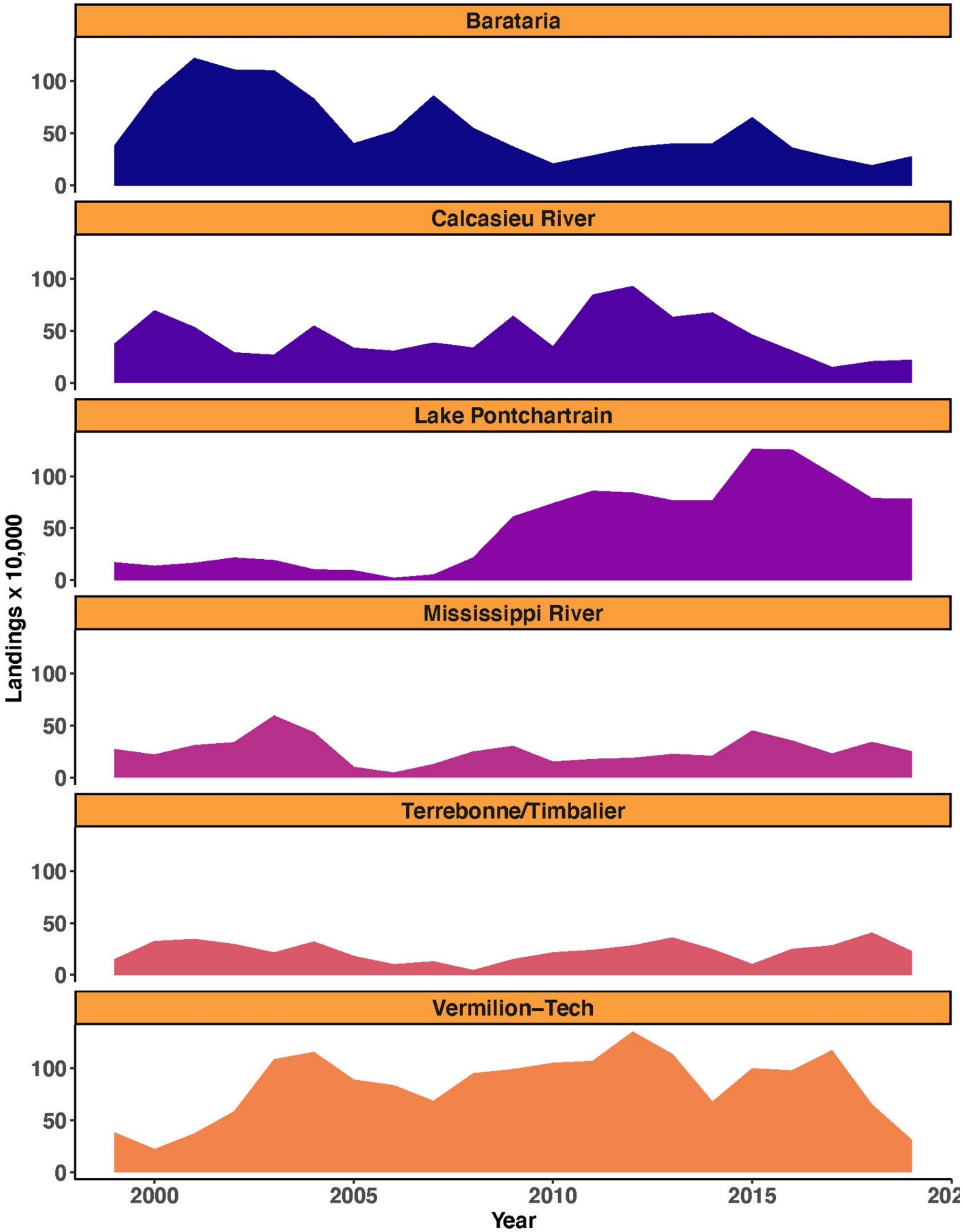


Figure 4.1: Black drum landings by coastal basin based on LDWF trip ticket data.

# PART II: SHEEPSHEAD

# CHAPTER 5

## Growth //

**Question**

**Does growth of sheepshead (*Archosargus probatocephalus*) vary by coastal estuary? For example, do sheepshead in different Louisiana estuaries grow at different rates or achieve different maximum average sizes?**

### 5.1 The Data

All sheepshead growth data were collected and provided by LDWF. In addition to date and location of capture, the primary variables of interest are fork length (FL) measured in millimeters, and age (years), which is estimated by LDWF biologists examining individual otoliths. The full sheepshead biological data set was unbalanced (i.e., not all data were available for all fish), so the first step we took was to subset the data to include only the useable records.

1. The total data set included $n$=16,050 fish, which were sampled between 1994 and 2019.
2. We first needed to remove any fish that did not have a recorded fork length or estimated age, because those two variables are required to estimate growth. $N$=1,803 fish were removed due to no recorded length, and all remaining fish had an estimated age.
3. Next we need to define the geographic areas to compare. Within our data, the length and age samples broke down geographically (Table 5.1).
4. The last four groups (Table 5.1) have less than 100 samples and are not particularly areas of interest, so we will drop those groups. We will also drop the first group, which is not really a group, but includes $n$=8,235 records that do not have a location associated with them. Finally, we also excluded Sabine and Calcasieu because almost no old or large fish were included in those samples, and as such, growth models cannot be fit to these groups.
5. We were left with $n$=5,670 samples that were complete with the total length, age, and location information needed to estimate variable growth in black drum across Louisiana estuaries.

Table 5.1: Black drum length-at-age samples by coastal location.

| Coastal Location | Records |
|---|---|
| None | 8235 |
| Barataria | 1954 |
| Pontchartrain | 1320 |
| Vermilion-Teche | 1270 |
| Terrebonne/Timbalier | 860 |
| Calcasieu | 266 |
| Sabine | 238 |
| Mississippi | 93 |
| Atchafalaya | 5 |
| Outside Waters | 4 |
| Mermentau | 2 |

## 5.1 The Model

We were interested in using a growth model to see if sheepshead grow at different rates and achieve different maximum sizes in different Louisiana estuaries. We enter into the analysis assuming fish in every basin have the same growth characteristics. However, we will use a growth model that is able to detect any differences in growth by location, should those differences occur. It is also worth noting that we have not mentioned anything about males and females at this point. In some fish species, males and females grow differently; however, previous growth modeling of sheepshead has had mixed results. McDonough et al. (2011) found no sex-specific differences in growth when investigating fish from South Carolina and Dutka-Gianelli and Murie (2001) found no sex-specific differences in growth in sheepshead from the northwest coast of Florida. In coastal Louisiana, Beckman et al. (1991) did find some evidence of sex-specific growth, as did Winner et al. (2017) who reported statistical significance but was less sure about biological significance. Based on the mixed evidence of sex-specific growth in the literature we can combined both sexes into one model.

The model we used was the von Bertalanffy growth model, which is by far the most common growth model used in fisheries. The von Bertalanffy growth model is a non-linear model that is characterized by a steep slope for younger ages (signifying faster growth) and then a leveling off of growth in later years. The two parameters of interest for the von Bertalanffy growth model are (typically) *k*, which captures the early life growth (technically the rate at which the asymptote is approached) and $L_\infty$, which describes the mean asymptotic fish length, or the largest average size that fish reach (note that individual fish can be larger than the $L_\infty$ estimate).

The model equation follows the form:

$$y_{ij} = L_{\infty j} \quad 1 - e(-k_j(t_{ij} - t_{0j})) \quad + \quad _{ij} \qquad \text{(Figure 5.1)}$$

with errors modeled as

$$_{ij} \sim N(0, \sigma^2) \qquad \text{(Figure 5.2)}$$

Where *i* represents individual fish and *j* represents the geographic grouping factor. $y_{ij}$ is fork length (mm) and $t_{ij}$ is the estimated age of fish *i* from basin *j*. Note that the full model description and fitting methods can be found in Midway et al. (2015).

## 5.3 Results

### 5.3.1 Maximum Average Sizes

Visual comparisons are useful 5.1, but to determine statistically significant differences between growth in estuaries, we need to look at the numerical parameter estimates. Fig 5.2 shows the parameter estimates for $L_\infty$, the maximum average size of sheepshead. Pontchartrain was found to have the largest maximum average sizes across coastal Louisiana, while Vermilion was home to the smallest maximum average size.

To further compare these basin-specific estimates of maximum average length (Fig 5.2), we can ran a simple test to see if the ranges of values between basins overlap with each other. Overlapping estimates suggest that the estimate of maximum average size does not differ between locations, or that the two basins have fish that reach approximately the same maximum average size (Table 5.2). Non-overlapping estimates provide strong evidence that fish reach different maximum average sizes in different basins.

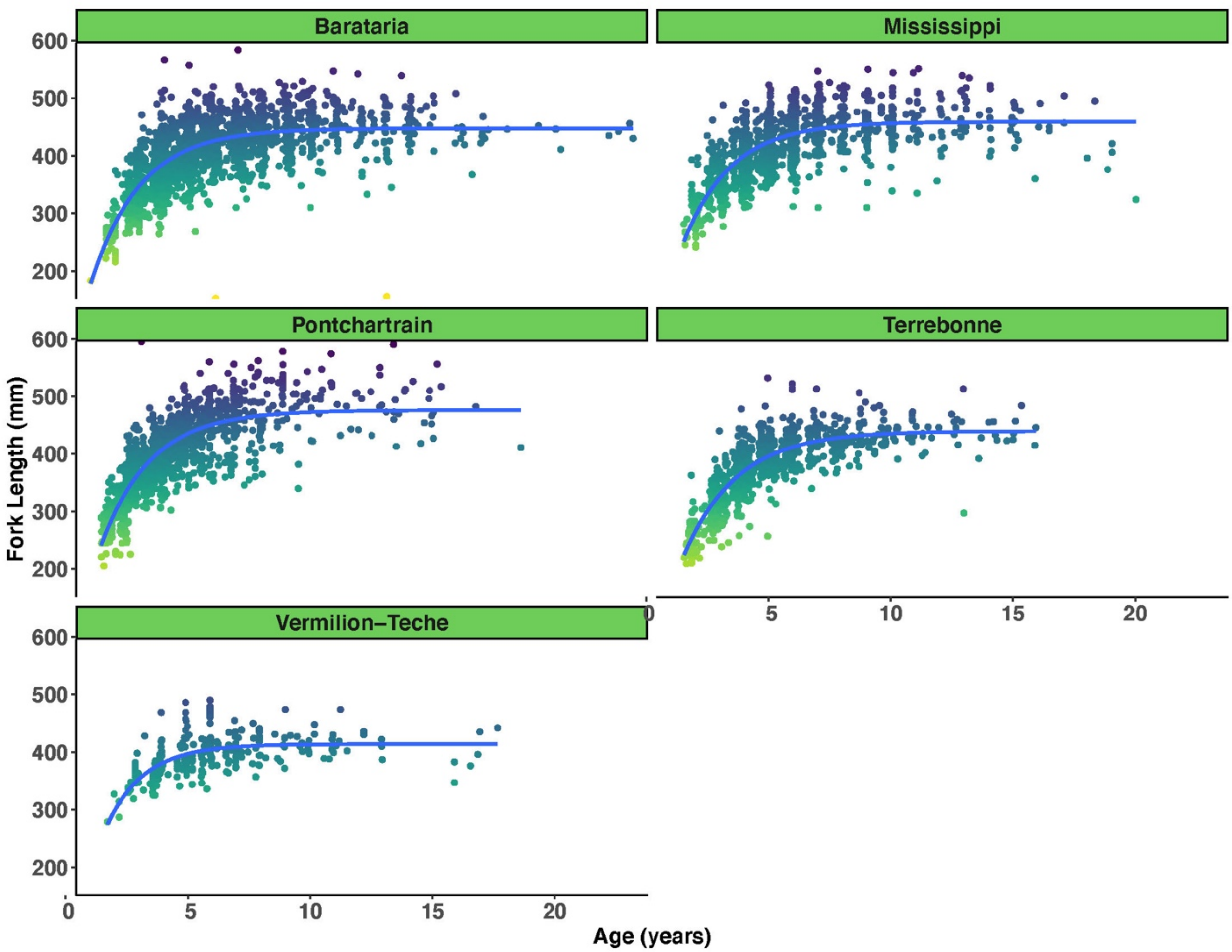


Figure 5.1: Sheepshead basin-specific age and growth samples (dots) and basin-specific growth model estimates (lines). Colors of dots correspond to fork length and are solely to aid in visualizing the size distribution.

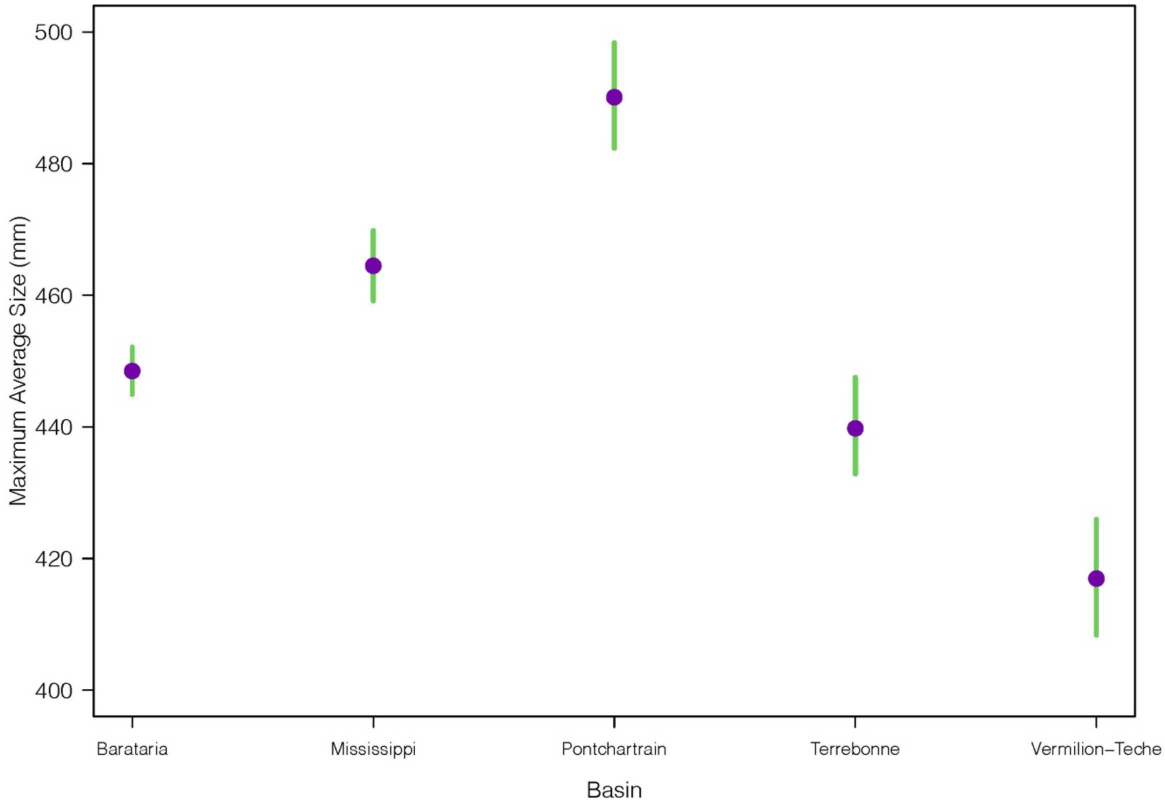


Figure 5.2: Basin-specific estimates of maximum average size of sheepshead in different Louisiana basins. The dot represents the mean estimate and the lines represent the 95% credible interval (uncertainty) around the estimate.

Table 5.2: Basin-to-basin comparisons of maximum average size. *Same* means that sheepshead in both basins reach the same maximum average size, while *Different* means that sheepshead in the two basins reach different maximum average sizes. When sheepshead in two basins were found to have different maximum average sizes, Fig 5.2 can be referenced to determine which basin reaches larger or smaller sizes.

| Basin | Barataria | Mississippi | Pontchartrain | Terrebonne | Vermilion-Teche |
|---|---|---|---|---|---|
| Barataria | Same | Different | Different | Different | Different |
| Mississippi | Different | Same | Different | Different | Different |
| Pontchartrain | Different | Different | Same | Different | Different |
| Terrebonne | Different | Different | Different | Same | Different |
| Vermilion-Teche | Different | Different | Different | Different | Same |

### 5.3.2 Growth Rates

Fig 5.3 shows the parameter estimates for k, the growth coefficient of sheepshead. Growth coefficients were very similar across the basins, with Vermillion having the largest coefficient, but also the most uncertainty.

To further compare these basin-specific estimates of growth (Fig 5.3), we ran a simple test to see if the ranges of k values between basins overlap with each other. Overlapping estimates suggest that the growth coefficient estimate does not differ between locations, or that the two basins have fish that increase in size at the same rate (Table 5.3). Non-overlapping estimates provide strong evidence that the sheepshead in each basin grow at different rates.

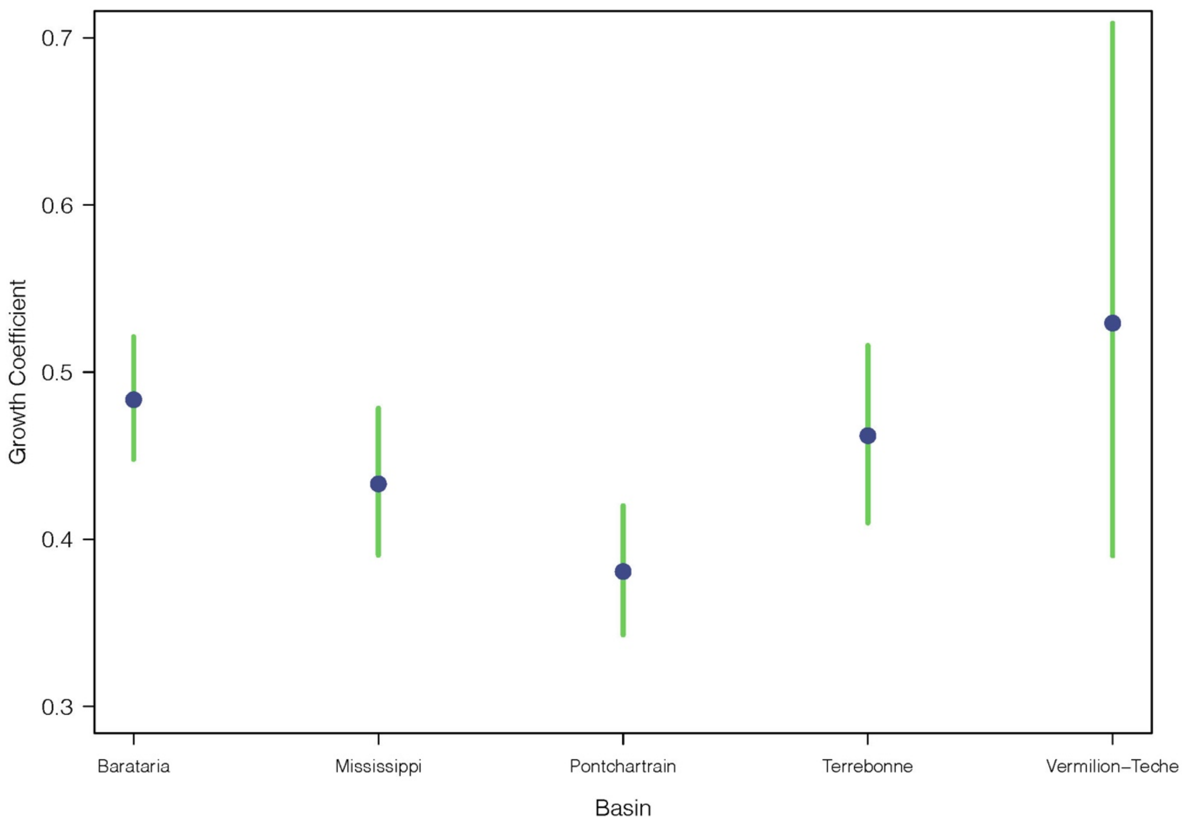


Figure 5.3: Basin-specific estimates of the growth coefficient of sheepshead in different Louisiana basins. The dot represents the mean estimate and the lines represent the 95% credible interval (uncertainty) around the estimate.

Table 5.3: Basin-to-basin comparisons of sheepshead growth. *Same* means that sheepshead in both basins grow at approximately the same rate, while *Different* means that sheepshead in the two basins grow at different rates. When sheepshead in two basins were found to have different growth coefficients, Fig 5.3 can be referenced to determine which basin exhibits faster or slower growth.

| Basin | Barataria | Mississippi | Pontchartrain | Terrebonne | Vermilion-Teche |
|---|---|---|---|---|---|
| Barataria | Same | Same | Different | Same | Same |
| Mississippi | Same | Same | Same | Same | Same |
| Pontchartrain | Different | Same | Same | Different | Same |
| Terrebonne | Same | Same | Different | Same | Same |
| Vermilion-Teche | Same | Same | Same | Same | Same |

# CHAPTER 6

## Abundance //

**Question**

**What is the relative abundance of sheepshead in different coastal basins? Do some basins have more or less sheepshead?**

### 6.1 The Data

For this analysis, we used LDWF's Index of Abundance (IoA, or *indices*) that is developed from fishery-independent trammel net sampling program, and which is fully described in Louisiana Department of Wildlife and Fisheries (2018). From the trammel net sampling, records of catch are calculated relative to effort and the resulting index is assumed to represent relative abundance. Indices are estimated on an annual basis pooling all of coastal Louisiana; however, for the purposes of this report LDWF generously ran estimates of IoA for each coastal estuary (CSA). The estimates we examined for this report include an annual IoA for every year from 1985–2018 for each of five coastal estuaries: Pontchartrain, Barataria, Terrebonne, Vermillion, and Calcasieu.

### 6.2 The Analysis

The first analysis we undertook with the data was to plot the estuary-specific indices over the time series of the data. This allows for a visualization of any synchronous periods of high or low abundance across coastal Louisiana estuaries. In order to quantify the actual synchrony between estuaries, we ran a synchrony analysis using a Pearson correlation that estimated the amount of positive or negative correlation in relative abundance between each of the estuaries. Finally, we calculated the average indices for the last 5 years and ranked them by estuary, which may serve as a proxy for recent sheepshead production across coastal Louisiana. (Note that this metric only estimates what the relative abundance might be, and does not reflect any information about landings.)

## 6.3 Results

Indices of abundance varied over time within each basin; however, there appeared to be little synchrony between or among basins (Fig 6.1). This lack of synchrony was further confirmed with low correlation coefficients (Fig 6.2). Interpretation of correlation coefficients varies, but typically anything less than 0.3–0.4 is considered weakly correlated or not correlated. Our results suggest that perhaps Pontchartrain and Terrebonne have a weak-to-moderate negative correlation (along with Pontchartrain and Calcasieu), and that Barataria and Calcasieu have a weak-to-moderate positive correlation, but otherwise virtually no correlation in sheepshead abundance exists among basins. Further, we do not hypothesize or evaluate any mechanisms for why we see or do not see correlations between basins. Our interest was purely in measuring whether the relative amount of sheepshead in each coastal basin tends to be independent or dependent on other basins.

Our 5-year average index found that recently, relative abundance among basins has been very different. Barataria has clearly had the highest relative abundance of all basins with Calcasieu, Vermillion, and Pontchartrain having intermediate relative abundances. Terrebonne basin reported the lowest relative abundance—less than half of the relative abundance in Barataria.

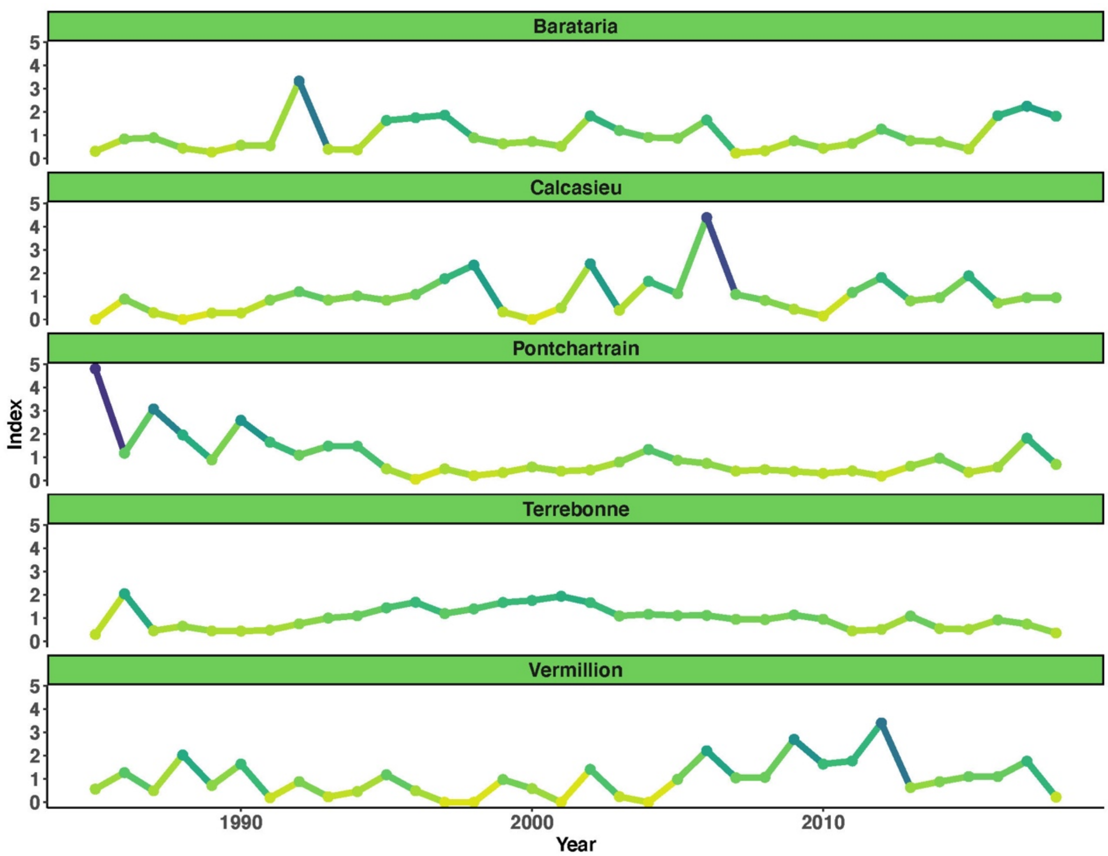


Figure 6.1: Sheepshead indices of relative abundance for five coastal basins in Louisiana. The time series begins in 1985 and go to 2018. Darker colors signify higher index values.

Table 6.1: Average index of relative abundance for the last 5 years of data (2013-2018). Longer time series are useful for understanding correlations (see Fig 6.1); however, examining only the most recent years provides a better indicator of recent black drum abundances.

| Basin | 5-Year Average |
|---|---|
| Pontchartrain | 1.603 |
| Barataria | 1.307 |
| Vermillion | 0.790 |
| Terrebonne | 0.654 |
| Calcasieu | 0.613 |

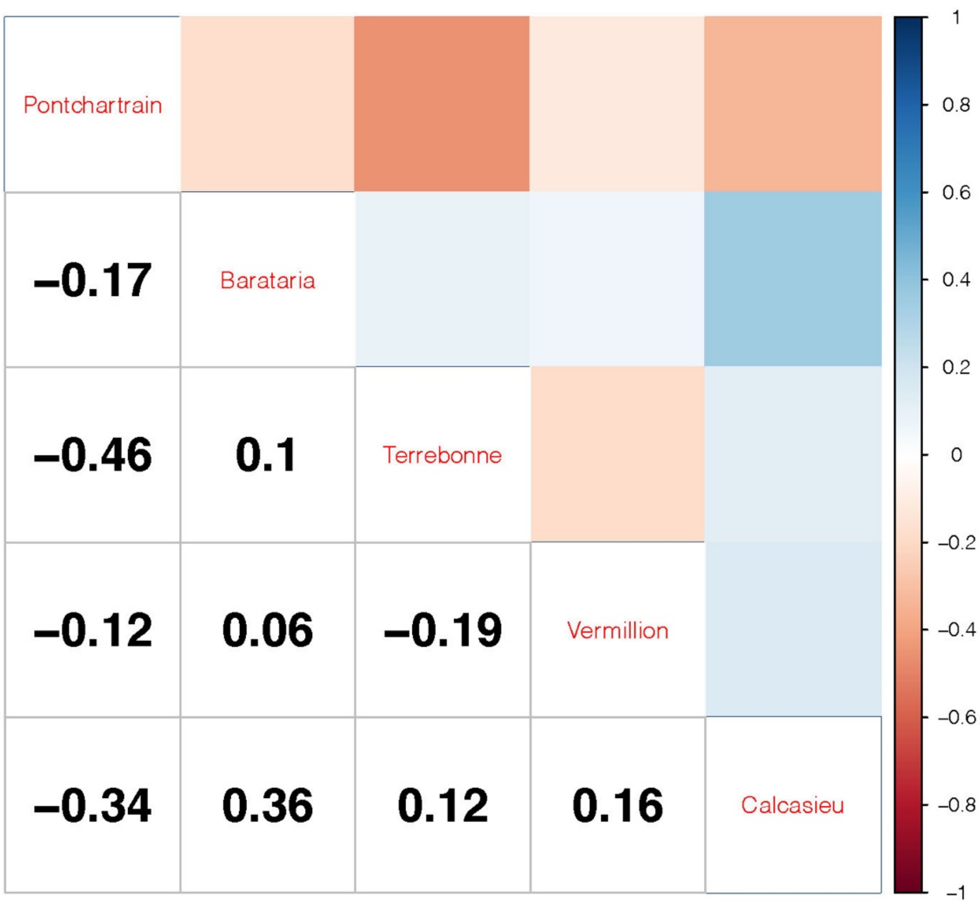


Figure 6.2: Correlation matrix of sheepshead indices of abundance over time. The lower left portion of the matrix displays the numerical estimates of the correlation between basins, which is described as the basin above and basin to the right of the number. The upper right portion of the matrix is displaying the correlation information using color intensity, which can be referenced in the legend to the right of the matrix.

# CHAPTER 7

## Landings //

**Question**

**What are the annual landings of sheepshead by areas of the state?**

### 7.1 The Data

For this analysis, we used LDWF trip ticket data that dates from 1999–2018. Due to confidentiality rules, not all landings were available for all sites and time periods, and in order to increase the amount of use-able data we pooled time into years. Originally, we intended to look time at a finer scale, but ultimately had to look at landings at the annual time interval.

### 7.2 The Analysis

We used descriptive analyses to understand sheepshead landings. Trip ticket landings of sheepshead were plotted over time to visualize any trends in landings.

### 7.3 Results

Sheepshead landings (Fig 7.1) were highest in Barataria, Pontchartrain, and Mississippi River areas, while Vermilion, Calcasieu, and Terrebonne reported almost no landings over the past 20 years.

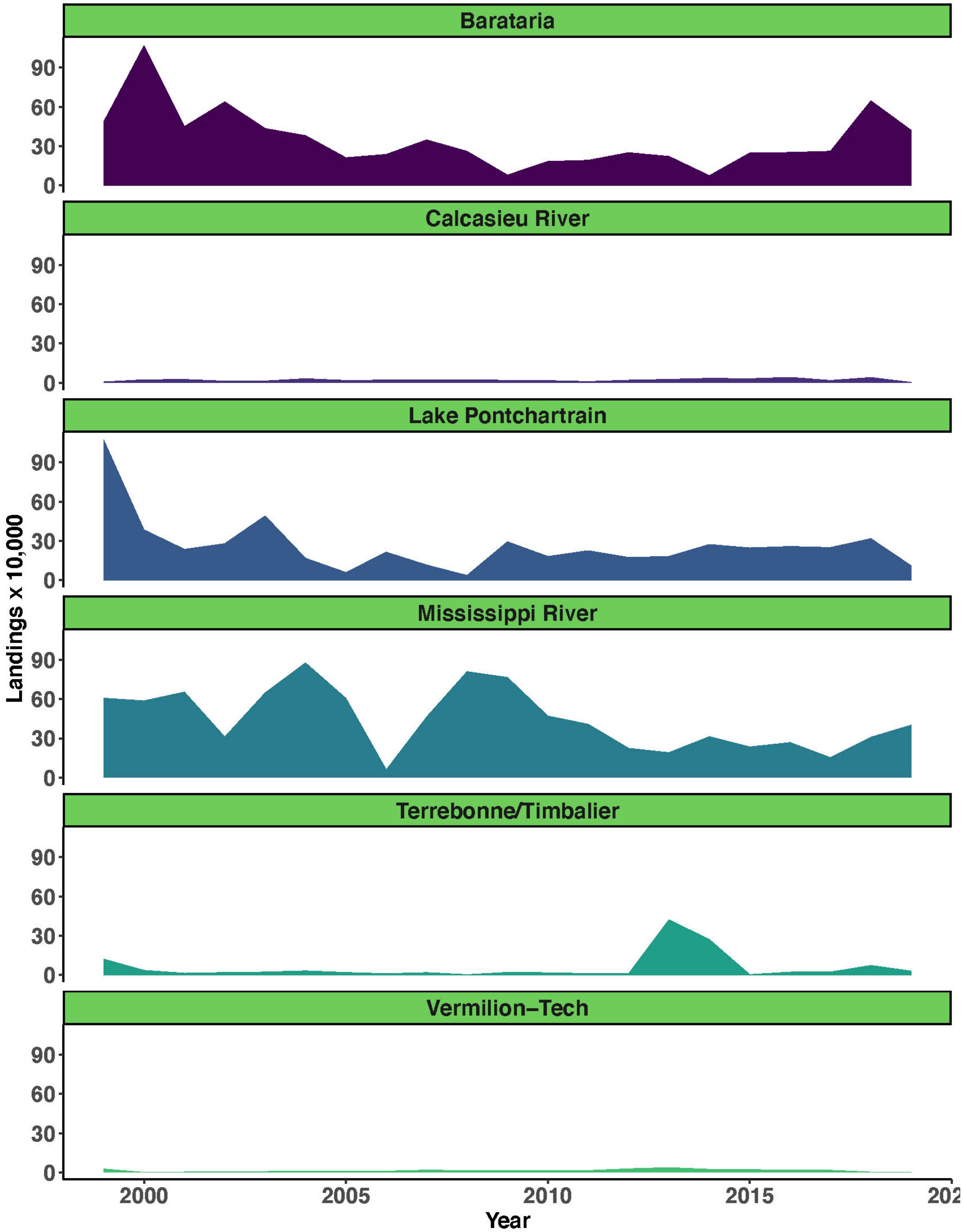


Figure 7.1: Sheepshead landings by coastal basin based on LDWF trip ticket data.

# CHAPTER 8

## Summary //

### 8.1 Black Drum

This report found that black drum reach different maximum average lengths in different coastal basins across Louisiana, in addition to growing at different rates in different basins. The relative abundance of black drum in coastal basins was found to be largely independent of other basins—in other words, the relative numbers of fish in one estuary was not found to be influenced by another estuary. Over the last five years, Pontchartrain and Barataria have been almost two times as productive as Terrebonne and Calcasieu. Pontchartrain has produced the most landings in recent years, along with Vermilion, which has produced generally high landings over the past 20 years.

### 8.2 Sheepshead

Sheepshead in Pontchartrain reach much larger maximum average lengths than sheepshead in other basins, especially Terrebonne and Vermilion. There were almost no differences be- tween estuaries with regard to sheepshead growth rates. Like black drum, sheepshead relative abundance was not found to be synchronous among estuaries and is thought to be largely independent within each estuary. Recently, Barataria has had the highest relative abundance, while Pontchartrain and Terrebonne have had the lowest relative abundances. Landings for sheepshead showed little temporal trend. Barataria, Pontchartrain, and Mississippi combined to land almost all of the fish over the time series, while Vermilion, Calcasieu, and Terrebonne landed almost no sheepshead over the last 20 years.

## Bibliography //

Beckman, D., A. Stanley, J. Render, and C. Wilson. 1991. Age and growth-rate estimation of sheepshead *Archosargus probatocephalus* in Louisiana waters using otoliths. Fishery Bulletin 89(1):1-8.

Beckman, D. W., A. L. Stanley, J. H. Render, and C. A. Wilson. 1990. Age and growth of black drum in Louisiana waters of the Gulf of Mexico. Transactions of the American Fisheries Society 119(3):537-544.

Dutka-Gianelli, J. and D. J. Murie. 2001. Age and growth of sheepshead, *Archosargus probatocephalus* (pisces: Sparidae), from the northwest coast of Florida. Bulletin of Marine Science 68(1):69-83.

Jones, C. M. and B. Wells. 1998. Age, growth, and mortality of black drum, *Pogonias cromis*, in the Chesapeake Bay region. Fishery Bulletin 96(3).

Louisiana Department of Wildlife and Fisheries. 2018. Independent sampling activities: Field manual. Technical report, Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA.

McDonough, C., C. Wenner, and W. Roumillat. 2011. Age, growth, and reproduction of sheepsheads in South Carolina. Marine and Coastal Fisheries 3(1):366-382.

Midway, S. R., T. Wagner, S. A. Arnott, P. Biondo, F. Martinez-Andrade, and T. F. Wadsworth. 2015. Spatial and temporal variability in growth of Southern Flounder (*Paralichthys lethostigma*). Fisheries Research 167:323-332.

Winner, B. L., T. C. MacDonald, and K. B. Amendola. 2017. Age and growth of sheepshead (*Archosargus probatocephalus*) in Tampa Bay, Florida. Fishery Bulletin 115(2).

www.LaFisheriesForward.org

QUALITY + EDUCATION + SUSTAINABILITY