

An overview of Louisiana Department of Wildlife and Fisheries data collected in the vicinity of Lake Pontchartrain and Lake Borgne from 2004 to 2017, as related to the MRGO Rock Dam closure in 2009

(Updated November 2018 to include LDWF 2017 and available 2018 Fisheries Independent and Dependent Data)



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INTRODUCTION

The primary response to the closure of the Mississippi River Gulf Outlet (MRGO) in 2009 has been observed to be hydrological changes in Lake Pontchartrain and Lake Borgne. Louisiana Department of Wildlife and Fisheries (LDWF) data shows a decrease in salinity in Lakes Pontchartrain and Borgne. There has also been the reduction in the frequency of occurrence of hypoxic zones in southern Lake Pontchartrain related to stratification of the water column caused by the introduction of large amounts of high salinity Gulf water through the MRGO. The effect of these hydrologic changes on mobile estuarine fish species appears to be within the range of prior observation, as recreational and commercial landings of finfish, shrimp and blue crab before and after closure of the MRGO appear to display similar patterns, with annual variability. The lower salinities in Lake Borgne post MRGO-closure resulted in reduction and loss of oyster populations in the area. It is noted that analysis of the effects of the MRGO closure is limited by the data available since the closure. This timeframe may not allow for collection of sufficient amounts of data to draw long-term conclusions about some fisheries populations in the area given the hydrological and weather events that have occurred in the recent past, as well as those variations associated with LDWF sampling (random selection and protocol changes). Annual availability, size of individuals, and size of populations can be highly dependent upon weather patterns, individual year class strength, major environmental events (storms, floods, and droughts), and prevailing hydrological conditions. There have been several severe weather and hydrological events in the areas of Lake Borgne and Lake Pontchartrain such as flooding (1997, 2008, 2011, 2016, and 2018), droughts, storms (Katrina, Rita, Gustav, Ike, Isaac, Nate and Gordon), and cold winters (2009, 2010, 2011, 2017, and 2018) that have influenced annual availability of some fisheries populations.

The following contains a brief overview of LDWF finfish, crab, shrimp, and oyster populations and hydrologic data collected during that sampling.

HYDROLOGY

Along with the closure of the MRGO by the addition of a rock dam at the Bayou la Loutre Ridge in 2009, several modifications have occurred within the Pontchartrain Basin which could potentially impact the hydrology in the area around the MRGO Channel (Figure 1). A more detailed graphic of the rock dam is provided in Figure 2. A storm surge protection wall at Bayou Bienvenue was constructed from 2008 to 2013 (Figure 3). This structure has the ability to restrict water flow from the MRGO, Gulf Intracoastal Waterway (ICWW), and Lake Borgne into the New Orleans Inner Harbor Navigation Canal (IHNC) and Lake Pontchartrain. The Surge Barrier Wall extends from just east of the Michoud Canal on the north bank of the ICWW to just south of the flood gate on Bayou Bienvenue on the west bank of the MRGO Channel. The IHNC Seabrook Floodgate structure (Figure 4) was built from 2010 to 2012. The floodgates have the potential to restrict water exchange between Lake Pontchartrain and the IHNC. The Violet Siphon was installed in 1979 with a capacity to deliver 500 cubic feet per

second (cfs) of Mississippi River water into the system. It was intended to introduce fresh water into the central marsh area of St. Bernard Parish, which was negatively impacted by salt water intrusion from the MRGO. The Siphon is not currently operating, but operated until about 2012. These additional features complicate the evaluation of the impact of the MRGO rock dam alone, as other factors may contribute to some of the observed changes. Figure 1 shows locations of the four LDWF sampling stations associated with hydrology analysis, as well as the water bodies and water control structures referenced in this report.



Figure 1. Location of MRGO rock wall and other recent hydrology-related structures in vicinity (black-centered dots with red labels) and LDWF sampling stations (stars with yellow labels).



Figure 2. MRGO rock dam.



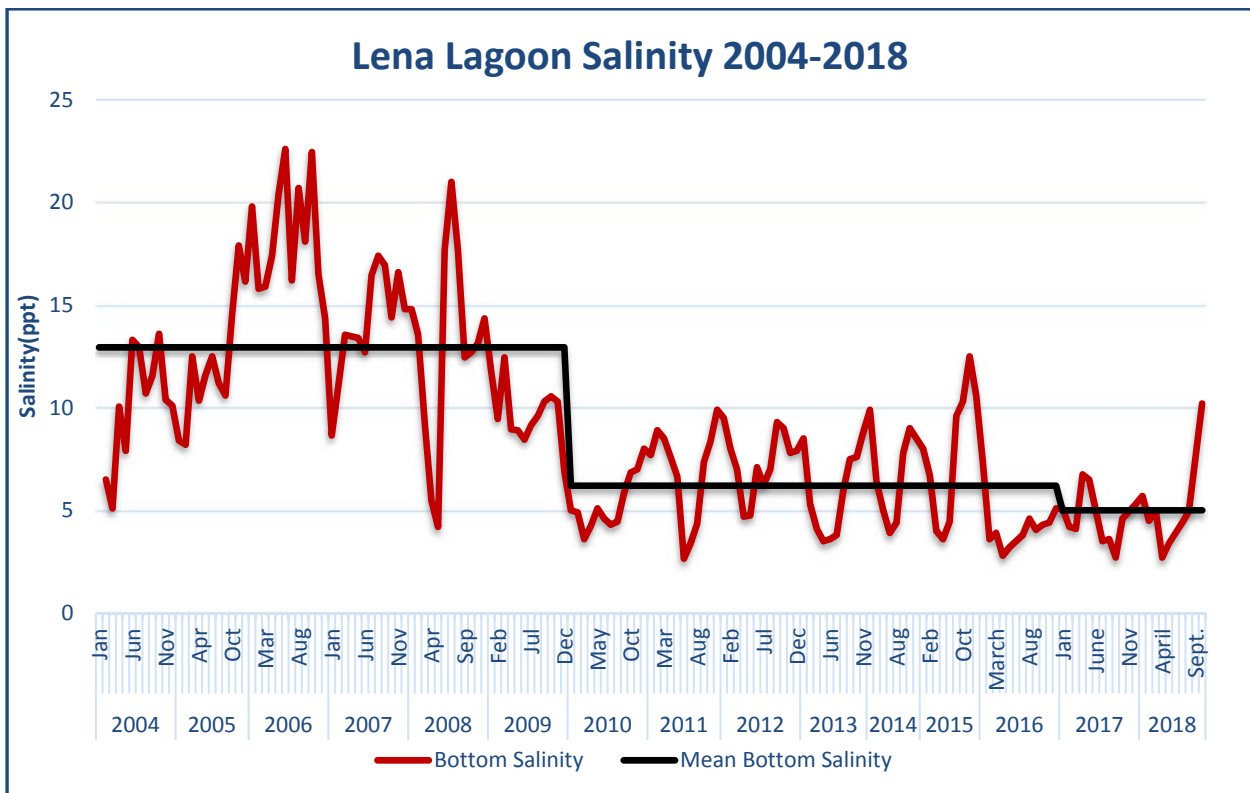
Figure 3. Storm surge protection wall at Bayou Bienvenue.

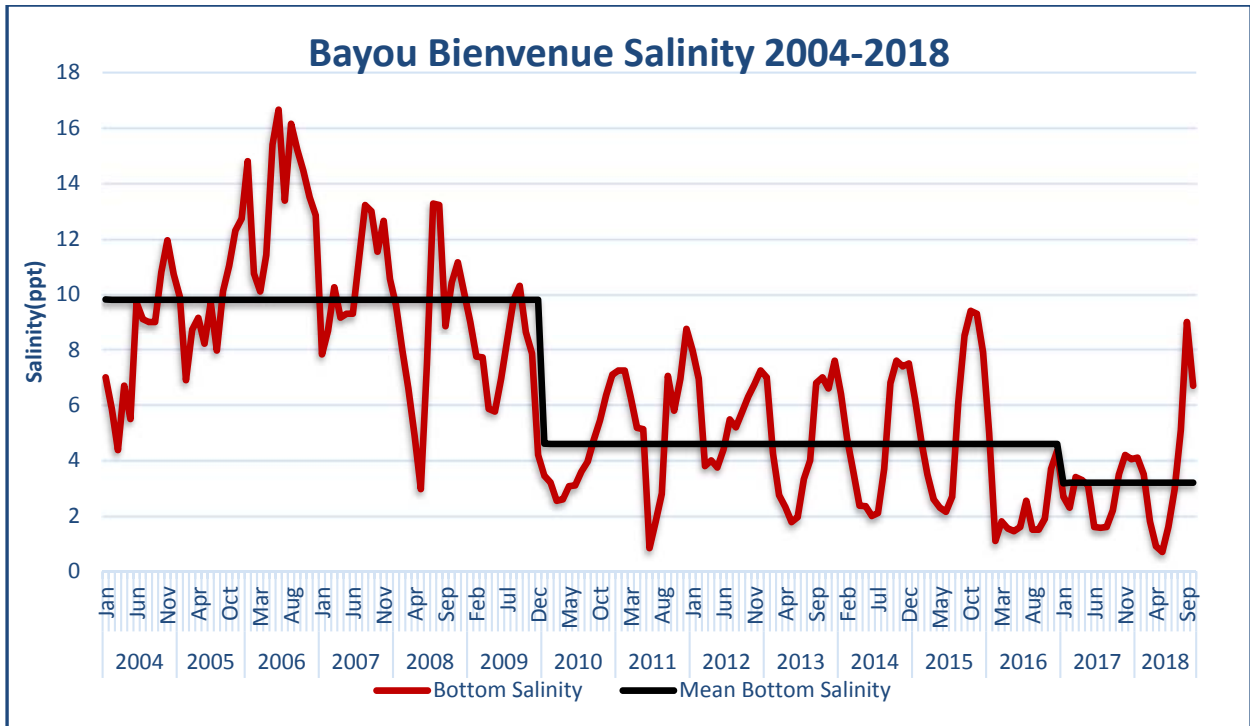


Figure 4. Inner Harbor IHNC Seabrook Floodgate structure.

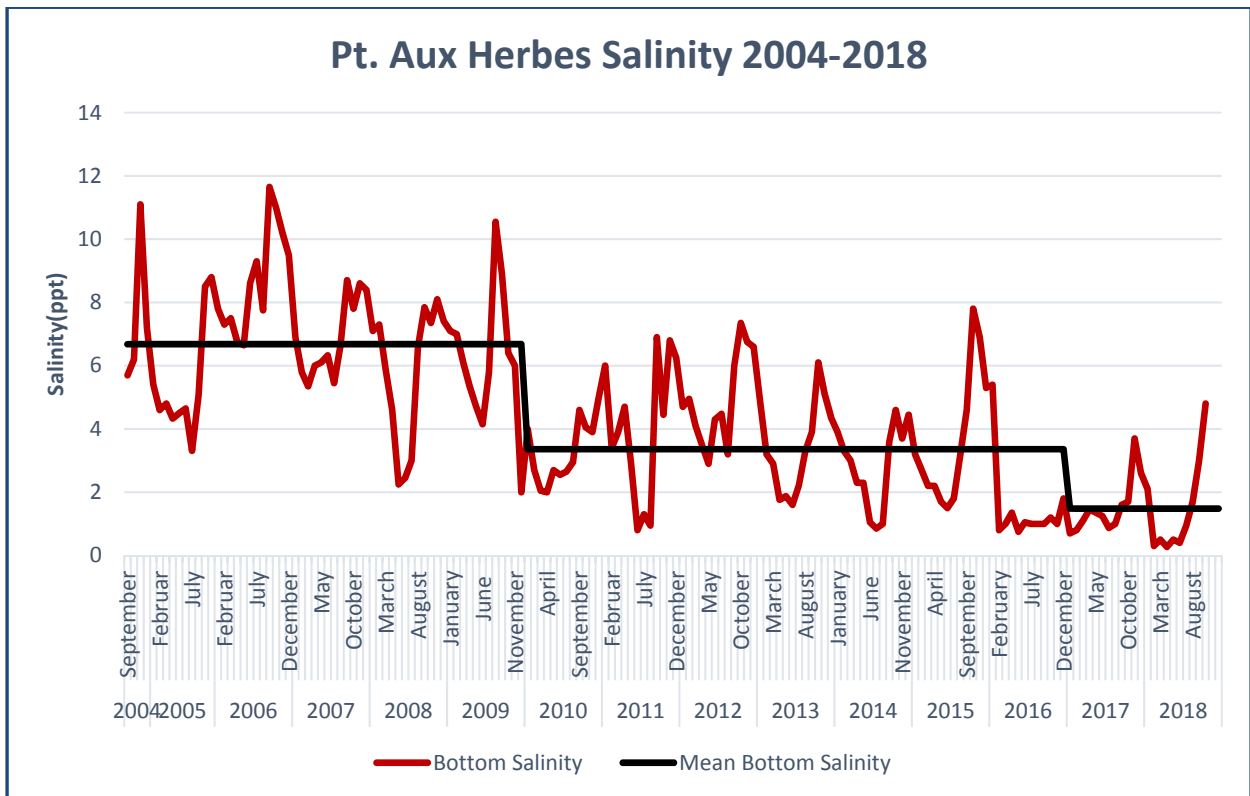
The most obvious result of the closure of the MRGO in 2009 (as well as the other hydrologic modifications described above) has been a decrease in observed salinity in Lake Pontchartrain and Lake Borgne. The graphs below show the observed salinity (approximately one foot from the water bottom) at two LDWF sampling sites near Lake Borgne from the years 2004 through 2018, five years prior to the MRGO closure to nine years after. The two most recent years' data, 2017-2018, are shown separate of the previous seven years in an effort to illustrate recent trends. The Lena Lagoon station is located near the southeast portion of Lake Borgne and is just west of the MRGO rock dam (Figure 1). Bayou Bienvenue is on the western edge of Lake Borgne (Figure 1). Salinities observed at Lena Lagoon ranged from 4.2 parts per thousand (ppt) to 22.6 ppt, with an average of 12.9 ppt in the five years prior to the MRGO closure. In the

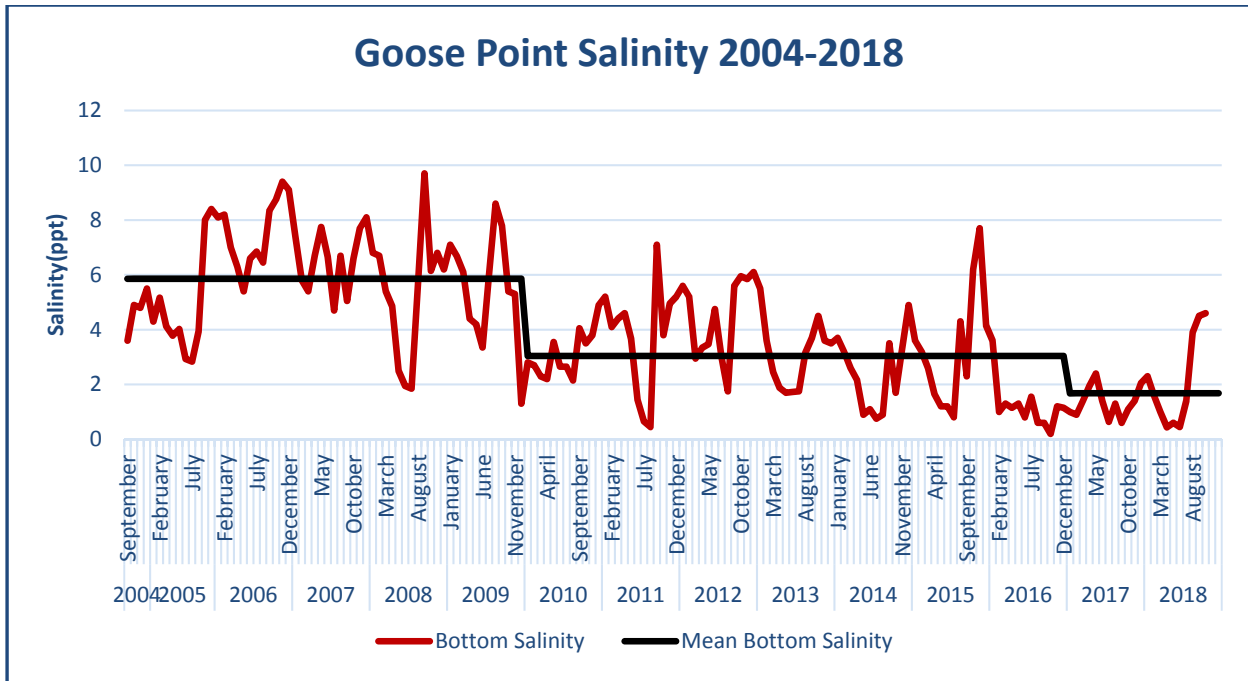
seven years following the closure, salinities at this site ranged from 2.7 ppt to 12.5 ppt and averaged 6.2 ppt. During the two most recent sampling years, observed salinities ranged from 2.7 ppt to 10.2 ppt, with an average of 5.0 ppt across that period. Similar observations were made at the Bayou Bienvenue station where pre-closure salinities ranged from 3.0 ppt to 16.7 ppt and averaged 9.8 ppt. Salinities measured post-closure ranged from 0.8 ppt to 9.4 ppt and averaged 5.0 ppt. A trend of increased freshening was seen at the Bayou Bienvenue station during the 2017-2018 sampling events, where the recorded salinities ranged from 0.7 ppt to 9.0 ppt and averaged 3.2 ppt. It should be noted that LDWF observations of salinity are discreet measurements taken during monthly or bi-monthly sampling events and are not monitored using constant recorders.





Similar trends have been observed within Lake Pontchartrain, as shown from Point-Aux-Herbes and Goose Point sampling stations (Figure 1) in the two graphs below.





The USACE (2012) documented spring and summer hypoxia events had been documented on the south shore of Lake Pontchartrain since 1978 and up to the closure of the MRGO. After the closure, no such large scale and persistent hypoxia events have been documented. Regrettably, LDWF data from within Lake Pontchartrain does not effectively address Dissolved Oxygen (DO) levels, as regularly recorded DO observations did not begin until 2010. There have been numerous occurrences of hypoxic conditions in Lake Pontchartrain, Lake Borgne and the MRGO investigated by LDWF since 2009. It was observed that, unlike the persistent events described in USACE (2012), these occurrences in Lake Pontchartrain were short-lived and generally came as a result of environmental conditions, such as extreme water temperatures or heavy rain events where run-off from surrounding communities was funneled into the Lake. Others were found to be anthropogenic, such as levee construction or shoreline restoration projects. In Lake Borgne and within the channel of the MRGO, low dissolved oxygen occurrences are often associated with stratification of the water column.

As we have observed, the hydrological impacts of the Mississippi River Gulf Outlet, both during its operation and after its closure have been far-reaching. Many studies, experiments, surveys, and field observations have been conducted that can be used to track these impacts. Now the question is asked, “What would the impacts be, if a portion of the MRGO Channel were re-opened?” More specifically, “if a section of the rock dam placed at the Bayou la Loutre Ridge in 2009 had a 100 feet wide and 15 feet deep gap placed in it.” Interestingly, in February 2006, The Lake Pontchartrain Basin Foundation et al. (LPBF), in its ‘Comprehensive Habitat Management Plan For The Pontchartrain Basin’, addressed the need for re-building the ridge at Bayou la Loutre, and recommended a partial closure of the MRGO. This recommendation was for a remaining channel 125 feet wide and 12 feet deep, which was similar to the Intracoastal

Waterway channel. LPBF cites U. S. Army Corps of Engineers modeling by Tate et al. in 2002 that made predictions in salinity change and velocity of flow through different widths and depths of channels. It should be taken into account that at the time of these observations and modeling, the surge barrier wall constructed at Bayou Bienvenue did not exist. We can; however, presume that any breach of the rock dam at the Bayou la Loutre Ridge will allow for an increase in salinity in surrounding waterways. These increases would likely be more evident in the marsh both north and south of the MRGO Channel and in eastern Lake Borgne. Lake Pontchartrain may see only minimal salinity change, which would primarily be along the south shore. With regard to dissolved oxygen and hypoxia, Swarzenski and Mize (2014) of the U. S. Geological Survey, documented the creation of a hypoxic zone in the remains of the MRGO Channel on the eastern side of the rock dam at the Bayou la Loutre Ridge. The presumption was that the hypoxia was the result of water flow being cut off at the dam and stratification of the water column within the channel. A partial opening of the rock dam could restore tidal movement of water through the channel and decrease, at least to some degree, the factors which cause this hypoxic zone. Another hydrological factor to be considered with a partial opening of the MRGO Channel would be the rate of flow through the opening and the potential for scouring as a result. Any structure put in place would require very careful planning and regular monitoring and maintenance.

When considering the hydrology of the area surrounding the MRGO Channel and the Bayou la Loutre Ridge rock dam, it would be necessary to take into account other structures that are in place. The Violet Canal Siphon, when operational, likely had an important contribution to the fresh river water input into this system. There would need to be an understanding of how the storm surge protection wall at Bayou Bienvenue and the Inner Harbor Navigation Canal locks at Seabrook will affect how and at what rate higher salinity water through a modified rock dam might reach Lake Pontchartrain. Complete analysis of the impacts of these structures, as well as environmental factors like annual rainfall and tropical storm events, although very important, lies outside the scope of this report.

FINFISH

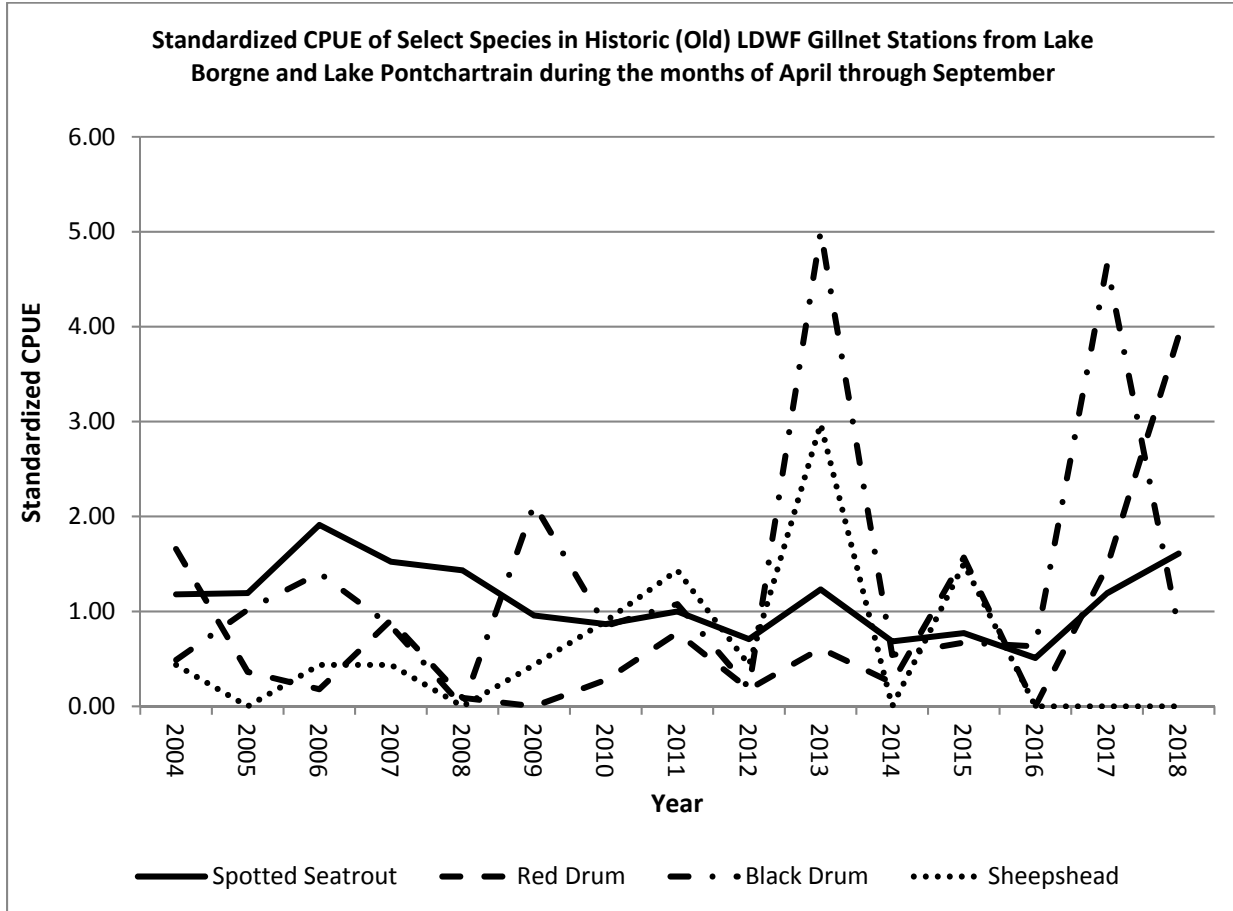
The following is an example relative to spotted seatrout. A colder winter in the estuary may lead to fewer juvenile spotted seatrout surviving into the next summer which may decrease availability of fish in the following years after that particular year class. While this may not have overall impacts on the status of the spotted seatrout population statewide, it can lead to fewer trout being available locally or basin wide. Conversely, when there is a highly successful year class of spotted seatrout following a warmer winter, trout availability can increase locally and can potentially lead to larger trout becoming available several years after a large year class. Examples of this are seen in the spotted seatrout catches of the early 2000s and for several years following Hurricane Katrina. Since most spotted seatrout do not survive beyond the age of 3 or 4, a larger more successful year class may allow for slightly more fish that are able to survive to “trophy” size. After this year class moves through the fishery, there may be a perceived decrease in larger trout until a few years after another highly successful year

class. The current management regime in Louisiana allows for harvest of the maximum number of spotted seatrout while sustaining the population, not necessarily for larger trout. Spotted seatrout tolerate a wide range of salinities. Spawning aggregations of spotted seatrout in Louisiana have been documented in salinities between 7 to 26 ppt. However, successful spawning occurs primarily in salinities at or above 15 ppt, with the majority of spawning likely occurring between 16 to 21 ppt during the warmer months of April through September (Saucier and Baltz 1993). Changes in salinity will influence the seasonal migration patterns of some species of fish, including spotted seatrout. Spotted seatrout will generally seek out higher salinity waters in the warmer months and lower salinity waters in the cooler months. A change in basin hydrography, which more closely reflects previous historic salinity regimes, will influence finfish distributions and they should more closely reflect distributions similar to those during historic salinity regimes.

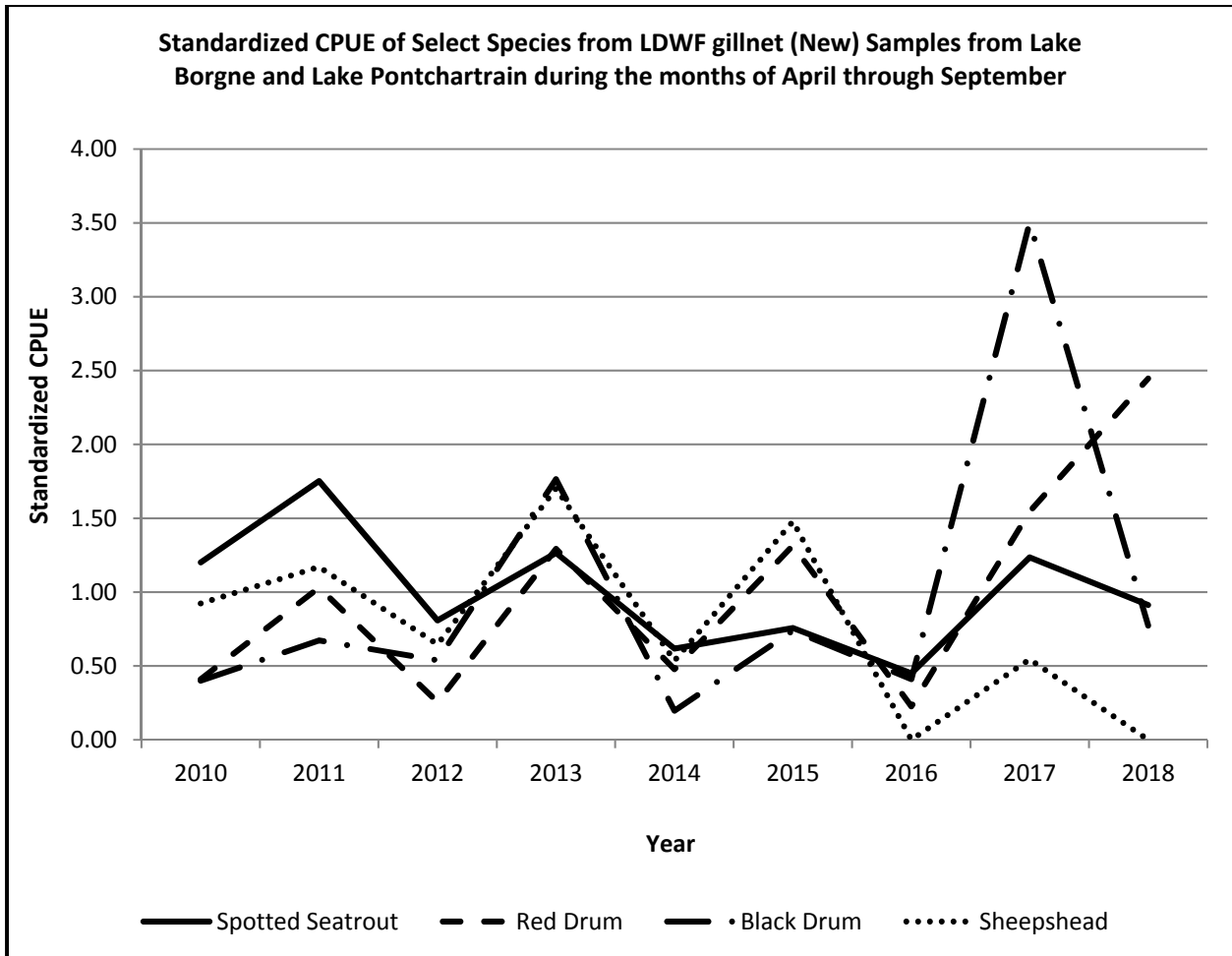
Commercial catches of finfish can display this same amount of variability depending on year class strength and local availability of the species sought. In Lakes Pontchartrain and Borgne, commercial catches of finfish appear to be highly dependent upon the number of trips taken by a relatively stable number of harvesters.

LDWF currently manages species at the statewide level. Recent changes in fishery-independent and fishery-dependent sampling are intended to eventually achieve basin level information for management of marine finfish; however this is not possible yet. Several more years of data are required to ascertain the ability to manage finfish species effectively at the basin level and any such basin level data should be viewed with an appropriate degree of uncertainty at this time in relation to perceived patterns in these data.

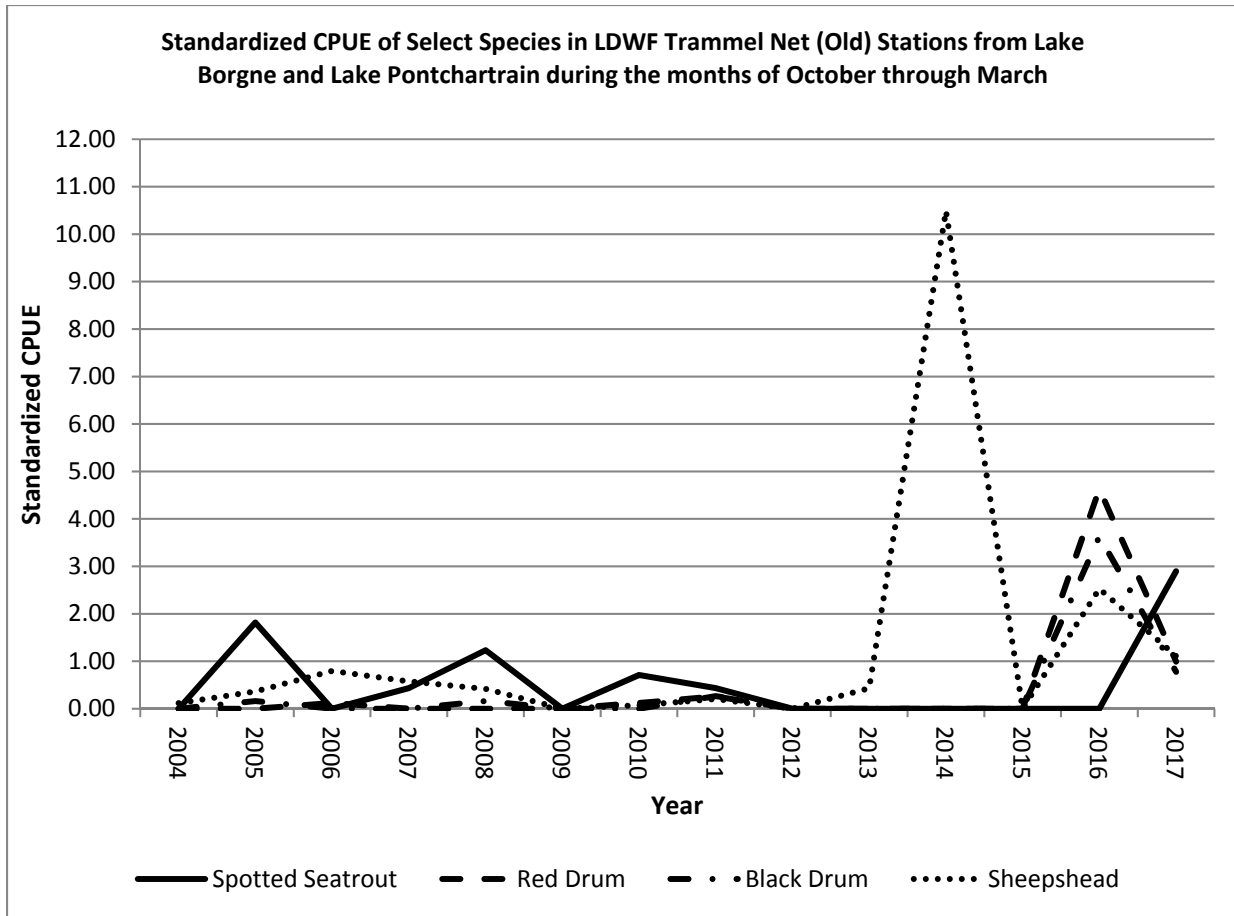
Fishery Independent Finfish Data



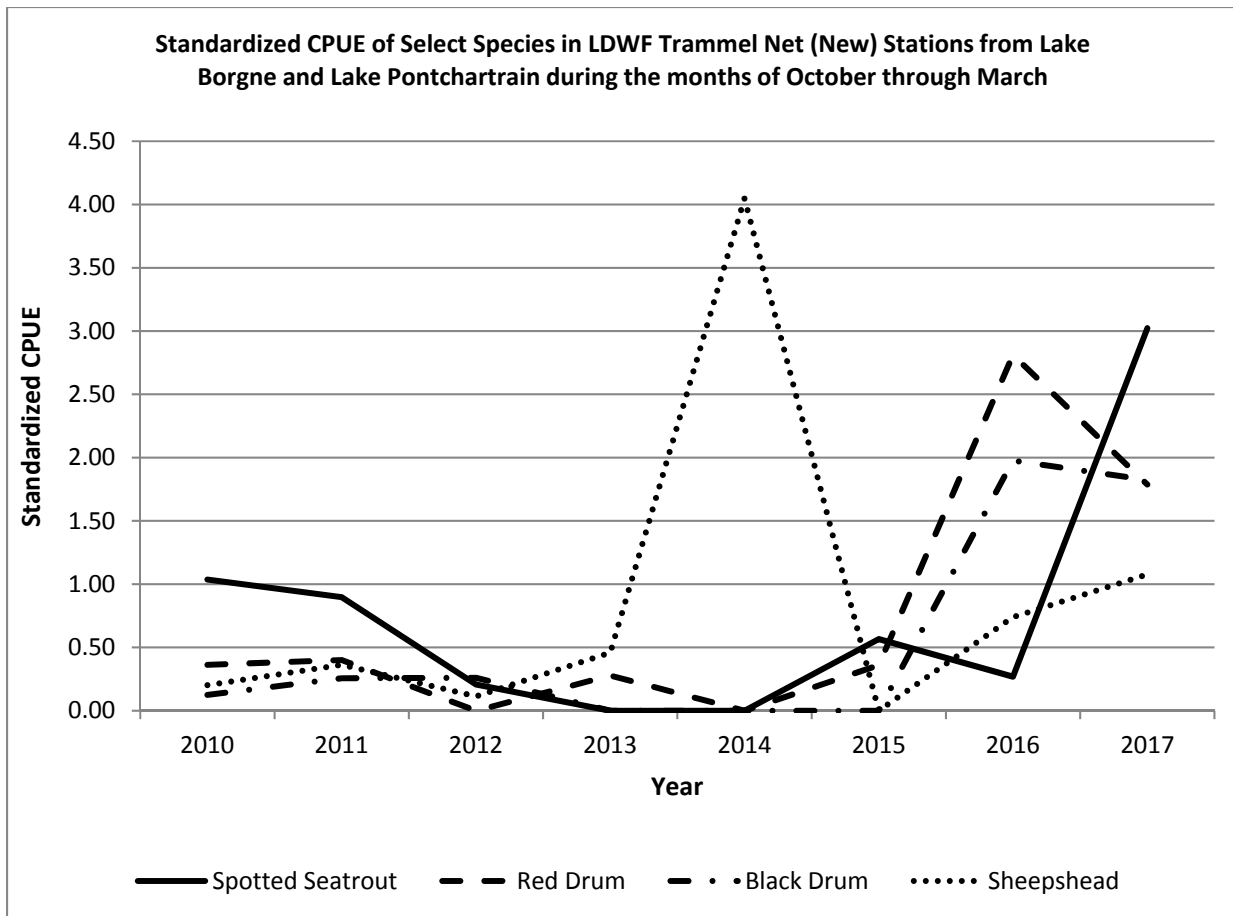
The above graph shows standardized CPUE data from LDWF gillnet samples at older historic stations in the Lakes Pontchartrain and Borgne area from 2004 through 2018. A CPUE of 1 is considered “average”. LDWF sampling protocols changed in 2010 and in 2013. These changes could manifest in the data. Sampling frequency of sites became randomized in 2013 and all sites are not sampled in all months. New sampling protocols may not be in place long enough to provide sufficient basin level data as these populations of finfish are currently still managed at a statewide level. While there is a slight decline in the standardized CPUE of spotted seatrout through 2016, an increase is noted in the most recent years. This decline was expected as the highly successful year classes of fish after Hurricane Katrina moved through the system. As those “Katrina” and subsequent larger year classes of trout moved out of the fishery by natural and fishing mortality, LDWF expected fewer fish to be available. Recent CPUEs of spotted seatrout may indicate more availability. It should be noted that the recent cold weather that lead to freezes in late 2017 and early 2018 may not yet be influencing those data presented above. Freeze events not only produce initial mortality events, but also contribute to higher incidences of secondary infections that can kill fish, which were already stressed due to cold water, sometimes weeks to months after a freeze event.



The above graph shows standardized CPUE data from LDWF gillnet samples at newer stations in the Lakes Pontchartrain and Borgne area from 2010 through 2018. A CPUE of 1 is considered “average”. LDWF sampling protocols changed in 2010 and 2013. Sampling frequency of sites became randomized in 2013 so all sites are not sampled in all months. New sampling protocols may not be in place long enough to provide sufficient basin level data as these populations of finfish are currently still managed at a statewide level, especially with these much newer sampling sites. There are increases noted in spotted seatrout, red drum, and black drum CPUEs after 2016, while sheepshead declined in recent years.



The above graph shows standardized CPUE data from the single old LDWF trammel net sample station located in Lena Lagoon from 2004 through 2017 (note the 2017 sampling year contains trammel net samples conducted from January of 2017 through March of 2018 as trammel net sampling spans an October through March time period over adjacent years). While the Lena Lagoon station may not have been sampled each month during the entire six-month trammel net sampling period each year after the 2013 changes to sampling protocols, increases in CPUEs can be noted in the most recent years.

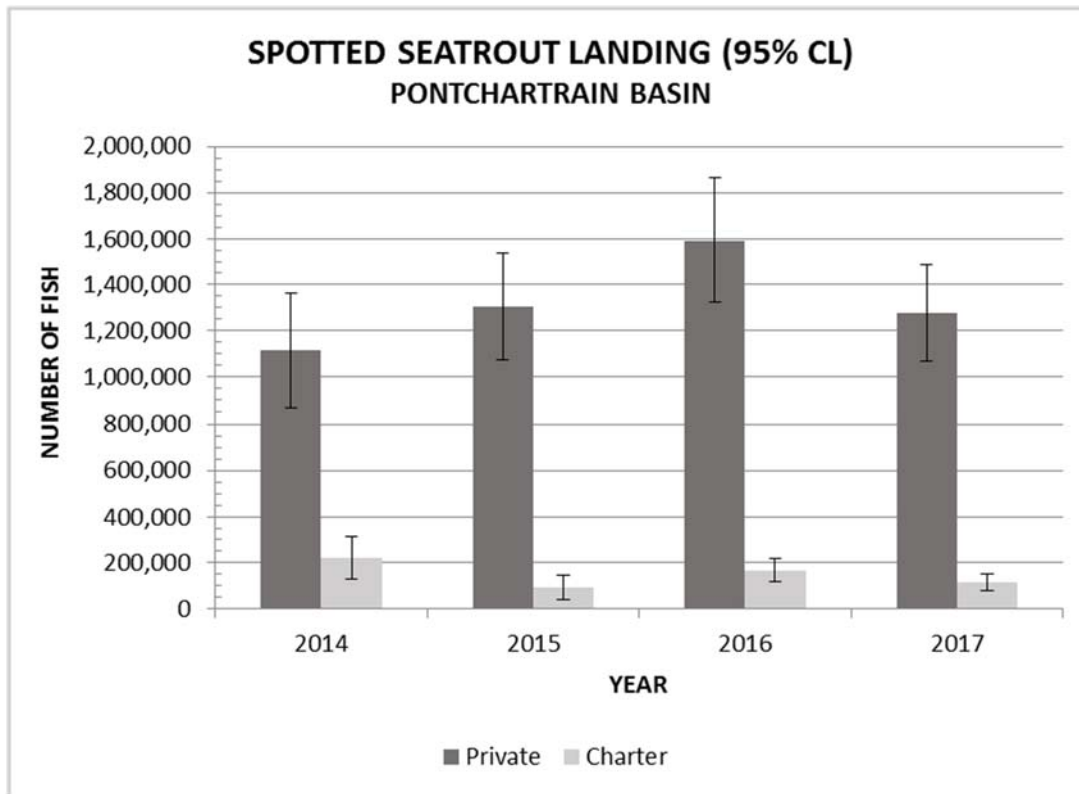


The above graph shows standardized CPUE data from LDWF trammel net samples at newer stations in the Lakes Pontchartrain and Borgne area from 2010 through 2017 (note the 2017 sampling year contains trammel net samples conducted from January of 2017 through March of 2018 as trammel net sampling spans an October through March time period over adjacent years). While sample locations may not have been sampled each month during the entire six-month trammel net period of each year after the 2013 changes to sampling protocols, increases in CPUEs can be noted in the most recent years.

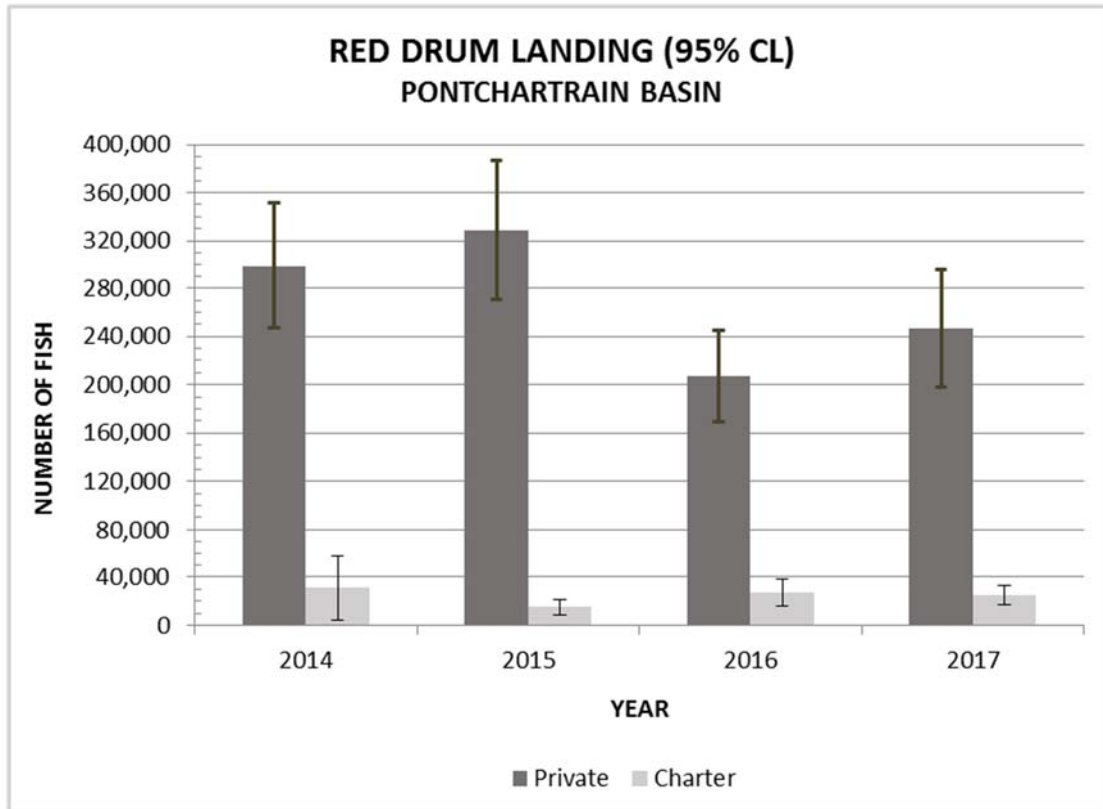
Recreational Finfish Data

Basin level recreational landings estimates are only available from 2014 through present from the La Creel survey program. Prior estimates through the federal Marine Recreational Information Program (MRIP) were only available at a statewide level and can be accessed at <https://www.st.nmfs.noaa.gov/recreational-fisheries/data-and-documentation/queries/index>. Please note that MRIP estimates are not directly comparable to La Creel estimates, as the two surveys have not been fully calibrated to each other. Estimates of recreational landings are presented below, for the Pontchartrain Basin, using La Creel data from 2014 through 2017. Recreational length data presented below are from LDWF biological sampling at recreational sites sampled from 2014 through 2017. Length data may or may not have been collected during a MRIP or La Creel assignment during the time period as biological sampling of

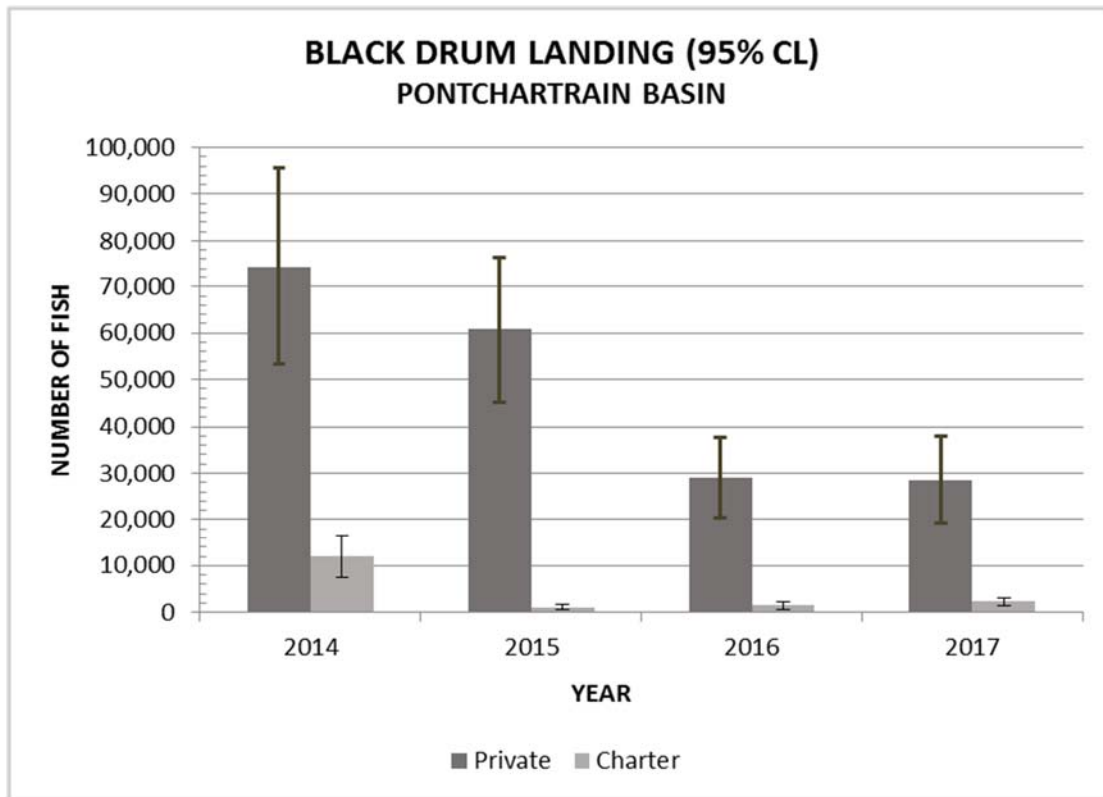
recreationally landed species can occur separate from dockside recreational harvest survey interviews.



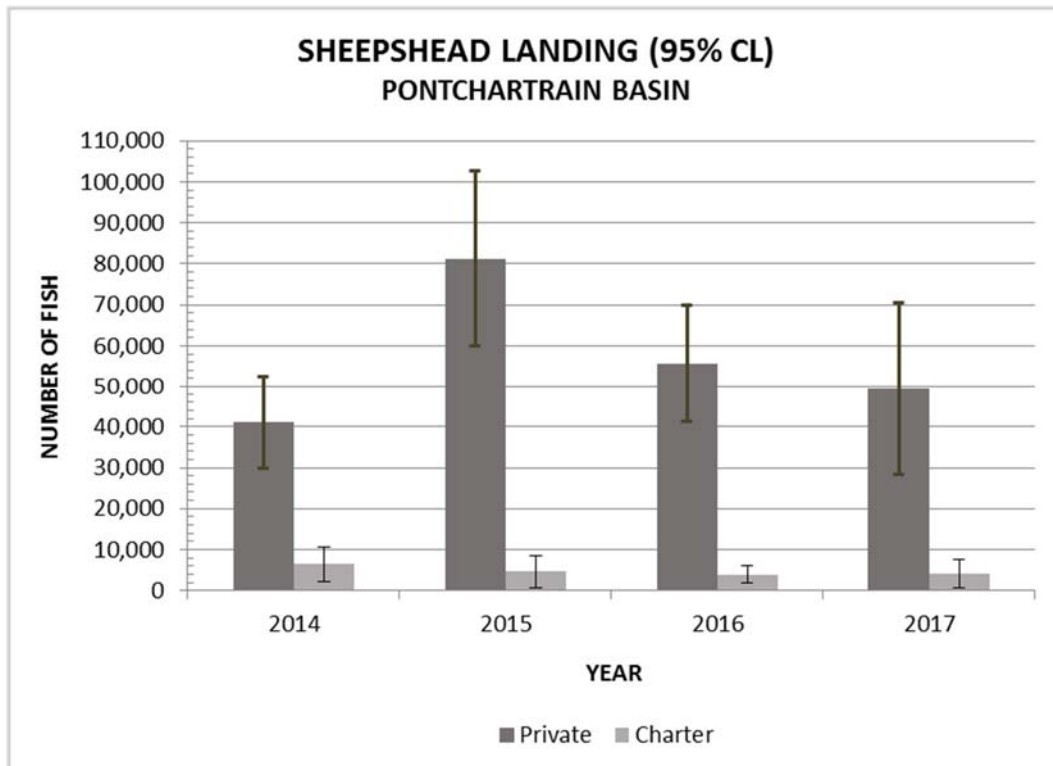
The above graphic depicts annual estimates of private and charter angler landings (in numbers of fish) of spotted seatrout, from the Pontchartrain Basin, for the years 2014 through 2017 with 95% confidence limits. Private angler landings increased annually through 2016, landings then dropped to levels similar to 2015 in 2017. Charter angler landings have varied more annually, with 2017 landings being lower than 2016 but higher than 2015.



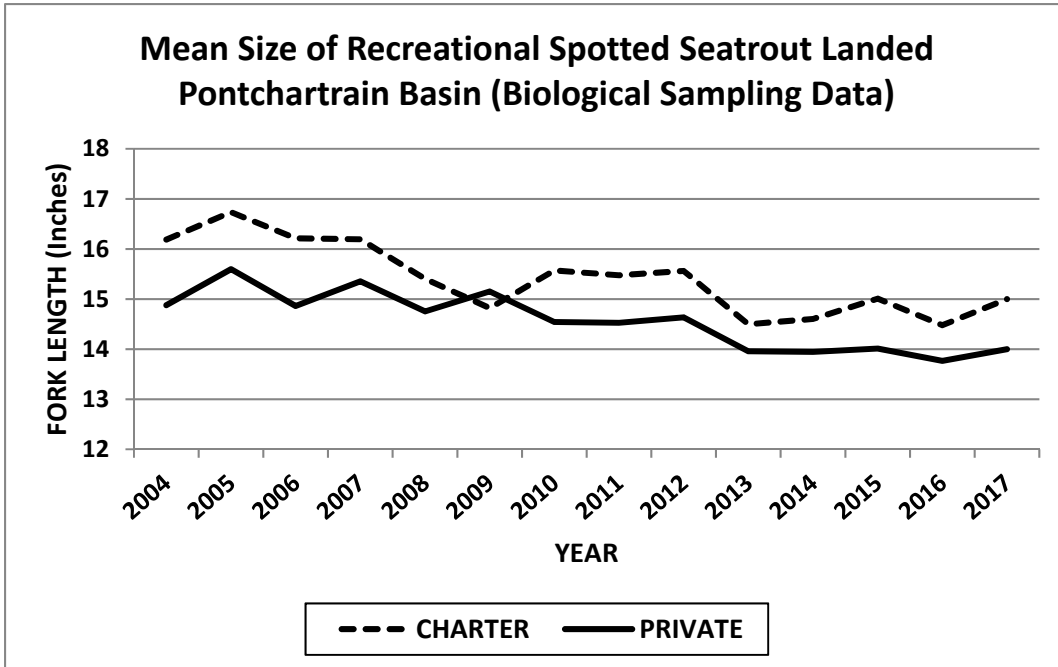
The above graphic depicts annual estimates of private and charter angler landings (in numbers of fish) of red drum, from the Pontchartrain Basin, for the years 2014 through 2017 with 95% confidence limits. Private angler landings have varied annually and increased from 2014 to 2015, then dropped in 2016, and increased in 2017 relative to 2016. Charter angler landings have remained more stable with the exception of lower values in 2015.



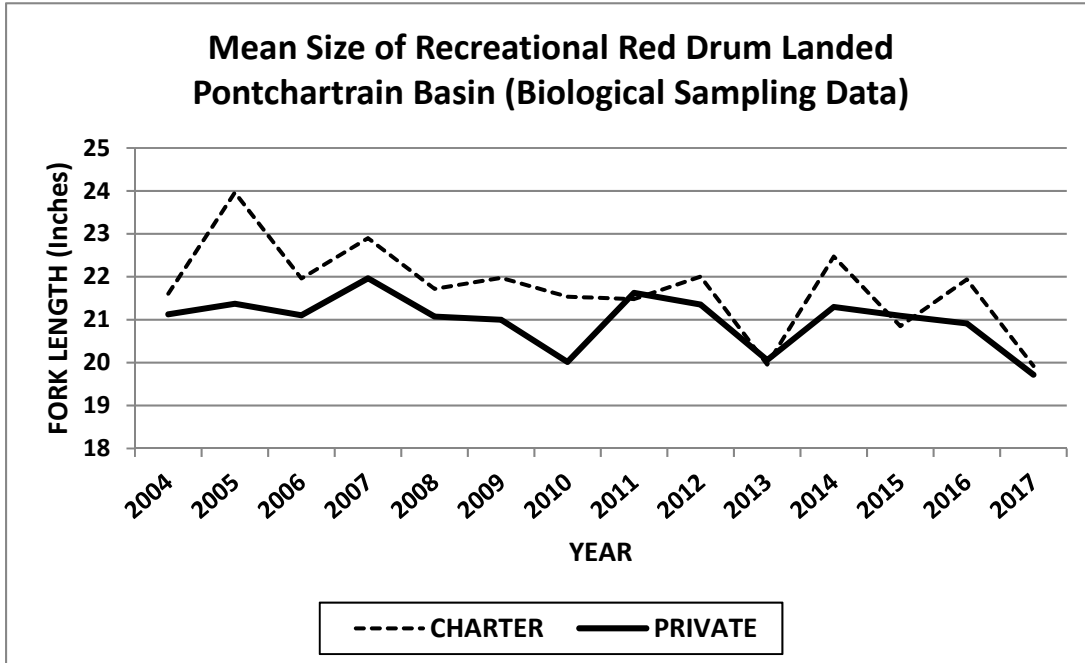
The above graphic depicts annual estimates of private and charter angler landings (in numbers of fish) of black drum, from the Pontchartrain Basin, for the years 2014 through 2017 with 95% confidence limits. Private angler landings have decreased each year from 2014 to 2017, with 2017 landings being only slightly lower than 2016. Charter angler landings have remained low during the three most recent years.



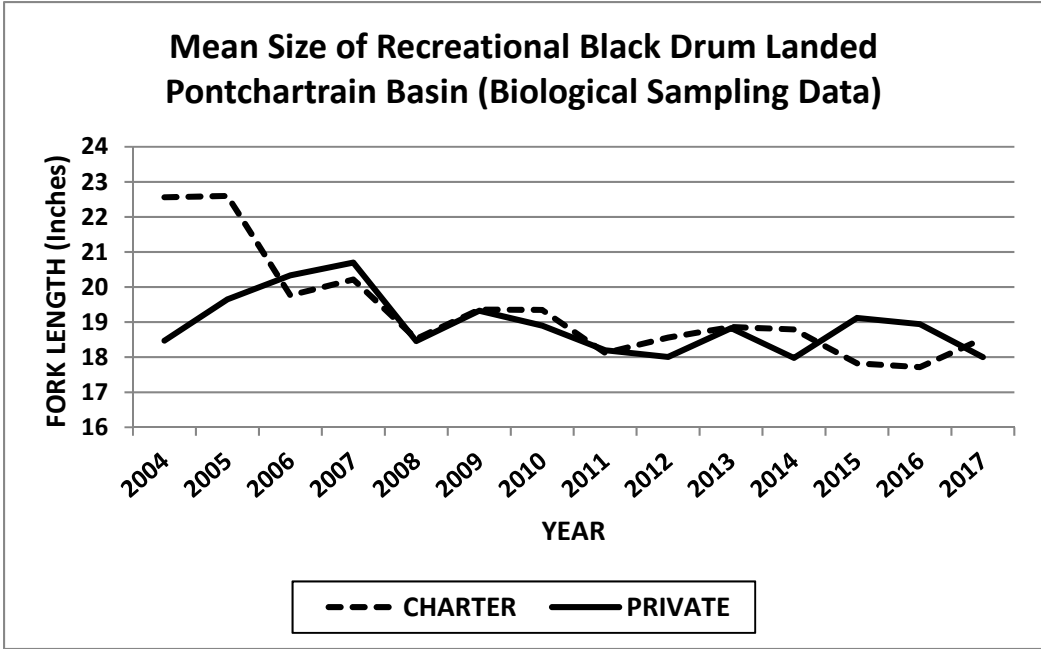
The above graphic depicts annual estimates of private and charter angler landings (in numbers of fish) of sheephead, from the Pontchartrain Basin, for the years 2014 through 2017 with 95% confidence limits. Private angler landings increased from 2014 to 2015, then decreased through 2017 to levels that were still above 2014. Charter angler landings have decreased from 2014 through 2016, with 2017 landings being similar to 2016.



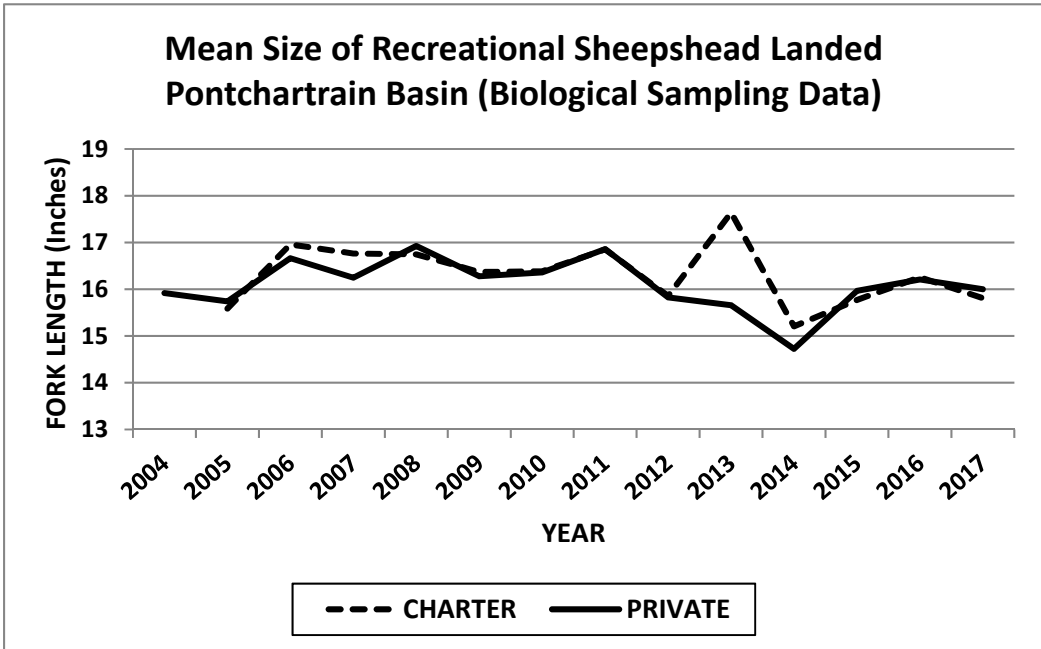
The above graphic illustrates mean size, in inches fork length, of spotted seatrout landed from the Pontchartrain Basin for 2004 through 2017 by private and charter anglers.



The above graphic illustrates mean size, in inches fork length, of red drum landed from the Pontchartrain Basin for 2004 through 2017 by private and charter anglers.

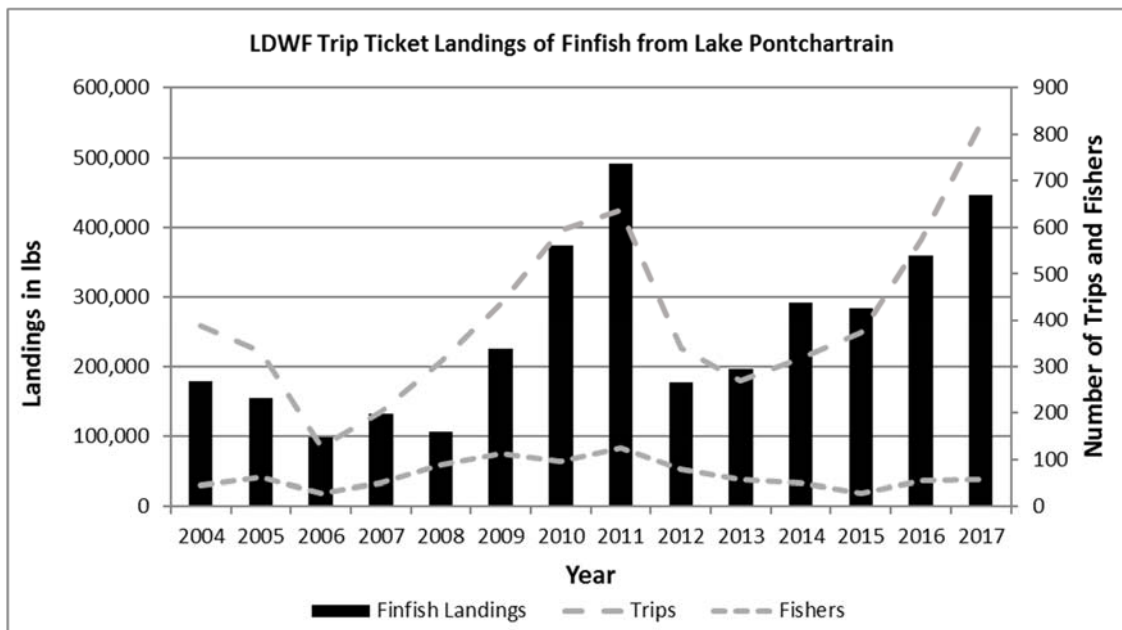
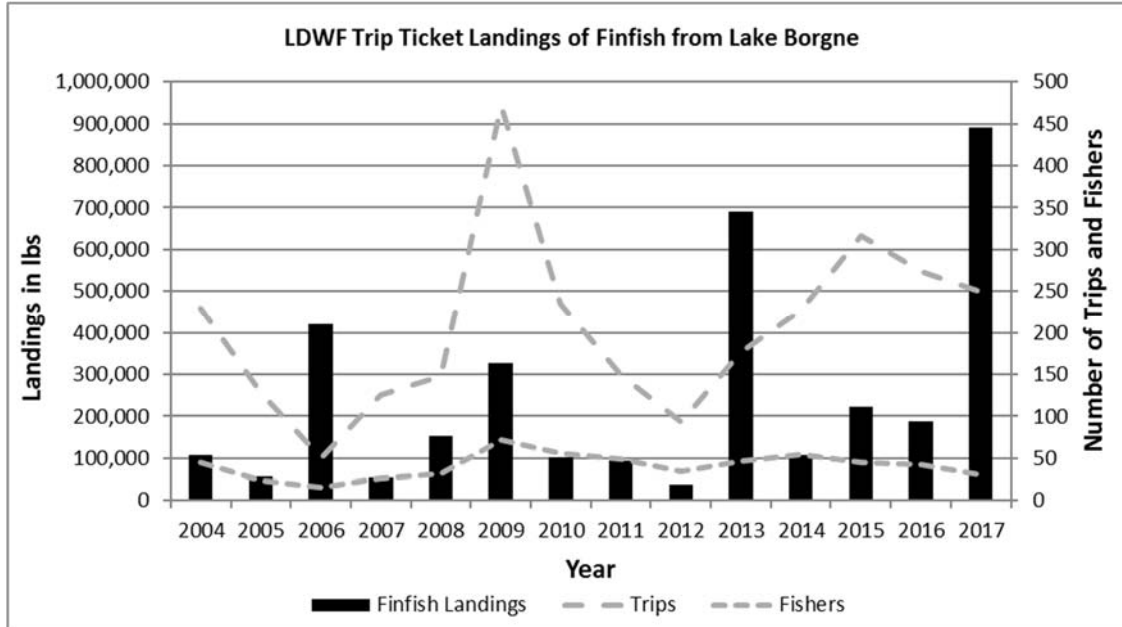


The above graphic illustrates mean size, in inches fork length, of black drum landed from the Pontchartrain Basin for 2004 through 2017 by private and charter anglers.



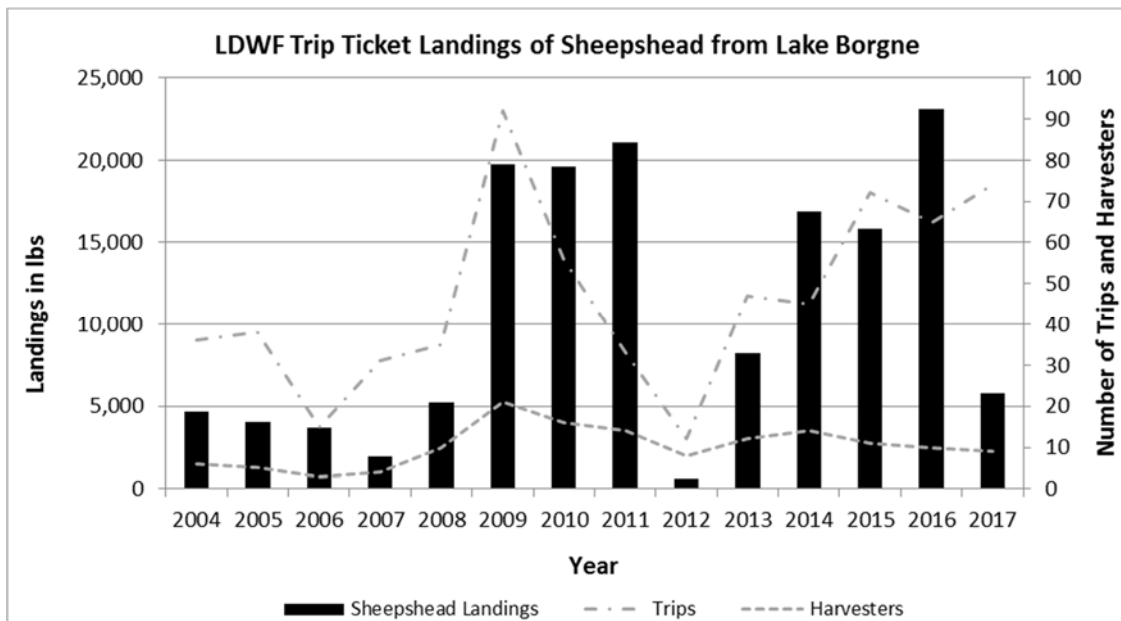
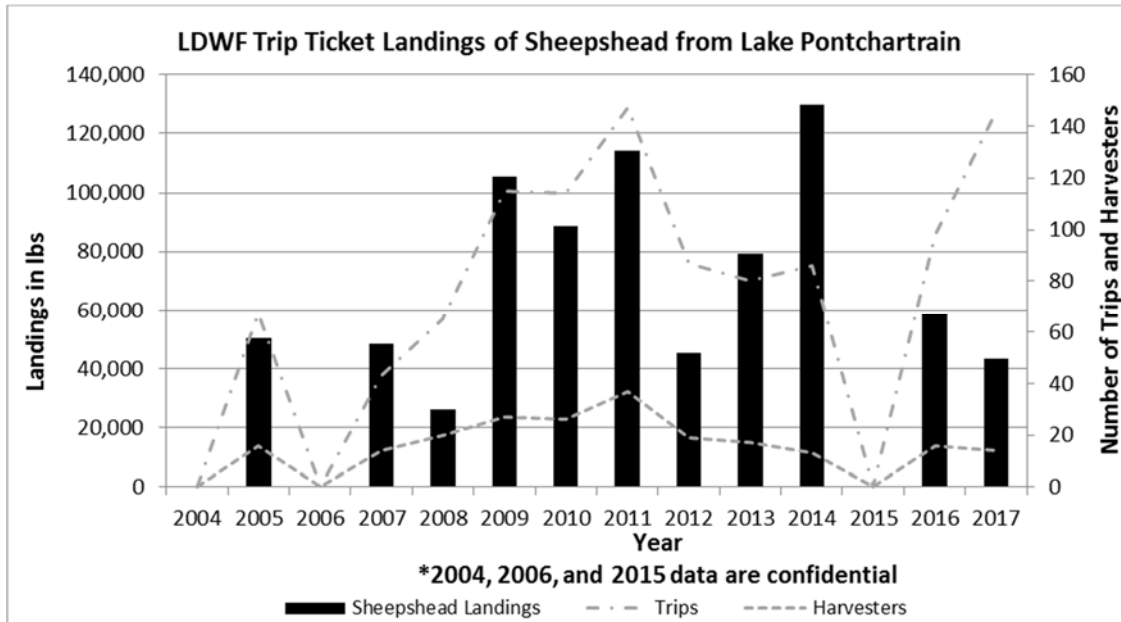
The above graphic illustrates mean size, in inches fork length, of sheepshead landed from the Pontchartrain Basin for 2004 through 2017 by private and charter anglers.

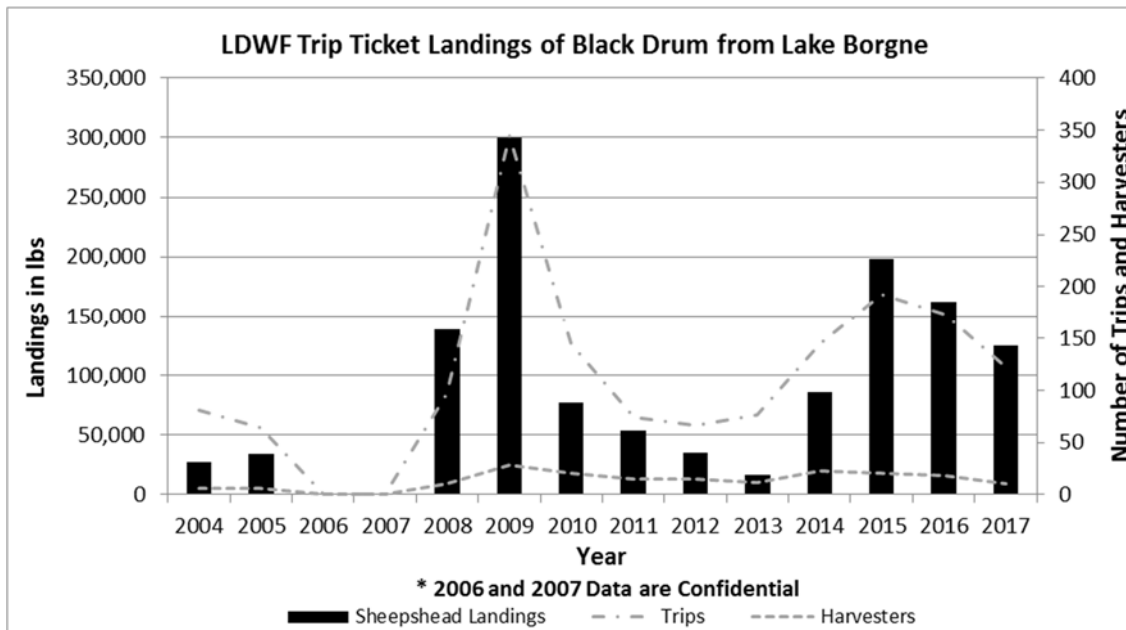
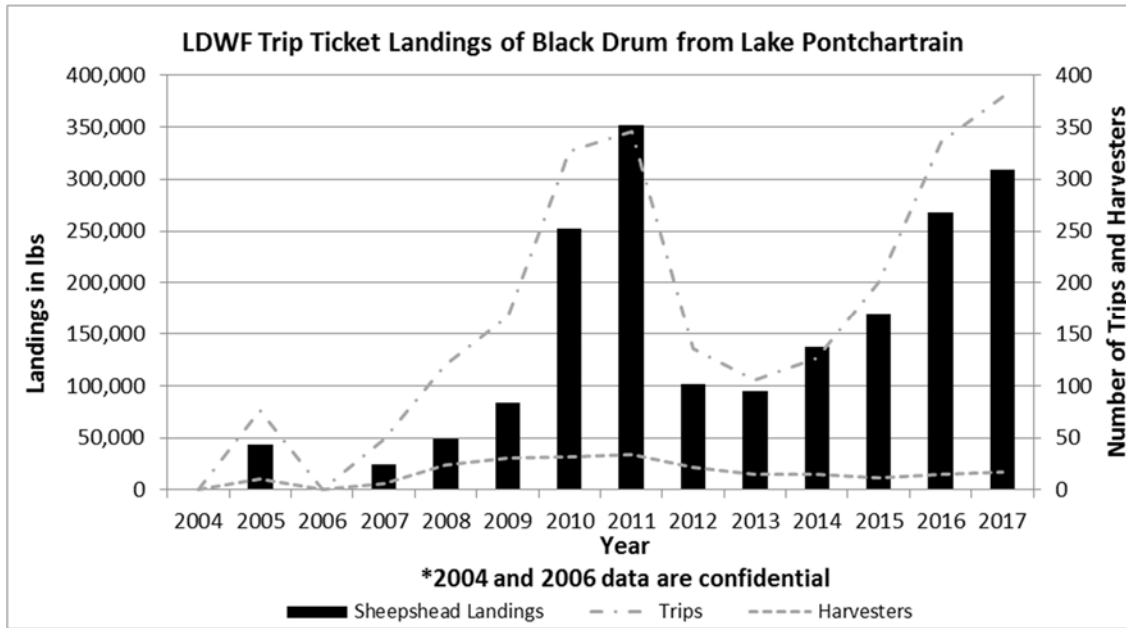
Commercial Finfish Data



The above graphs display landings of all commercial finfish (including freshwater species), annual trips, and number of unique commercial fishers for finfish landings from Lakes Pontchartrain and Borgne from 2004 through 2018. Landings appear to be greatly influenced by the number of trips taken while the number of unique harvesters landing catch has remained stable over time. This type of relationship would appear to indicate an effort pattern, not an environmental pattern.

Below are graphs of commercial landings of sheepshead and black drum from Lakes Pontchartrain and Borgne with the same data displayed. Patterns indicated in those graphs appear similar to those of all finfish, where the greater the number of trips being taken results in periods of greater landings while the number of harvesters remains relatively stable. This type of relationship would appear to indicate an effort pattern, not an environmental pattern.





CRUSTACEANS

White shrimp, brown shrimp and blue crab are all species that could be considered an annual crop. They are short lived and highly fecund. Similar to terrestrial crops, the availability and size of the population is highly dependent on environmental conditions. This dependence on favorable environmental conditions can lead to variability in population size from year to year.

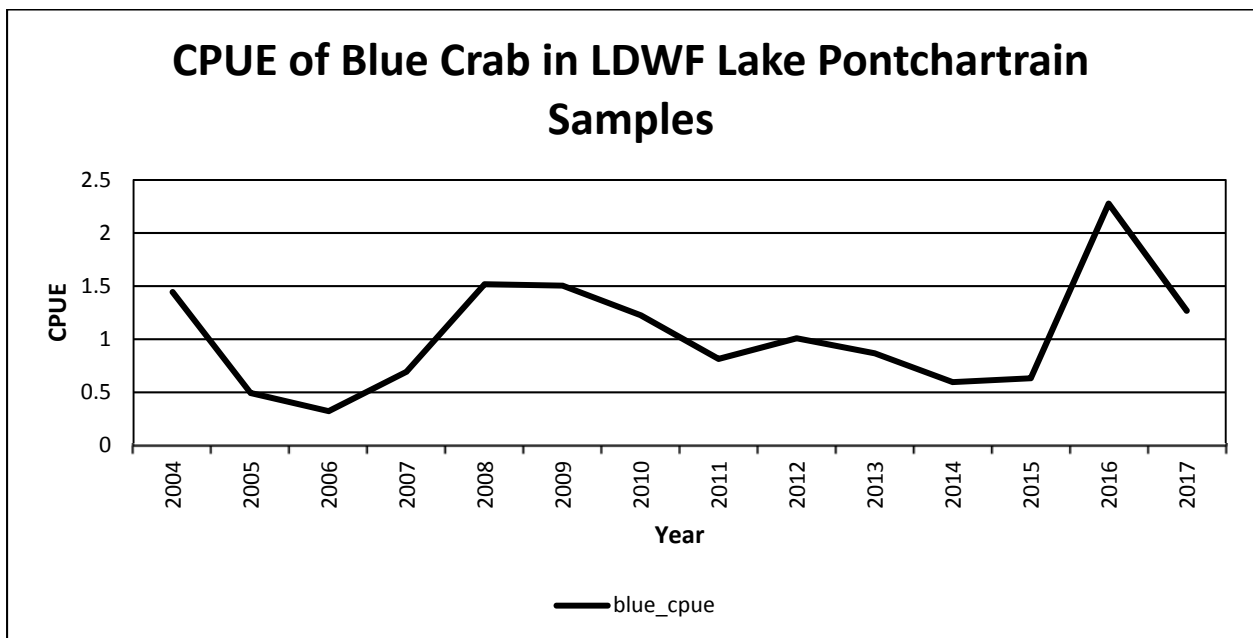
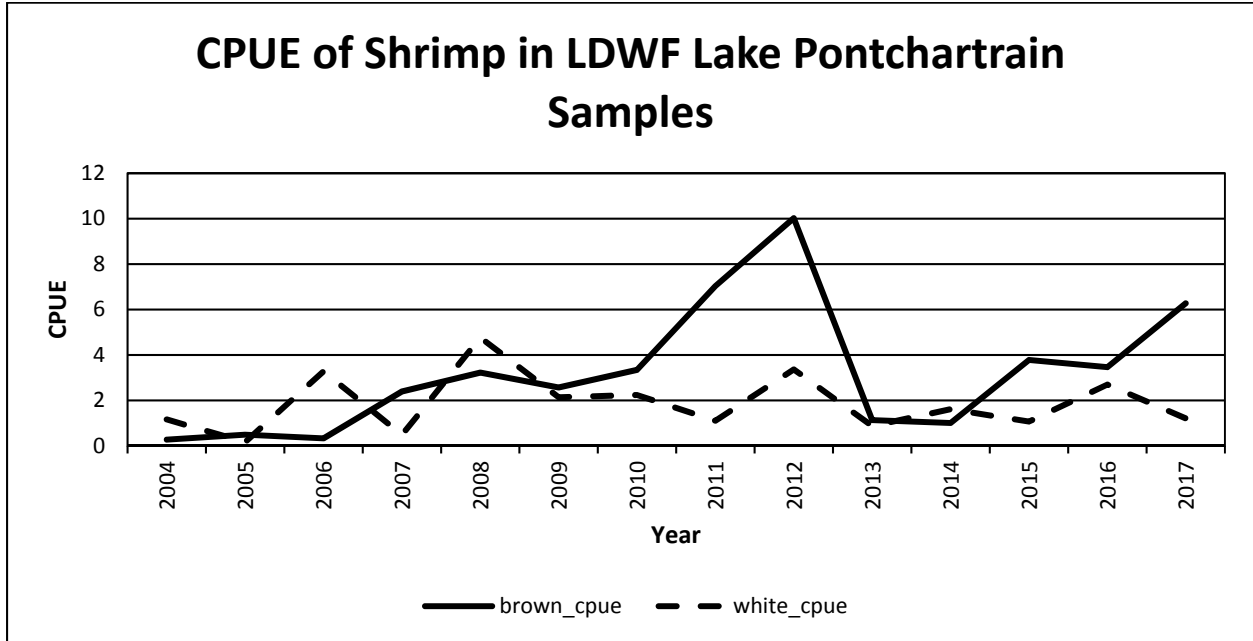
Examining the LDWF 16 foot trawl samples from Lake Pontchartrain, Catch per Unit Effort (CPUE) of brown shrimp fluctuates between 0.3 and 10.0 with the average CPUE from 2004 to 2017 being 3.2. White shrimp CPUE fluctuates between 0.1 and 4.7 for all years from 2004 to 2017, with a spike during 2008; the average CPUE during the fourteen year time frame is approximately 1.9. CPUE of blue crab varies between 0.3 and 2.2 for the fourteen year time series. Blue crab CPUE spiked during 2004, 2008, 2009, and 2016, while the average during the entire period was approximately 1.0.

Commercial landings (source LDWF trip tickets) of brown shrimp from 2004 to 2017 from both Lake Pontchartrain and Lake Borgne show the high annual variability of shrimp crops. In Lake Pontchartrain from 2004 to 2006, landings were very low. Then, landings increased from 2007 through 2010 and again in 2012. Landings began to decrease in 2013 and have since slightly risen. During the same time in Lake Borgne, brown shrimp landings averaged nearly the same as those in Lake Pontchartrain, 255,000 pounds and 274,000 pounds, respectively. Landings in Lake Borgne were highest in 2004 and 2014.

Commercial landings of white shrimp show the same variability that is seen in the brown shrimp. White shrimp landings were high in Lake Pontchartrain from 2008 to 2010. White shrimp landings in Lake Borgne have many ups and downs over the entire time period. Brown and white shrimp landings do show a trend when comparing them to the number of trips taken in each basin. In most cases, when the landings of shrimp in a certain year are high so are the number of trips taken for the same year.

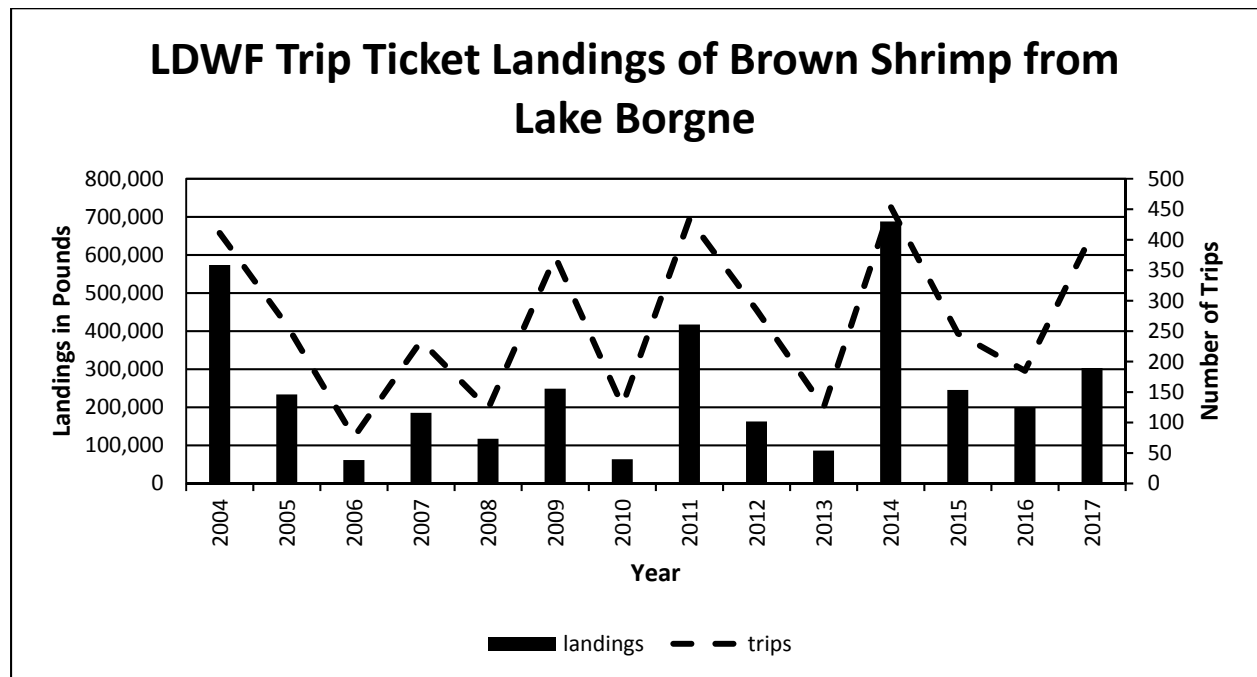
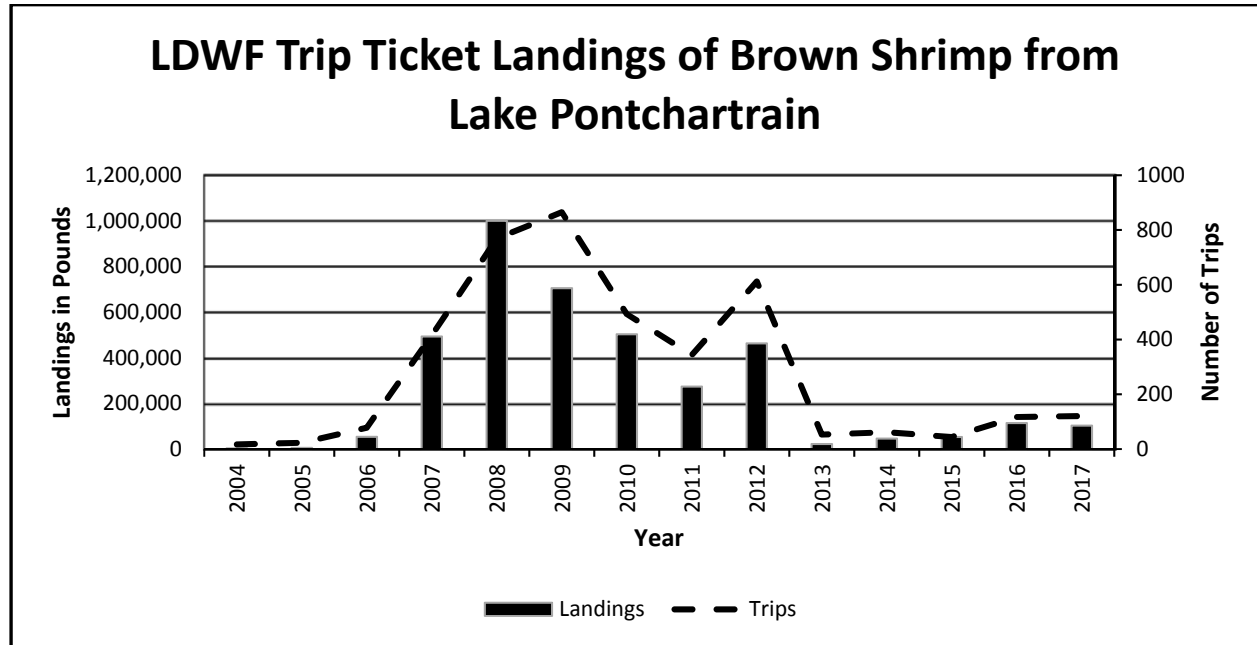
Commercial landings of blue crab have seen a decline in Lake Pontchartrain since 2009. However, when comparing the landings from 2004 to 2008 with the landings from year after 2011, they are not that different. The landings increase of blue crabs from 2005 to 2009 corresponds to a period of higher exploitable biomass that was seen across the entire state. The exploitable biomass of blue crabs has been on a steady decline statewide since 2006. The exploitable biomass dropped below the target benchmark from 2012 to 2015, but rose slightly above the target benchmark in 2017.

Independent Trawl Samples



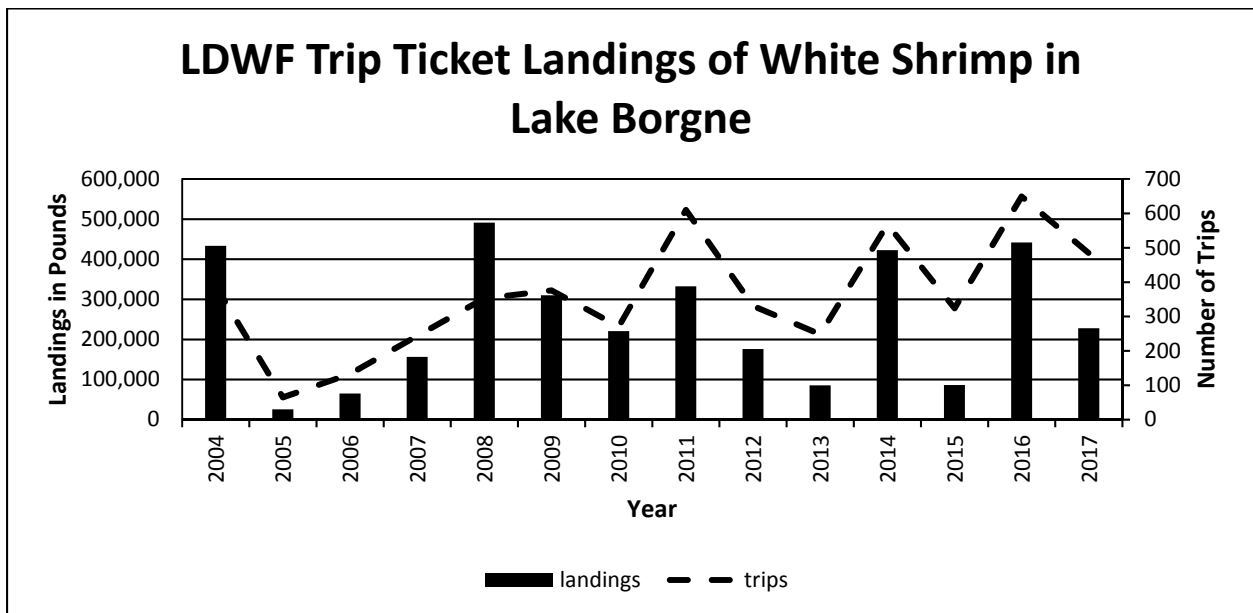
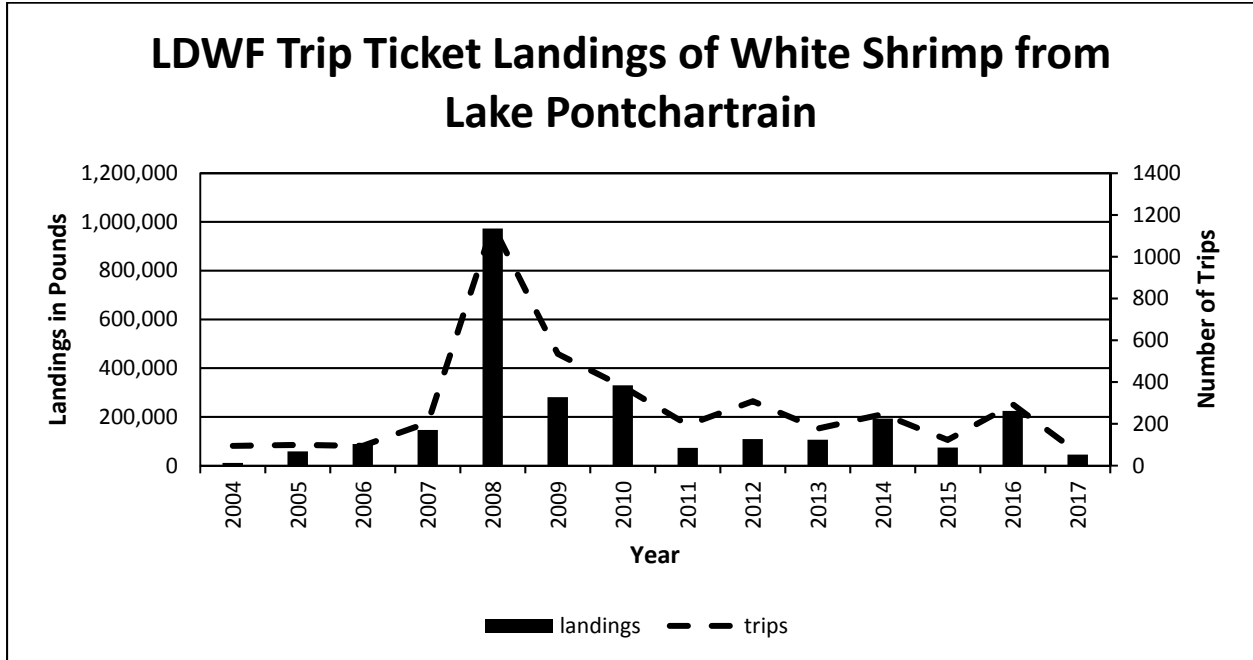
The graphs above show the Catch per Unit Effort (CPUE) of brown shrimp, white shrimp and blue crabs in the LDWF 16 foot trawl samples from 2004-2017.

Commercial Brown Shrimp Data



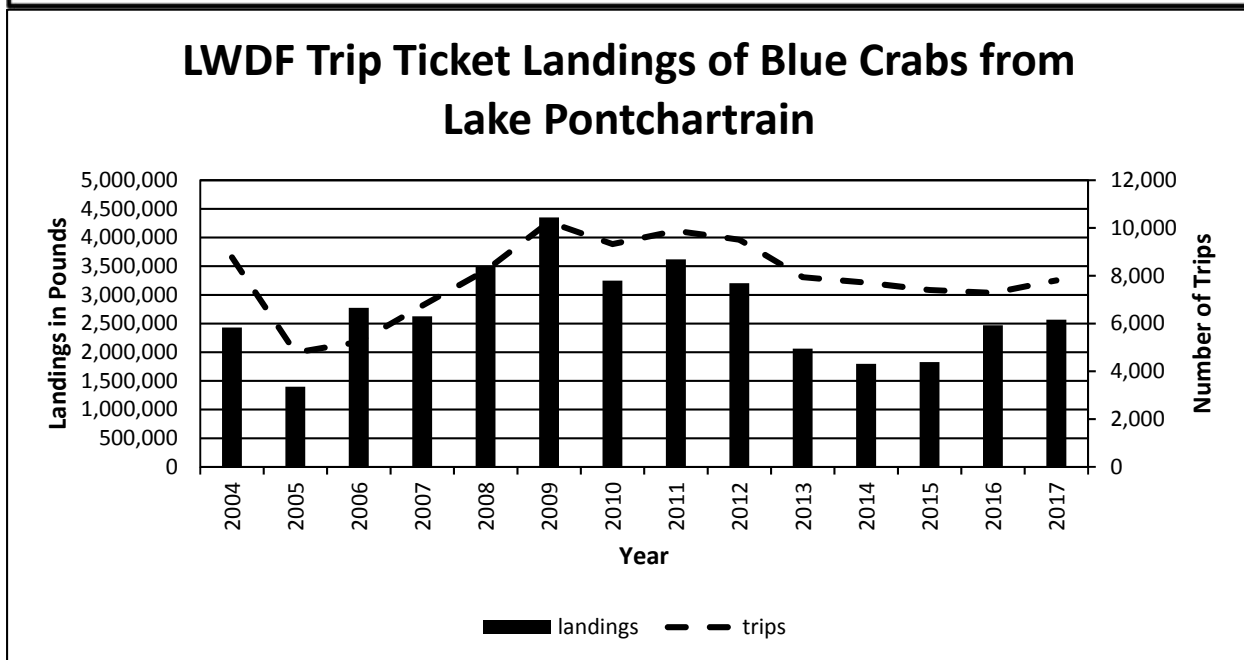
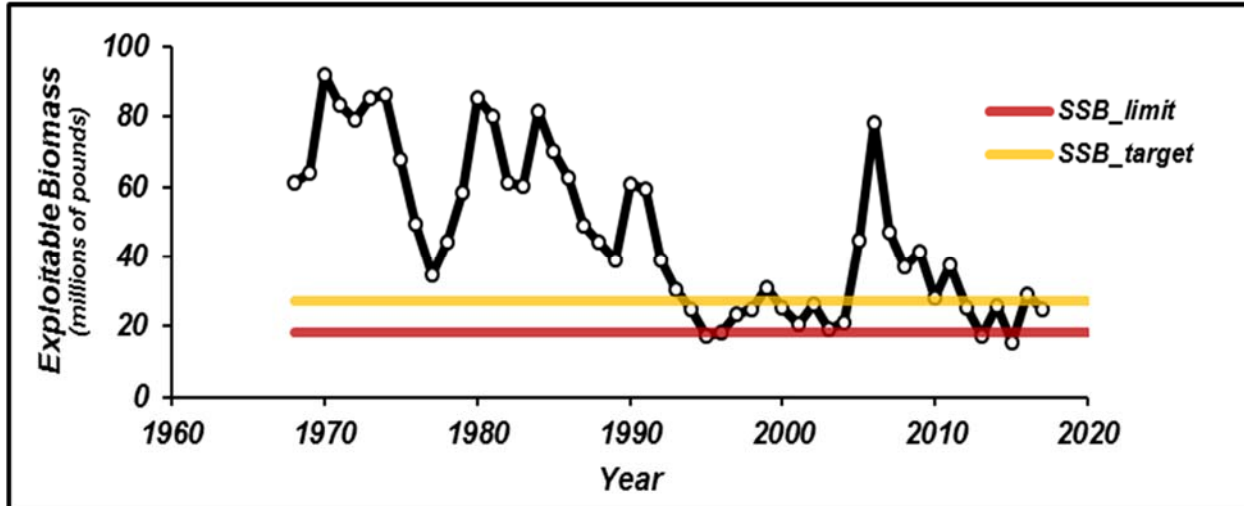
Landings of brown shrimp and the number of trips from Lake Pontchartrain and Lake Borgne are shown in the graphs above.

Commercial White Shrimp Data



The graphs above show the landings of white shrimp and the number of trips in both Lake Pontchartrain and Lake Borgne. Similar to brown shrimp, white shrimp landings correlate to the number of trips made by fishermen.

Commercial Blue Crab Data



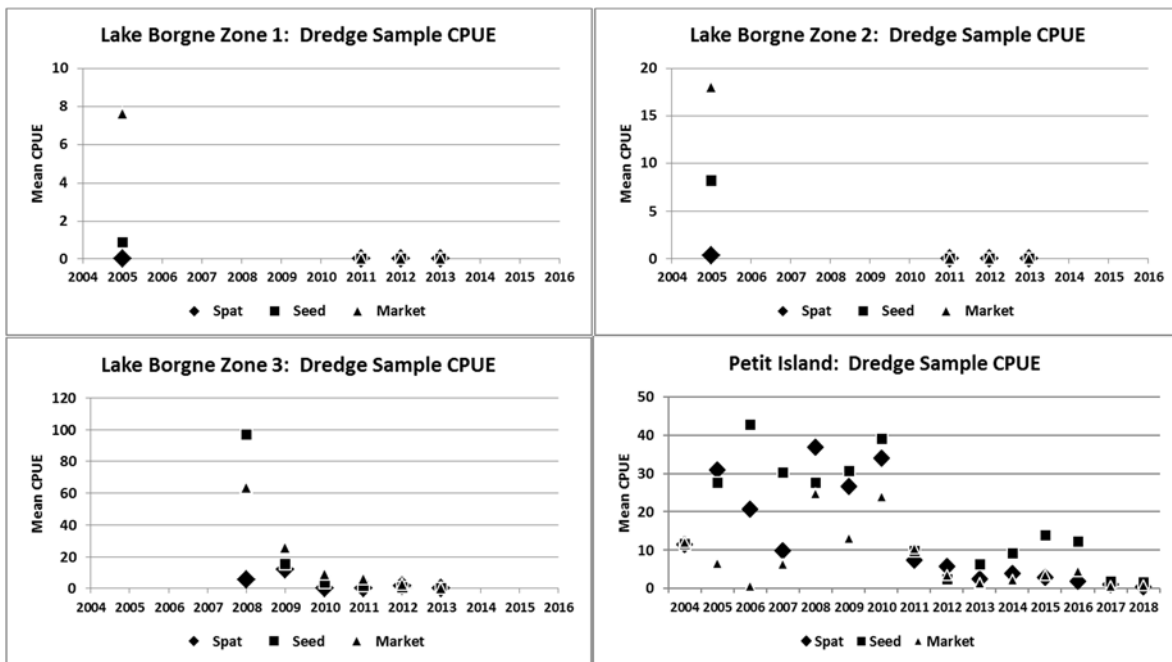
The top graph above shows the exploitable biomass of blue crabs since the 1970s. The bottom graph shows LDWF trip ticket landings of blue crabs from Lake Pontchartrain.

OYSTERS

Independent Dredge Sampling

Prior to the closure of the MRGO, salinities in Lake Borgne were sufficient to support oyster production throughout Lake Borgne. Several private oyster leases were (and are still) present in the southern half of Lake Borgne. Public Oyster Seed Grounds were expanded into Lake Borgne in 2003/2004. Two dredge sampling stations were added in the southern portion of Lake Borgne (Zones 1 and 2) and were sampled in 2005 and

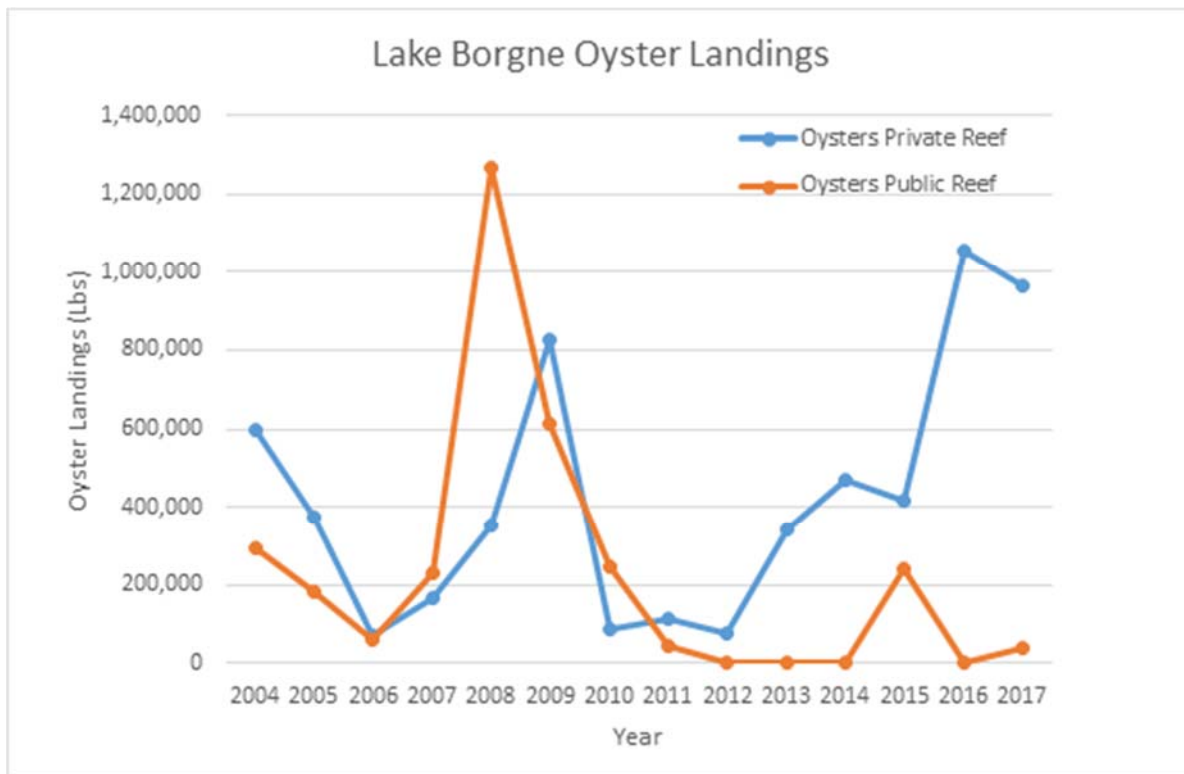
from 2011-2013, and discontinued due to lack of resource. The Lake Borgne Zone 3 station was added mid-lake in 2008 and is still currently sampled, although no live resource has been documented since May 2013. The Petit Island station is located further north in the pass between Lake Borgne and Mississippi Sound. While LDWF oyster data in this area is limited, the figures clearly indicate loss of the oyster population in the southern portion of Lake Borgne post MRGO closure (Zones 1 and 2), the decline and eventual loss of the oyster resource mid-Lake (Zone 3), and a decrease in oyster production at the Petit Island station. These changes are likely associated with decreased salinities in southern Lake Borgne resulting from the closure of the MRGO, with decreasing impact northward. The Petit Island station and reefs east of this area are also heavily influenced by discharge of the Pearl River. It is possible that closure of the MRGO could have shifted optimal salinity regimes for oyster production seaward, however east and south of Lake Borgne, Pearl River discharge, conditions in Chandeleur/Breton Sound, and other MS River diversions are also heavily influencing oyster populations. Discerning the interactive effect of these various hydrologic influences on oyster populations is beyond the scope of this report. It is anticipated that a partial re-opening of the MRGO could increase salinities in the Lake Borgne area which would improve conditions for oyster production. If oyster production is restored in this area post re-opening, it would likely be to a lesser extent than before the MRGO closure given that the MRGO would only partially be re-opened and salinities would not increase to the same level as a full re-opening. There also appears to be a risk that a partial re-opening could increase the occurrence of hypoxia in the Lake Borgne area, which could jeopardize any potential increase in oyster production.



Commercial Oyster Data

LDWF trip ticket data collects harvest information at large spatial resolution and determination of MRGO closure impacts on localized oyster harvest may be beyond the scope of this report due to numerous potentially confounding factors. Trip ticket landings in Lake Borne Public Oyster Seed Grounds have steadily declined since MRGO closing in 2009. However, the landings on private leases have increased, but there is no method available to quantify location of those landings in spatial relation to MRGO and may reflect the earlier mentioned shift to Petit Island/Mississippi Sound area.

In March of 2018, Lake Borgne was opened by Declaration of Emergency ahead of the Bonnet Carre Spillway opening to allow harvest of available resource before freshwater influx, but minimal effort was observed. The six day harvest (March 12-17) resulted in only 600 barrels of bedding material removed, with three boats observed.



The above graph shows LDWF Trip Ticket landings of oyster meat (in pounds) from Lake Borgne from 2004 to 2017.

Fisheries Impacts as a Result of a Partial Opening of the MRGO Channel at the Bayou la Loutre Ridge

It has been noted that the most obvious hydrological impact of the MRGO construction and its subsequent closure has been change in the salinity regime across the Pontchartrain Basin. It has been further noted that zones of hypoxia were created both with the opening and with the closing of the channel. These hydrological changes have

had notable impacts on the fisheries in the Basin. During the MRGO Channel's operation, increased salinity expanded usable habitat for many marine/estuarine sportfish and commercial species and for oysters westward toward and into Lake Pontchartrain. At the same time, benthic organisms in Lake Pontchartrain became stressed and died out in portions of the Lake. Upon closure of the MRGO by placement of the rock dam at Bayou la Loutre, areas to the west experienced an observed freshening. This has led most notably to the loss of oyster production in Lake Borgne. A partial opening of the MRGO Channel would likely again expand habitat which is more desirable to many sportfish species, such as Spotted Sea Trout. Additionally, usable habitat for Eastern Oyster would be presumed to return to Lake Borgne. A partial opening of the MRGO could also allow for the increased transport of larval and juvenile stages of finfish, shrimp, crabs, and oysters between the upper and lower estuary. The trade-off unfortunately could be the loss of submerged aquatic vegetation (SAV), which serves as nursery grounds for most estuarine species, due to their intolerance of higher salinities. There is also the possibility of hypoxia developing in Lake Borgne and again in eastern Lake Pontchartrain, as was experienced with the original MRGO opening. With regard to availability and size of finfish, shrimp, crabs and oysters; it has been shown that these are annual crops and are subject to a myriad of factors. In regard to actual harvest of finfish, shrimp, crabs, and oysters; we have shown through our observations that harvest is directly correlated to effort.

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