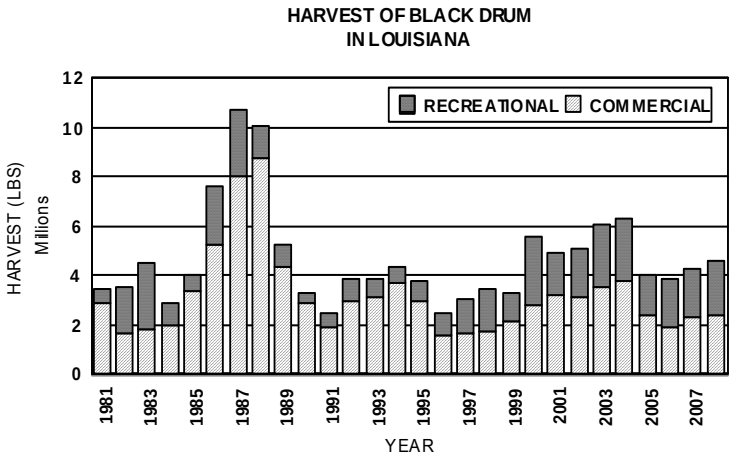
ASSESSMENT OF BLACK DRUM IN LOUISIANA WATERS – 2010 REPORT

Executive Summary

- The 2008 combined commercial and recreational harvest of 4,638,804 pounds was 83% of the 2000-2004 average. It was 38% of the 1987 harvest peak, and 65% of the 2004 harvest. Much of the decline from the harvests seen after 2000-2004 may be attributed to effects of Hurricanes Katrina and Rita on fishing effort in both recreational and commercial sectors in years immediately following those hurricanes. Harvest in the commercial sector has not re-gained the volume from years immediately before 2005.

- The conservation standard for black drum in Louisiana is 30% spawning potential ratio (SPR). The results of yield per recruit analysis indicates that if the natural mortality rate (M) =0.1 (the value that provides the lowest allowable harvest within the range of estimates), the fishery prior to existing regulations (Act 1316 of 1995) was operating above $F_{0.1}$ and below F_{MAX} with yield of 92% of maximum, and spawning potential ratio (SPR) at 44%. An M of 0.15 or 0.2 would indicate a more lightly fished stock with yield being 66% to 45% of maximum and with SPR being 57% to 66% respectively.



- It should be noted that the method used in this are not immediately sensitive to changes in regulations, effort or harvest methods. Black drum enter the fishery at age 0 and are fully recruited by age 5. It takes several years of consistent regulations after regulations are imposed before disappearance rates would accurately measure the impact of those changes, since the method relies on the relative abundance of the age-classes in the fishery. In the case of black drum it would take 6 years of consistent management and harvest effort, assuming selectivities of age 5 and older is 100%. Changes in demand in the commercial fishery for older black drum have made it difficult to quantify that portion of the fishery, and thus of the status of the stock as a whole.

- As a result of having several years of commercial trip ticket data, and collecting recreational fishery statistics data, the department was able to begin a program to representatively sample fishery dependent otoliths in 2002. The program uses trip ticket data and recreational survey data to weight sampling sites based on the volume of fish landed there for the collection of otoliths for the species of interest. It is expected that this method of otolith sampling will improve stock assessments by providing more accurate annual catch-at-age data

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SUMMARY OF CHANGES FROM 2008 ASSESSMENT

- There are no substantive changes in methods from the 2008 assessment. Harvest estimates and catch-per-unit-effort indices have been updated through 2008.

ASSESSMENT OF BLACK DRUM IN LOUISIANA WATERS
2010 REPORT

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Contents

Introduction

This assessment uses yield-per-recruit (YPR) and Spawning Potential Ratio (SPR) to estimate the impact of fishing pressure on potential yield and the spawning potential of the black drum stock in Louisiana waters. Estimates derived from YPR and SPR are based on information regarding the growth rate and spawning potential of the fish, and on estimated natural mortality rate (M) and fishing mortality rate (F) on the stock. The results from this assessment provide a generalized approach towards estimating the impact of fishing on the spawning potential and potential yield of the fish stock. The spawning biomass of females is assumed to be the factor limiting the spawning potential of the stock; therefore, where possible, only data on female black drum are used. Yield- per-recruit and SPR analysis, as with many other generalized assessments, should be used only as a guide until a more comprehensive assessment can be conducted.

In developing a stock assessment, the unit stock must be defined. While a unit stock is often represented by that portion of the population which is genetically similar, for our purpose, the most applicable definition seems to be one which considers the unit stock as that portion of the population which is either dependent on Louisiana waters, or which is available to Louisiana fishermen.

1 - Growth

Luquet *et al*. (2001) presents several growth equations for black drum. The one chosen for this assessment was developed by Geaghan and Garson (unpublished), and is a sloped asymptote model fitted to a von Bertalanffy growth equation. The data used by Geaghan and Garson (unpublished) was from Beckman et al. (1988) who used sectioned otoliths to age fish caught in Louisiana waters. The sloped asymptote model proved to fit the data better than did other equations. The equation is as follows:

$$L_t = (610 + 9.959 * t) * (1 - e^{-0.6226(t-0.1229)})$$

where L_t = fork length in millimeters at age t, and t = age in years.

The weight-length regression described by Beckman et al. (1990) from fish harvested in Louisiana was used in this assessment. The equation is as follows:

$$W = (1.14 * 10^{-5}) FL^{3.05}$$

where, W = weight in grams, and FL = fork length in millimeters.

2 - Natural Mortality

Natural mortality (M) is one part of total mortality (Z) and is the mortality due to all causes other than fishing. These include predation, disease, spawning stress, starvation, and old age. Typically, natural mortality is estimated, as it is difficult to directly measure, especially on exploited fish stocks where natural mortality and fishing mortality occur simultaneously.

This assessment follows the former Louisiana Department of Wildlife and Fisheries (1990) assessment in using a range of values for natural mortality (0.1, 0.15, and 0.2) to evaluate the sensitivity of M on the resulting spawning stock.

3 - Fishing Mortality

Fishing mortality (F) estimates derived in the former Louisiana Department of Wildlife and Fisheries (1990) assessment were used in this assessment to evaluate the impact of current fishing regulations on the spawning potential of the stock. The former assessment did not address the concept of spawning potential as a management measure. The current assessment uses yield-per-recruit and SPR analysis to estimate the impact of fishing on spawning potential.

The former assessment used the growth equation described in Section 1 to develop annual catch-at-age tables.

4 - Yield-per-Recruit

Yield-per-recruit and SPR analysis provide basic information about the dynamics of a fish stock by estimating the impact of mortality on yield and the spawning potential of the stock. The results can be examined as to the sensitivity of natural and fishing mortality rates on yield and spawning potential.

The growth parameters described in Section 1, the age-specific fishing mortality rates described in Section 3, and the natural mortality rates described in Section 2 were incorporated into the yield-per-recruit and spawning potential analysis. Fecundity estimates derived by Nieland and Wilson (1993) were used to estimate spawning potential. The equation is as follows:

$$BF = 49{,}249 * Age + 530{,}052$$

where BF=batch fecundity. Since the fecundity estimates are in both the numerator and denominator of the YPR and SPR calculations, unless there is a trend in spawning frequency with age, either batch fecundity or annual fecundity can be used to calculate YPR and SPR. The results are presented in Table 1, which contains estimates of F_{MAX} (fishing mortality rate that produces maximum yield), $F_{0.1}$ (fishing mortality rate representing 10% of the slope at the origin of a yield-per-recruit curve), $F_{20\%SPR}$ (fishing mortality that produces 20% SPR), $F_{30\%SPR}$ (fishing mortality that produces 30% SPR), and estimates of F from Section 3.

5 - Conservation Standards

Conservation standards are based on one of a number of biological measures of the dynamics of fish stocks, intended to protect the viability of that stock for future generations. These standards have historically been based on different measures of the dynamics of fish stocks, depending on the data available, the needs of fishery and of the resource.

Sufficient information is not available to directly estimate a conservation threshold for black drum in Louisiana. However, the conservation target of 30% SPR established by Act 1316 of the 1995 Regular Session of the Louisiana Legislature for black drum sheepshead, southern flounder and striped mullet appears to be adequate to maintain the black drum stock and prevent recruitment overfishing.

6 - Status of the Stock

Recent Regulatory History

Regulations were implemented by the Wildlife and Fisheries Commission in 1989 as follows: 16 inches minimum total length and 5 fish per person daily bag and possession limit with not more than one exceeding 27 inches for recreationally harvested black drum. For commercially harvested black drum there is a 16 inch minimum total length and an annual harvest quota of 3.25 million pounds for black drum measuring 16-27 inches total length and annual harvest quota of 300,000 fish measuring longer than 27 inches total length with the fishing year beginning September 1.

Commercial harvest methods were changed on August 15, 1995 when Act 1316 of the 1995 Regular Legislative Session, the Marine Resources Conservation Act of 1995, became effective. This act outlawed the use of "set" gill nets or trammel nets in saltwater areas of Louisiana, and restricted black drum harvest by the use of "strike" nets to the period between the third Monday in October and March 1 of the following year. A "Restricted Species Permit" was required in order to harvest black drum , and several criteria were established in order to qualify for that permit. After March 1, 1997, all harvest by gill or trammel nets was banned, and legal commercial gear to harvest black drum was limited to trawl, set lines and hook and line. This set of regulations had the effect of reducing the harvest of black drum by this segment of the commercial fishing industry.

Current recreational regulations are as follows: 16 inches minimum total length (TL) and 5 fish per person daily bag and possession limit with not more than one exceeding 27 inches TL. For commercially harvested black drum there is a 16 inch minimum TL and annual harvest quotas of 3.25 million pounds for black drum measuring 16-27 inches TL and 300,000 fish for black drum measuring longer than 27 inches TL, with the fishing year beginning September 1.

Trends in Harvest and Abundance

Commercial landings prior to 1991 were obtained from the National Marine Fisheries Service's (NMFS) General Canvass Landing Program. From 1991 through 1998 landings were collected by the LDWF Monthly Dealer Reports and from 1999 to present LDWF's "Trip Tickets" program has been utilized to gather these data. For this report, annual commercial landings were obtained from the NMFS Commercial Landings database, which acquires the "Trip Ticket" data from the Gulf States Marine Fisheries Commission. Landings by gear are available for the "Trip Ticket" program, and for the General Canvass Landing Program.

Black drum were lightly exploited by the commercial fisheries until the early 1980s when commercial harvest began to increase dramatically (Figure 1). Commercial landings went from 0.4 million pounds in 1980 to 8.7 million pounds in 1988. The regulations implemented in 1989 (and possibly other factors such as market forces, fishing effort, and variations in available stock) reduced the commercial harvest from the 1988 commercial harvest peak of 8.7 million pounds to between 2 and 4 million pounds annually for the 1989-1995 period. Regulations implemented by Act 1316 may have reduced harvest even further as evidenced by reduced landings from 1996 to 1999, but commercial landings later increased, and 2004 landings were slightly above the 1995 level. However, the 2005 landings were 83% of the 1989-2004 average, about 27% of the 1988 peak, and about 63% of the 2004 landings. The 2006 landings were 22% of the peak, about 68% of the 1989-2004 average, and about 51% of the 2004 landings.

The 2005 and 2006 landings were directly influenced by the passage of Hurricanes Katrina and Rita in late August and late September of 2005. These storms reduced the number of commercial vessels harvesting black drum, as well as the number of wholesale/retail dealers in operation to receive them, and otherwise disrupted infrastructure including roads, fuel supplies, docks, maintenance facilities, etc. 2006 landings data indicate that the reduction in effort and landings continued into that year as well. Through 2008, there has been a slow increase in the commercial harvest of black drum, but it has not returned to the levels seen in the early 2000's or in some earlier time periods, remaining below 2.5 million pounds.

Commercial landings for larger black drum (>27" TL) have declined substantially since the peak of the fisheries for those size classes in the mid- to late-1980's and early 1990's. A larger fraction of the harvest has come from the 16-27" TL size range, while some contributions continue from fish somewhat over 27 inches TL (LDWF "Bull Drum Permit" data 1990-1999, LDWF trip ticket data,1999-2008). The fishery for the largest fish, the so-called "bull drum" fishery targeting fish over about 15 lbs. gutted weight, has declined most substantially over this time period.

Recreational landings or harvest information has been consistently collected since 1981 (Figure 2). Fisheries dependent recreational landings data are collected by the NMFS Marine Recreational Fisheries Statistical Survey (MRFSS) and are currently collected by LDWF biologists. In the earlier years of the survey, estimates of harvest were relatively broad, due to lower numbers of samples in the Louisiana MRFSS survey. Increased effort in the survey in years after about 1987 has increased the precision of harvest estimates. The point estimate of the harvest has fluctuated between 0.4 and 2.7 million pounds from 1981 through 2006. There seems to be some cyclic variation in recreational harvest estimates, and recent estimates (1990-2008) show an increasing trend. As was also the case for other species, the freeze of late 1989 seems to have reduced recreational harvest of black drum in 1990 and 1991. The recreational harvest was also reduced in 2005, as was the commercial harvest, at least partially due to the passage of Hurricanes Katrina and Rita. Although the commercial harvest continued to decline in 2006, the recreational harvest did show some increase from the 2005 value, but remained well below the trend seen in years prior to 2005. Recreational catch-per-trip also declined in both 2005 and 2006. One factor that may have affected the recreational CPUE estimates for 2006 was increased recreational harvest of spotted seatrout in that year. Methods of fishing for spotted seatrout are significantly different than for black drum, which could lead to decreased black drum CPUE estimates.

After the hurricanes of 2005, the 2006 combined commercial and recreational harvest of 3,911,537 pounds was 93% of the 1989-2004 average. It was 38% of the 1987 overall harvest peak, and 64% of the 2004 harvest. This harvest was consistent with the 2005 harvest, and was below the longer-term trend of gradually increasing harvest seen in both the recreational and commercial sectors since about 1996. Much of the decline seen in these recent years may be attributed to effects of Hurricanes Katrina and Rita on fishing effort in both recreational and commercial sectors. By 2008, combined landings had increased to 4,638,804 pounds, 110% of the 1989-2004 average, 43% of the 1987 peak, and 74% of the 2004 harvest. The increase from the 1989-2004 average is due to the long-term increase in recreational harvest, which was 164% of the average, while commercial harvest was 85% of the average by weight.

Mean catch-per-trip from the recreational fishery was calculated by selecting those trips that had black drum in their catch. Black drum are seldom a primary target species for Louisiana angling trips, they are more often reported as a secondary target species. Therefore, many black drum encountered by MRFSS samplers are likely to have been incidentally captured by an angler targeting other species, or fishing with no target species in mind. We did not attempt to select trips targeting black drum in our calculations of catch-per-trip due to concerns for post-trip reporting bias (anglers who harvest drum are more likely to report them as a target species, inducing bias into estimates). These issues create challenges for developing a fishery-dependent index of abundance from the recreational fishery.

The results of the recreational catch-per-unit-effort (CPUE) analysis are presented in Figure 3 along with 95% confidence limits around the mean. The CPUE index cycled throughout the period examined (1981-2008), with no indication of a long-term trend. Increased sampling effort in the MRFSS survey in recent years has contributed to the more precise estimates of CPUE seen in those years. The years 1985, 1991, 1996, 2003, and 2005 through 2008 showed the lowest mean CPUE and were significantly lower than 1982, 1986, 1993, and 2000. The years 2005 and 2006 were the lowest estimates of CPUE within the entire time series examined. While 2007 and 2008 showed increases from those values, they remained below the long-term mean for the data series.

Catch-per-effort data from the Department's, fishery-independent trammel net (750' x 6' - 1 5/8" inner, 6" outer bar mesh wall) and small mesh bag seine (50' length, 1/4" delta bar mesh) samples were calculated as follows:

$$\text{Mean CPUE} = (\exp (\Sigma \ln (\text{catch} + 1) / N)) - 1$$

where catch is the total number caught in each set and N is the number of samples taken annually. Trammel net and seine data were used for the period 1986-2009. The CPUE fluctuated throughout the time period in both the seine and trammel net samples with no indication of a long-term downward trend (Figures 4 and 5). Rather, there seemed to be a period of relatively low recruitment from the mid-1980's until the mid-1990's, followed by a period of relatively high recruitment, which reduced to more moderate levels in the early 2000's. The last two years of seine CPUE, and the trammel data from 2006, 2008 and 2009 are above the long-term mean. Overall, there seemed to be some correspondence between the seine and trammel net indices, with the trammel net index showing about a 1- to 2-year lag from the seine index. The peak seen in the trammel net information from 2006 did not seem to have any precursor in the seine index.

Comparison of the standardized fishery-dependent recreational CPUE index and the fishery-independent trammel net CPUE index (Figure 6) showed little similarity between the two indices, though the trammel net gear captured size ranges available to the recreational fishery. Some of this lack of similarity may be due to lack of directed recreational effort toward black drum, inclusion of sub-legal black drum in the trammel net CPUE index, variation in availability of other species targeted by recreational harvesters, or other factors.

Estimates of Yield and Spawning Potential

It should be noted that the following results of YPR and SPR analysis do not reflect the impact of current regulations and variation in harvest described above. With this type of general assessment, it may take several years before the impact of changes in harvest will be observed in the disappearance rates from the fishery.

The results of YPR analysis indicate that if M=0.1 (the most conservative value within the range of estimates), the fishery prior to existing regulations (Act 1316) was operating above $F_{0.1}$ and below F_{MAX} with yield of 92% of maximum, and SPR at 44%. An M of 0.15 or 0.2 would indicate a more lightly fished stock with yield ranging from 66% to 45% of maximum and with SPR estimates of 57% to 66% respectively (Table 1).

7 - Research and Data Needs

Estimates of natural mortality used in the present assessment vary substantially. This variation lessens the ability of the present assessment to provide a more accurate estimate of the potential yield of the stock, and also reduces the confidence level of the present estimate of SPR. A more accurate estimate of natural mortality would improve both estimates.

Annual age-length keys should continue to be developed to provide catch-at-age data necessary to conduct age-based population assessments. The department is actively collecting otoliths for development of annual age-length keys.

The assessment faces challenges since the harvest of adult black drum currently comprises only a small fraction of the overall harvest. Characterization of the age structure of the adult harvest is difficult, since these fish are seldom encountered as part of the random sampling of the harvest. A project to determine the current age frequency of the adult population should provide valuable insight into the impact of existing regulations, and greatly assist in refining our estimate of the status of the black drum stock in Louisiana. The project should attempt to collect samples representative of the adult black drum population in Louisiana waters, recognizing that populations exist inshore, offshore and in various parts of the state that all may have different age structures. Such a project could be either fishery-dependent or fishery-independent in nature. When age data are sufficient, the Department intends to conduct additional VPA analyses and to explore other statistical methods of evaluating the status of the black drum stock.

Beyond the analyses discussed above, the Department intends to evaluate additional methods (statistical catch-at-age, age-based production models, tag-return studies, etc.) to better evaluate the current status of the black drum fisheries.

The original VPA had access to information on harvest-at-size by gear from the commercial fishery during the mid-1980s. This information was presented in graphic form in annual State/Federal Cooperative Statistics reports that covered July 1984 through March 1987 (Bane et al., 1985, Russell et al., 1986, Russell et al., 1987). However the original data is not currently available through either LSU or NMFS, and the graphics in the above-cited reports are not adequate to reconstruct the original information. Availability of this information would enhance estimates of the harvest at age by gear at times when age information is unavailable.

The relationship between wetlands losses or modifications and the continuation of fishery production within the state has been discussed by many authors. However, this relationship is likely to vary among fishery species. Understanding this relationship for black drum should be an ongoing priority.

In the presence of changing regulations, fishery-dependent information is not a reliable source of data for assessing the status of a fish stock. However, such data are necessary to measure the effects of fishing on that stock. Consistent fishery-dependent and fishery-independent data sources, in a comprehensive monitoring plan, are essential to understanding the status of fishery stocks, and to identifying causes of changes in stock abundance. Current programs should be assessed for adequacy with respect to their ability to evaluate stock status, and modified or enhanced to optimize their capabilities.

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Tables

Table 1. Results of yield per recruit and spawning potential ratio analyses for black drum. Estimates reflect the status of the stock including the impact of regulations and harvest strategies prior to1995.

M=0.1

	F Ratio	YPR	SPR	%SPR	%YPR	
Fmax =	0.982	3.0260	1,659,670	23.80%	100.00%	
F0.1 =	0.260	2.4809	3,902,316	55.96%	81.99%	Benchmarks
F20% =	1.156	3.0159	1,394,714	20.00%	99.67%	
F30% =	0.760	3.0022	2,092,071	30.00%	99.21%	
* Regulations =	0.426	2.7925	3,089,373	44.30%	92.28%	Estimate

M=0.15

	F Ratio	YPR	SPR	%SPR	%YPR	
Fmax =	2.100	2.1766	373,755	11.48%	100.00%	
F0.1 =	0.605	1.7506	1,466,963	45.05%	80.43%	Benchmarks
F20% =	1.462	2.1353	651,218	20.00%	98.10%	
F30% =	1.019	2.0185	976,828	30.00%	92.74%	
* Regulations =	0.376	1.4562	1,880,508	57.75%	66.90%	Estimate

M=0.2

	F Ratio	YPR	SPR	%SPR	%YPR	
Fmax =	3.822	1.8101	61,480	3.52%	100.00%	
F0.1 =	1.153	1.5197	545,318	31.22%	83.96%	Benchmarks
F20% =	1.671	1.6792	349,286	20.00%	92.77%	
F30% =	1.199	1.5388	523,929	30.00%	85.01%	
* Regulations =	0.326	0.8173	1,375,910	66.71%	45.36%	Estimate

Figures

Figure 1. Commercial harvest of black drum in Louisiana, in pounds, 1950-2008.

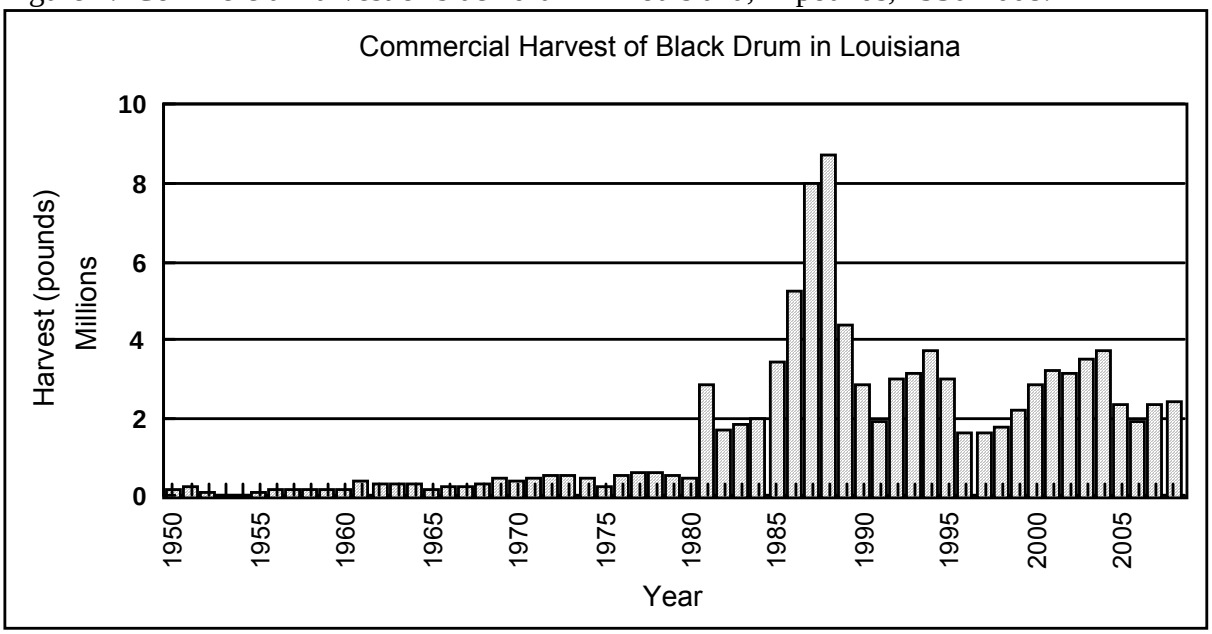

Figure 2. Recreational harvest of black drum in Louisiana in pounds, including 95% confidence limits on the estimates. Source: NMFS MRFSS (pers. comm.)

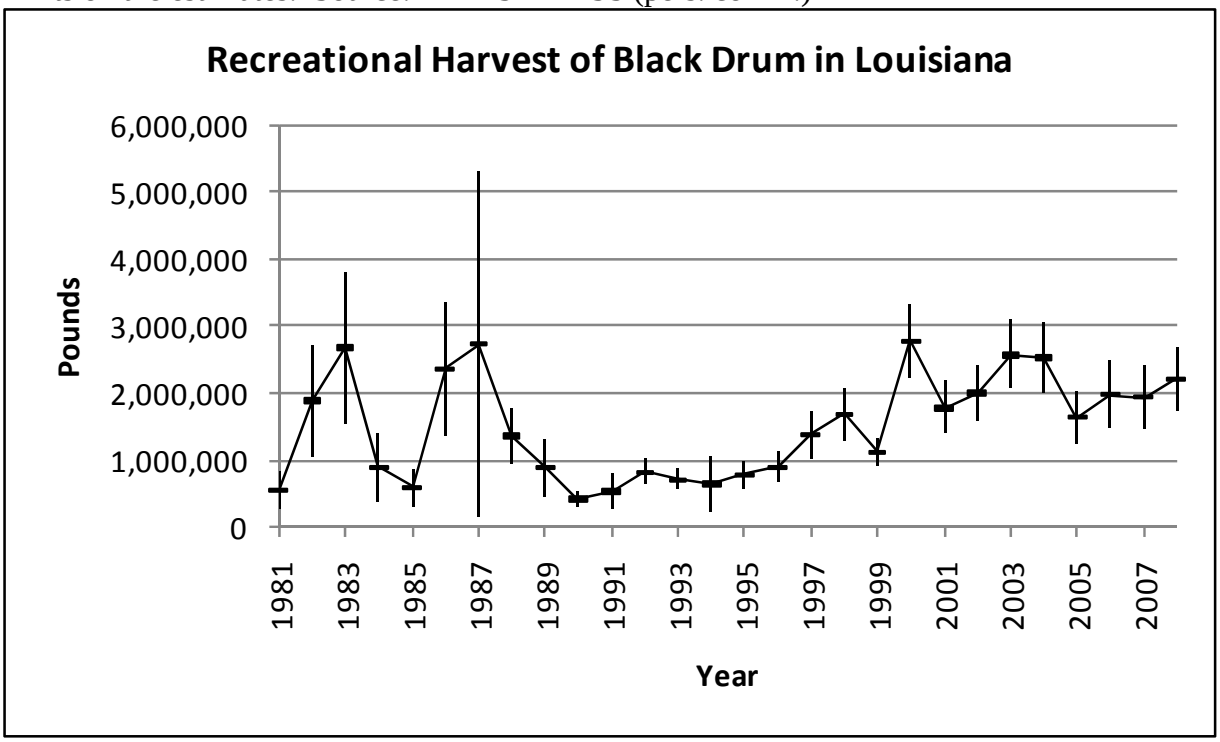

Figure 3. Catch per unit of effort from the Louisiana recreational fishery, based on MRFSS intercept survey information.

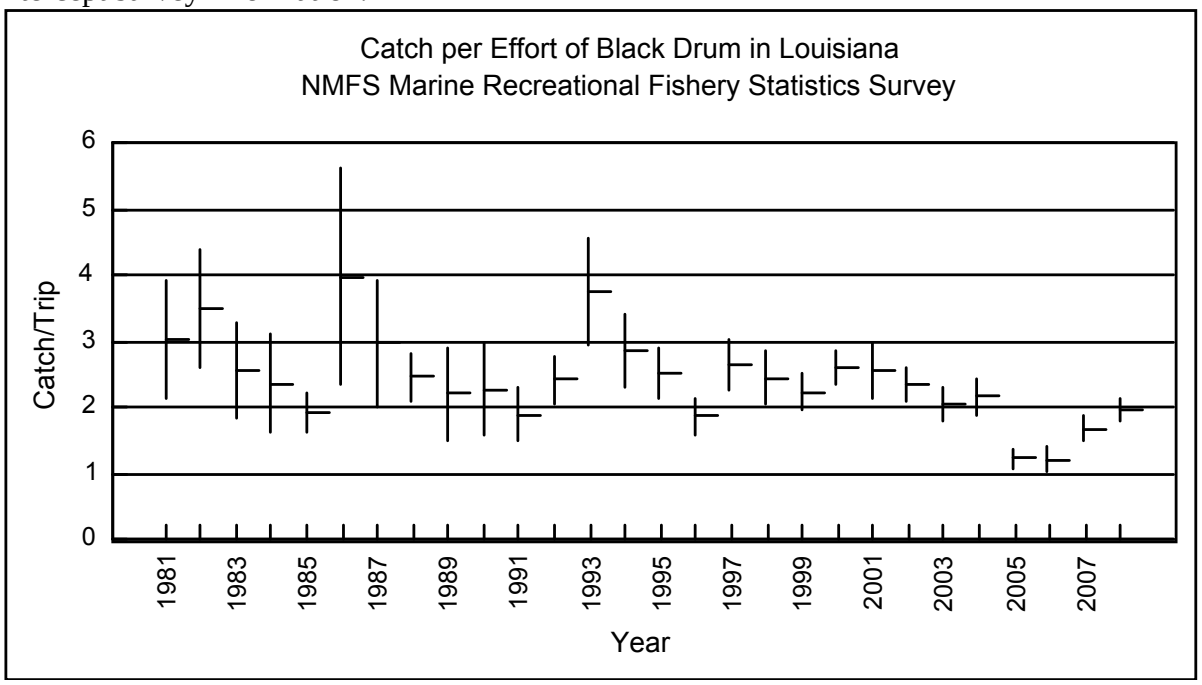

Figure 4. Catch per unit of effort of black drum from seine samples in the LDWF fishery-independent sampling program.

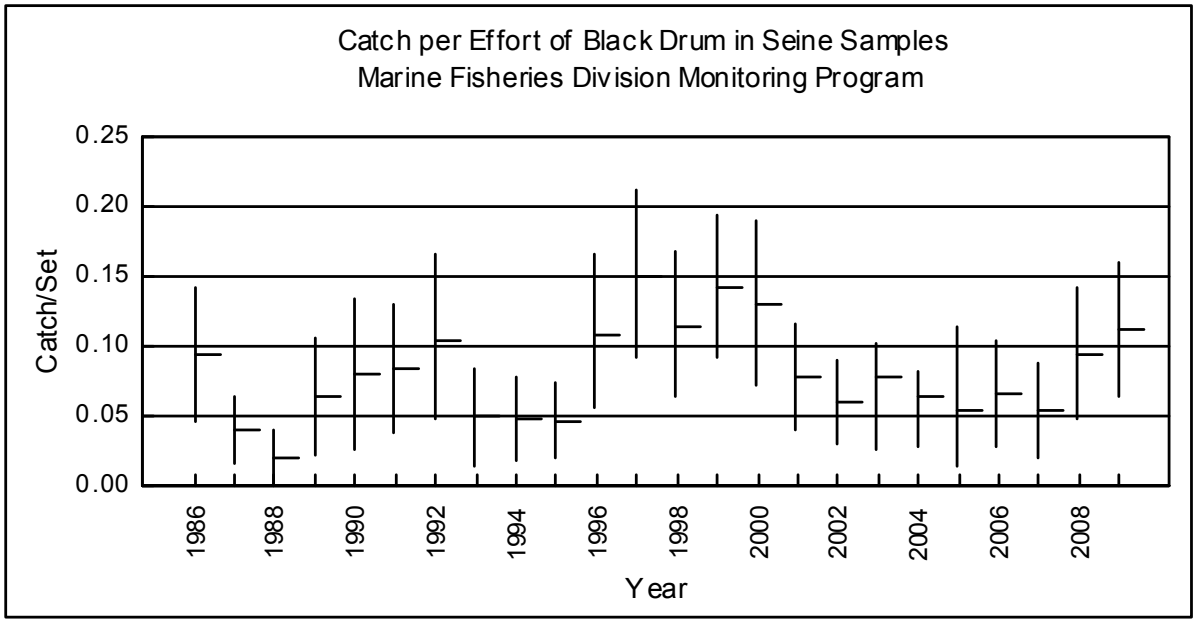

Figure 5. Catch per unit of effort of black drum from trammel net samples in the LDWF fishery-independent sampling program.

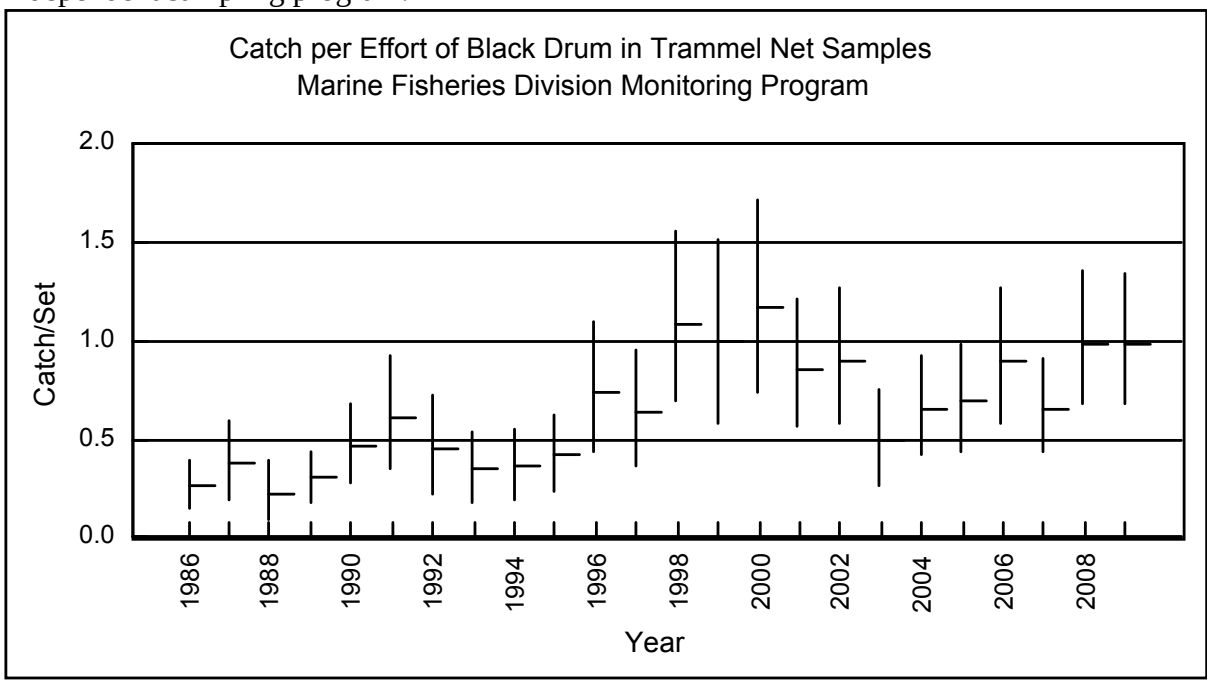

Figure 6. Standardized CPUE of black drum from fishery-dependent recreational harvest samples compared to CPUE from trammel net samples taken in the LDWF fishery-independent sampling program.