PROGRESS REPORT

Project Title: Characterization of Recreationally Caught Adult Red Drum Stocks in Port Royal Sound, South Carolina.

Report Period: Oct 2011 – November 2012

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Project Goal:

The goal of the proposed research is to continue a program initiated in 2007 that augments existing SCDNR adult red drum studies through cooperative sampling with area charter and private boat captains. This study provides additional data on adult red drum population characteristics (relative abundance, size composition, movements and stock mixing) of adult red drum in Port Royal and Calibogue Sounds and adjacent coastal waters. This information in conjunction with ongoing SCDNR studies can be utilized in future stock assessments and the development of management recommendations to protect this important resource.

Project Objectives:

The following objectives were developed to meet the research goal:

1. To maintain and further develop a network of cooperating charter boat captains and private boat anglers to participate in adult red drum sampling efforts.
2. To insure effective and accurate data collection through direct participation by the PI in tagging activities on trips targeting adult red drum.
3. To collect data on catch and effort in the recreational adult red drum fishery that may be useful in determining trends in adult drum abundance.
4. To measure, examine for existing tags and tag (PIT and Hallprint nylon dart) adult red drum to generate data on size/age composition and migratory behavior/stock mixing.
5. To collect fin clip samples for SCDNR studies on DNA stock identification, detection of recaptures and determination of the contribution of hatchery-produced red drum to the spawning stock.
6. To disseminate accomplishments and results to the Low Country Institute, Hilton Head Reef Foundation , SCDNR investigators, participating captains and the public.

INTRODUCTION

The red drum (*Sciaenops ocellatus)* is one of the most important recreational species in the southeastern United States. The species' popularity with anglers and prior commercial exploitation resulted in over-fishing of the stocks. Information on adult stocks of red drum has been identified as a critical data need to improve regional stock assessments. Fishery independent indices of spawning stock size and the rate at which 3-5 year old red drum leave estuarine areas to become part of the offshore spawning stock are crucial data elements for these assessments. The SCDNR initiated adult red drum sampling in the Charleston area in 1994 and in Winyah Bay and Port Royal sound in 2005 although effort levels were much lower than for the Charleston vicinity. The importance of adult red drum to the Port Royal/ Calibogue Sound ecosystem and the Hilton Head recreational fisheries warranted more intensive sampling.

Additionally, there is a need to determine the migratory behavior of southeastern stocks of red drum to determine if the current stock assessment approach (NC – FL) is appropriate or reduced scale (estuarine-based) assessment and regulation would be more suitable to the long term health of the stocks and fisheries. Tagging studies indicate a high degree of site fidelity in adult stocks and little evidence of stock mixing between estuaries along the South Carolina coast.

SCDNR bottom longline sampling is an effective method for sampling adult red drum in coastal waters. In areas such as Port Royal Sound where an extensive recreational fishery for adult red drum has developed, utilizing the charter boat fishery for sampling and tagging these stocks provides a cost-effective method for collecting additional adult red drum data.

Assessing the effectiveness of red drum stock enhancement programs requires confirmation that stocked red drum enter the adult spawning stocks in the area where they were introduced. This can be accomplished by non-lethal sampling such as fin clips for DNA analysis from fish taken by this sampling. Additionally the DNA samples can be used to identify individuals that have lost their tags.

This work augments SCDNR sampling in the Port Royal Sound vicinity by increasing the number of tagged adults, DNA samples and extending sampling throughout the season to increase the probability that all segments of the stock are represented in the data base.

Charter and private boat captains are an essential part of this study; providing the platforms for the collection, tagging and specimen workup of adult red drum. During work performed in 2007-2009 we developed a strong working relationship with 7 Hilton Head charter boat captains and 3 private boat anglers that assisted in the tagging of 176, adult red drum. The current work has utilized many of these same captains and we have continued to look for other interested cooperators. Area fishing clubs promoted awareness of the program and provided a valuable service by promoting the goals of the program and the importance of accurately measuring and reporting tagged fish.

We have maintained a good working relationship with the Adult Red Drum Project of the Inshore Fisheries Section (SCDNR, Marine Resources Research Institute) and provided all data for inclusion in their long term adult red drum database.

MATERIALS AND METHODS

Fishery dependent sampling was conducted from Hilton Head charter boats that direct effort on adult red drum during the fall run of post spawning adults as they initiate offshore movements. Presentations were made to local sport fishing clubs to explain the objectives and methodology of the study and enlist the assistance of private boat anglers that target adult red drum. The PI conducted all tagging operations since it was determined that the burden of collecting data interfered with the captains' primary duty of providing an enjoyable fishing experience for his clients. The number of rods fished and the time fished was recorded for catch per unit effort calculations. Location, water temperature and other environmental parameters such as tide stage were recorded.

Tag and release

Red drum were brought aboard with a landing net and the hook was removed. In cases of deep-hooking the leader was cut as close to the hook as possible and no attempt was made to remove the hook. Any instances of deep-hooking were recorded. Fish were measured (fork length, FL and total length, TL mm). Only male red drum are known to produce drumming sounds and the presence of "drumming" was noted when the fish was handled to provide rough information on sex ratios in our samples. Running ripe males are sometimes encountered and this was also noted.

Adult red drum (> 700mm TL) were tagged with two types of tags; an external dart tag and a PIT (passive integrated transponder/microchip tag). The external dart tag was a Hallprint nylon dart (15 cm) inserted through the bony, supporting structure under the second dorsal fin. PIT tags (microchips) were inserted in the dorsal musculature at the intersection of the first and second dorsal fins. Red drum are long-lived fish (in excess of 40 years) and a PIT tag should be retained throughout the life span of the fish, whereas an external tag has a more limited retention period. The use of PIT tags will also provide information on tag loss rates for the external tags if study efforts are continued. Prior SCDNR sampling efforts in Port Royal Sound placed PIT and external tags in adult drum. During this study all fish were scanned with a PIT tag reader prior to tag implantation to determine if the fish is a recapture that has lost its' external tag. The Hallprint dart tags have SCDNR return addresses imprinted to utilize the long term database already established for adult red drum and recognizing that many members of the public return tags or tag numbers to SCDNR regardless of what address is printed on the tag.

A small piece of tissue from the tip of the anal fin was taken and placed in a vial of Sarcosyl-urea for DNA analysis by SCDNR investigators. This analysis will be used to determine if Port Royal red drum have a unique genetic composition and what percentage of our adult samples came from prior stock enhancement efforts in the Port Royal system.

Tagging, measurement and fin clip collection were carried out as rapidly as possible consistent with careful procedure. When a released fish had difficulty submerging it was retrieved with a dip net and the fish vented with a hypodermic needle to allow the fish to submerge.

All tagging data was maintained in the project database and also supplied to SCDNR for inclusion in their long term adult red drum database. Reward hats or T-shirts were provided to anglers reporting a tagged fish.

Fishing methods

Sampling for this project was conducted using prevailing fishing methods in the recreational fishery which generally involved fishing from an anchored boat and deploying multiple rods (4-6). Rods were usually 20-30 pound class spinning or boat rods, with reel spooled with either braided line or monofilament. The typical rig was a "Carolina rig", sliding egg sinker on the main line with terminal gear consisting of a barrel swivel, a 3-5 foot 50-100 pound test monofilament leader and a 10/0-14/0 circle hook. Most captains preferred to use live baits (menhaden or thread herring) if they were available but fresh cut baits were also routinely used and didn't appear to be significantly less effective than the live baits. Baits were distributed at varying distances from the boat to increase the fished area and reduce the incidence of line tangling. Some captains deployed chum before casting out the baits but this was not standard procedure. Deployed rods were placed in rod holders and any slack that developed in the line was frequently taken up. No attempt was made to set the hook and the rod was not picked up until it was apparent that the fish was hooked (strong bend in the rod). Not attempting to set the hook is standard procedure when using circle hooks and increases their effectiveness.

When anchoring, GPS was often used to position the boat at a previously productive location or the vessel motored to the approximate position and used the fathometer to locate the desired depth. After deploying baits and fishing without success for 30-60 minutes the captain may make a short move and re-anchor the boat or move to a completely new location. The amount of movement and number of sites fished depended on if the trip was a charter and what the duration of the charter was. Obviously on a half day charter the number of locations that can be checked is limited. Weather conditions also played a role in determining which areas could be fished. When winds were high the vessels were limited to protected areas and were unable to access any areas outside or in the mouth of Port Royal Sound. Tide stage played a major role in fishing success in all areas and the productive time was 1-1.5 hours on either side of slack water. However, the most effective fishing tides (high or low) varied by location. When tides began to run fast around mid-tide, fishing success declined. Fishing was usually less productive around the full and new moons when tidal amplitude and currents were at their maximum.

In addition to anchored bottom fishing for red drum two other techniques were used occasionally; trolling and "bird fishing". Trolling utilized planers and drone spoons or rigged ballyhoo, usually deployed near tide rips or in areas where there was significant diving bird activity. This activity was usually conducted when proven fishing areas were not productive and only in the ocean.

"Bird fishing" is an active sight fishing technique conducted in the late fall when most if not all of the adult red drum have left the sounds and moved into the ocean waters. Captains cruise and look for actively diving gannets which sometimes have large schools of adult red drum under them. Dolphins are also often associated with the feeding birds. When actively diving birds are located, the vessel proceeds at high speed to that area and stops in the center of where the most diving activity was noted. The birds move away but bait schools and larger fish can often be observed on the fishfinder. As soon as the vessel stops,

baits are dropped to the bottom and if no bites occur within a few minutes the search for a new pod of feeding birds begins. This technique can be very effective and produced this projects' best single days' catch of 20 fish. These fish were captured and tagged in about 45 minutes as the boat drifted approximately 1.5 miles. Not all pods of birds have red drum under them and this is a technique to be used opportunistically when other more consistent tactics are not productive.

RESULTS AND DISCUSSION

Sampling effort

A total of 18 sampling trips occurred for the combined 2011 and 2012 seasons. Eight trips were conducted in 2011 (September - November). Ten trips were conducted during the 2012 season (October - November). Seven of the 2011 trips were made in Port Royal Sound with one trip to the "Savannah Rockpile", an area north of the Savannah shipping channel. In 2012 one trip was conducted in Calibogue Sound with the remaining nine trips in Port Royal Sound or the ocean adjacent to the PRS entrance channel. Since the projects inception in 2007 there has been varying amounts of effort expended in Calibogue Sound ,which is an area not sampled by the SCDNR adult red drum longline survey. Captains choose fishing locations based on a number of factors such as, prevailing winds, success at a location in prior years during a given week and reports of success at a particular location from other captains. The areas fished over the 2007-2012 period have not changed although there is variation from year to year in the success rates at various sites.

A number of factors contributed to the number of project sampling days and tagged fish being less than anticipated. Weather played a significant role in reducing potential sampling days, particularly when large drum had moved lower in the sounds or into the ocean in response to dropping water temperature. In addition, when weather was good enough to fish offshore waters, many anglers wanted to fish for snapper-grouper. Although the "bull reds" are considered a trophy fish, their "catch and release only" status precludes some anglers from targeting them on a charter. Some charter boat clients prefer to fish for species that they could retain for food. In cases when a charter boat was booked with the maximum party of six, space constraints on most of the vessels precluded the biologist from making the trip. At other times several red drum trips would be booked on the same day and the biologist would sample the first vessel that he was offered a trip on.

Catch and Tagging Results

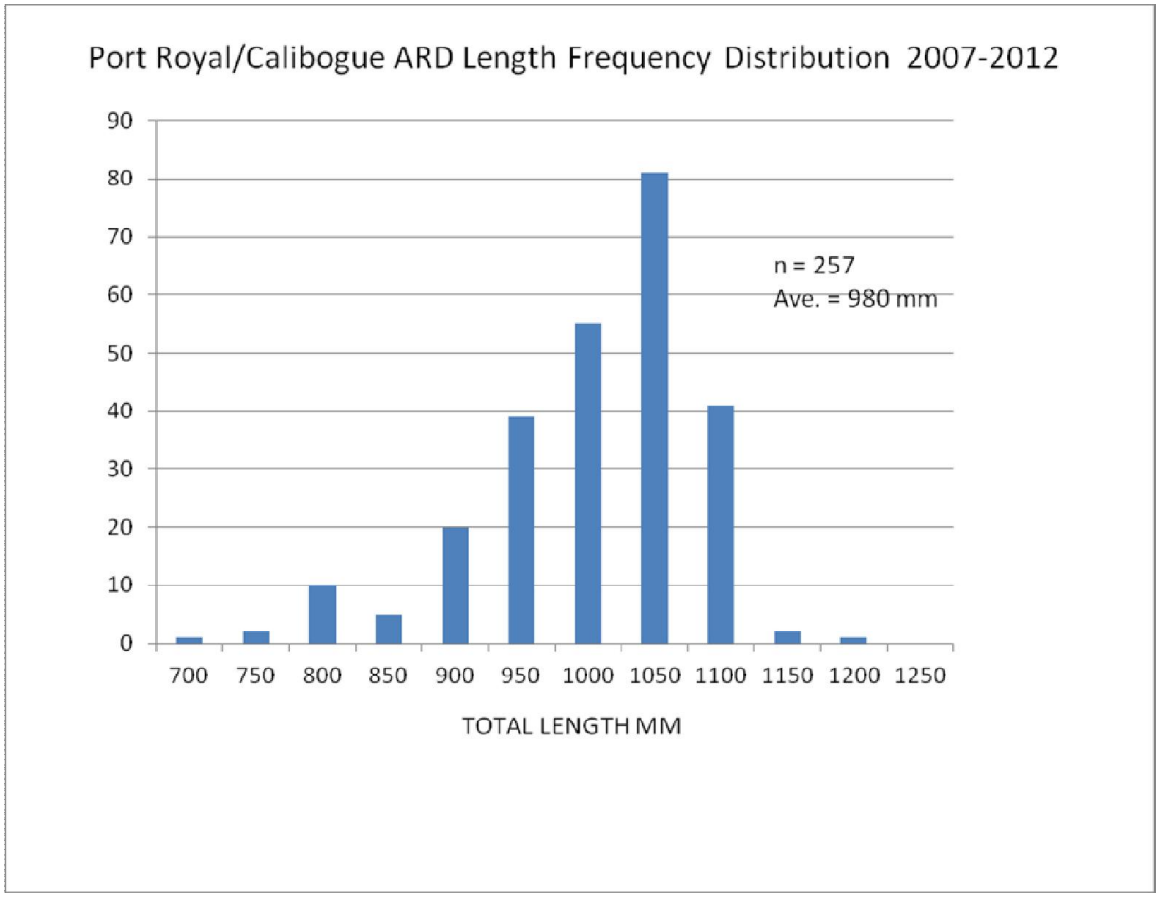
A total of 82 adult red drum were caught in 2011 and 2012. Thirty and 52 drum were captured in 2011 and 2012 respectively. Nylon dart and PIT tags were applied to these fish and fin clips were also taken. The fin clip samples have been provided to the genetics lab (SCDNR) for analysis.In addition to identifying hatchery origin fish the fin clips will enable researchers to determine if any of the sampled fish was a recapture that had lost its' external tag and a PIT tag was not detected. Current techniques enable researchers to match individual fish (those from which a fin clip had already been collected) with a very high degree of reliability.

Since 2007 a total of 257 adult drum have been tagged by this project and 628 by the SCDNR adult drum longline survey for a total of 885 tagged fish in the Port

Royal/Calibogue systems. The SCDNR tagged fish were all from the Port Royal Sound area whereas 22.2 percent (57) of this project's fish were tagged in Calibogue Sound, expanding the geographic range of South Carolina adult red drum studies.

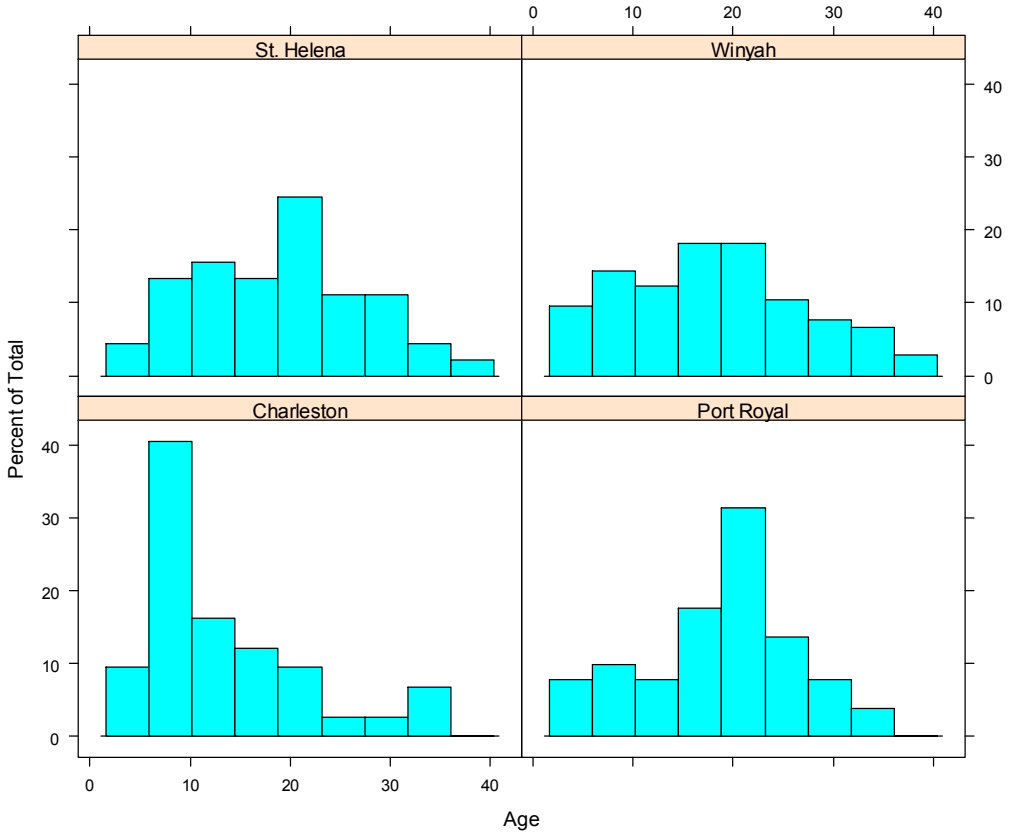
The average length of sampled red drum for the combined 2007-2012 seasons was 980 mm TL (38.6 in.) with a range from 726 mm TL (28.6 in.) to 1155 mm TL (45.5 in.). The length frequency distribution for the 2007-2012 samples is shown in Figure 1. The modal length is 1001-1050 mm TL (39.4 - 41.3 in.). This is comparable to the mean length of the 2005 -2012 longline samples (n=628), taken by SCDNR in the Port Royal sound area. The mean and modal lengths for these collections were 1001 mm TL (39.4 in.) and 1000 mm TL (39.4 in.), respectively. Red drum in the Port Royal Sound longline samples ranged from 660 mm TL (26.0 in.) to 1156 mm TL (45.5 in.). The close agreement of the SCDNR and charter boat mean lengths and length frequency distributions indicates that both fishing methods were sampling the same population and the charter boat mode samples could be included in the assessment database.

Figure 1



The length distribution in Figure 1 is indicative of a healthy population with a strong representation of fish in the 950 mm and under category that range in age from 3-10 years of age and indicates that adequate numbers of juvenile fish are surviving to become part of the adult stock. Samples taken by the SCDNR for aging in major estuaries (Figure 2) verifies the interpretation of the length/frequency distribution showing a normal distribution of age groups in the Port Royal population.

Figure 2.



Catch per effort

Data on the number of anglers, rods fished and hours fished were collected but due to similarities in these parameters for all trips the most appropriate unit of effort was determined to be the trip. The number of rods fished on all trips was usually the same, ranging from 4-6, regardless of the number of anglers. Time fished was usually about 3 hours which represented the most productive fishing periods 1.5 hours on either side of slack water.

The number of fish per trip was highly variable, ranging from 0 to 14 fish per trip. Catch per unit effort (CPUE) in 2011 (September – November) was 3.75 fish per trip. CPUE in 2012 increased to 5.2 adult red drum per trip. Catch rates in 2007 and 2008 were lower at

3.35 and 1.97 fish/trip, respectively. Establishing reliable trends in abundance from CPUE data requires a long time series and the differences shown here don't necessarily reflect significant differences in abundance between years. The high variability in catch per trip and the influence of environmental factors such as weather precluding sampling during peak availability can be more responsible for short term fluctuations in CPUE. Or in the case of charter boat sampling a lack of charters directed at red drum during optimum fishing periods. However precipitous changes in abundance should show up relatively quickly in the recreational CPUE. SCDNR longline sampling between 2007 and 2010 showed a relatively stable trend in CPUE ranging from 0.75 – 1.2 fish /40 hook set.

Recaptures

Tag recaptures have provided information on stock movement patterns and survival of tagged fish. The recaptures of project tagged fish and their time at liberty and recapture source are shown in Table 1. None of the project recaptures moved from the tagging estuary which reinforces our previous observations that adult fish exhibit very strong site fidelity. Three of the seven recaptures were from Calibogue Sound which had substantially fewer tagged fish (57 of 257). Fishing is concentrated in a smaller area in Calibogue Sound and two of the recaptures were short term which may account for the higher return rate. The overall recapture rate was 2.7 % ; substantially higher than the recapture rate for SCDNR tagged adult drum of 0.6 percent. The recapture rate for Charleston harbor for DNR tagged fish is 4-6 percent.

Table 1.

Tag Date	**Recap. Date**	**Recap. Source**	**Tag Area/Recap. Area**
11/27/07	10/13/10	DNRLL	PRS/PRS
12/18/07 *	10/23/12	DNRLL	PRS/PRS
10/10/08 *	10/11/2012	Angler	PRS/PRS
10/15/08	10/21/12	Angler	CS/CS
10/17/09	10/31/09	Angler	CS/CS
10/17/09	11/01/09	Angler	CS/CS
10/18/09	10/09/10	Angler	PRS/PRS

* Deep hooked fish, leader cut near hook before release.

Given the amount of angling directed at adult drum in the Port Royal Sound area and the interest of local anglers in this species it seems unlikely that there is insufficient fishing/sampling to make recaptures or that there is major non-reporting of recaptures. The relatively low recapture rate may be indicative of a large adult population although continued sampling will be required to determine the validity of this interpretation.

Two of the recaptures had lost their nylon dart tag and were identified by their PIT tag. These tags have continued to demonstrate their value in long term identification of adult red drum. Fin clip samples can be matched to identify recaptures of fish that have lost their external tags, not been PIT tagged or lost their PIT tag, however there is often a several year

time lag before DNA samples are analyzed. Given their low cost relative to the expense of tagging operations, the ability to quickly determine if a fish is a recapture would seem to justify the continued use of PIT tags.

In many tagging studies recapture data is used to determine growth rates but with adult red drum the growth in length is very minimal after they reach a total length of 950 mm. Observed growth is less than 25.4 mm (1 inch) for drum at liberty for 3-5 years. Growth of two juveniles that were tagged in the SCDNR trammel net survey and recaptured by this project exhibited substantial growth in length; 16.2 inches in 8 years and 17 inches in 11 years. These fish were also notable because they showed substantial movement from initial tagging location to the recapture location. Both of the fish had been tagged in the Ashley River in Charleston County.

Tag returns have also given us insight into the survival of deep hooked fish. Long term recaptures of several of these fish has demonstrated that at least some portion of these fish survive although efforts to reduce the incidence of deep hooking should be promoted.

Incidence of deep hooking

Circle hooks were used exclusively in all fishing conducted for this project and the occurrence of deep hooking (hook in stomach or pharyngeal area) was noted. The use of circle hooks is supposed to eliminate or substantially reduce deep hooking. During sampling in 2007 and 2008, 23 of 156 fish were deep hooked (14.7%). This was a higher rate than expected. The incidence seemed to be highest around periods of slack water or when the wind and tide were in opposition making it difficult to keep lines taut from the anchored boat. Circle hook effectiveness is based on the fish meeting resistance as it swims off with the bait, turning the hook and causing it to hook in the mouth. When leaders are long, sinkers are rigged to slide and there is slack in the main line, the requisite resistance is missing and there is more chance for the fish to ingest the bait and get hooked deeply.

A study conducted on a directed recreational fishery for adult red drum in North Carolina investigated the effects of circle hook size, leader length and weight rigging on the incidence of deep hooking (Beckwith and Rand, 2005). This study tested the following terminal rigs: long leader (18 in.) with sliding 3 oz. egg sinker and 14/0 Mustad circle hook and a short leader rig (6 in.) with the egg sinker fixed near the barrel swivel with beads and stop sleeves and the Mustad 14/0 circle hook. The deep hooking rate for the long leader rig was 22.0% and only 4.0 % for the short leader with fixed weight. These findings were communicated to the Hilton Head recreational fishing community through fishing clubs and local news releases and these rigging changes were adapted by some of the fishermen targeting adult red drum. In our sampling in 2011 and 2012, only 5 out of 82 fish (6.2 percent) were deep hooked.

In our study most of the deep hooked fish swam off vigorously when released but their short and long term survival is not known. In a recreational fishery targeting protected spawners, it would be advisable to utilize any techniques that would reduce deep hooking and potential mortalities. The North Carolina study did not detect any decrease in fishing success when using the short leader, fixed weight rigs.

DNA Analysis:

In addition to determining genetic differences between various estuarine populations of adult red drum, the collection of fin clips can also determine the contribution of hatchery fish to the adult population. The SCDNR has so far analyzed the Port Royal samples from 2005 – 2008 and determined that less than 1 percent of the adults were hatchery produced fish. The low contribution could be because insufficient time has elapsed for the stocked fish to recruit to the adult population. Analysis of the 2009-2012 samples may show a higher contribution of stocked fish. In areas where stocking has occurred earlier and over a longer time period (Charleston Harbor) the hatchery contribution is 5-6 percent.

CONCLUSIONS

This study is a good example of a cooperative effort utilizing the charter industry and private boat partners and the support of local conservation/environmental organizations to collect fishery dependent data on an important recreational species. Data collected by this project augments data collected from existing SCDNR programs and has fostered a greater understanding among Hilton Head recreational industry participants and the angling public of research and management needs for red drum. Utilizing the expertise of charter captains and local anglers and their vessels has provided a cost effective means to expand the data base for adult red drum in the Hilton Head/Port Royal Sound area.

The size composition of the adult red drum collected by this project was very comparable to the collections from the SCDNR longline sampling which indicates that recreational collections are adequately sampling the adult populations and not a particular segment of the population. Fin clips collected during this segment of the project will be analyzed by SCDNR scientists to answer the important questions of the contributions made to the adult spawning populations by stocked fish and whether there are genetic characteristics unique to the Port Royal Sound red drum. The increased levels of tagged fish provided by this project and ongoing SCDNR longline sampling will provide information on exploitation rates and the relative size of the adult fish populations with continued monitoring. Another important question that increasing numbers of tagged fish will be able to answer is whether there is any significant migratory behavior by Port Royal/Calibogue Sound red drum and if there is any mixing of these stocks or those of other estuarine systems. This study has also provided some baseline data on recreational catch and effort, information that can be utilized for stock assessment purposes and monitoring of trends in abundance as a greater time series of data is acquired.

Some fishery managers have expressed concern over directed fishing for adult red drum given the unknowns of the rate and effects of deep hooking on the survival of these fish. The information collected by this project indicates a decreasing rate of deep hooking with changes in fishing techniques. These changes resulted from outreach activities to educate charter and private boat anglers on preferred rigging techniques that will provide additional protection for the spawners that support one of the most important recreational fisheries in South Carolina.

Literature Cited

Beckwith, G. H. Jr. and P. S. Rand. 2005. Large circle hooks and short leaders with fixed weights reduce incidence of deep hooking in angled adult red drum. Fisheries Research , 71(2005) pp. 115-120.