Trends in relative abundance of reef fishes in fishery-independent surveys in waters off the southeastern United States

Standardized Abundance Based on the
Southeast Reef Fish Survey Chevron Trap (1990-2019 and 2021) and the MARMAP/ SEAMAP-SA Short Bottom Longline (1996-2021) and Long Bottom Longline Surveys (1996-2011, 2015-2016, and 2019)

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Introduction

This annual trends report is meant to serve as an overview of catches of selected snapper-grouper species from a collaboration of fishery-independent surveys (MARMAP, SEAMAP-SA, and SEFIS) using a variety of gears. As such, it should not be considered an update of stock status. For a full stock status update other inputs including, but not limited to, landings, length and age compositions, and life history parameters are needed. Abundance indices developed for this report are standardized to account for factors that may affect the abundances and have varied over the years such as temperature, depth of sampled stations, etc. (see details below). Note that constraints, stratification, units, years used, and models for standardization of abundance used in this report may be different from those used in (SEDAR) stock assessments. For ease of visualization and consistency purposes, abundance indices developed for this report are standardized using similar procedures among species. In addition, it is worth noting that the status of many of the species in this report have not been assessed or updated recently (via SEDAR or other assessment processes), which means there is no pre-existing assessment framework.

Fishery-Independent Monitoring

Fishery-independent measures of catch (abundance) and effort with standardized gear types and deployment strategies are valuable for monitoring stock trends, interpreting exploitation information, providing data for stock assessments, and providing context for developing management regulations. These data are particularly valuable in light of increasing regulations such as minimum size limits and quotas imposed on many managed species. Fishery-dependent measures of abundance are affected by management actions and industry practices, making it impossible to separate population level responses from changes in fishery behavior and management actions (Williams and Carmichael 2009), thereby limiting the use of fishery-dependent data for population/stock assessment. When fisheries are highly regulated, fishery-independent surveys often become the only method available to adequately characterize population size, age and length compositions, and reproductive parameters, all of which are needed to assess the status of stocks. The use of adequate fishery-independent data also decreases assessment uncertainty over fishery-dependent information alone.

The Marine Resources Monitoring, Assessment and Prediction (MARMAP) program has conducted fishery-independent research on ground fish, reef fish, ichthyoplankton, and coastal pelagic fishes of the continental shelf and shelf edge between Cape Hatteras, North Carolina, and St. Lucie Inlet, Florida, since 1972. A major component of MARMAP activities always has been monitoring work using standardized sampling of fish populations over time and the development of an historical base for comparisons of long-term trends in abundance and size compositions. Over time, the sampling strategy changed to become more focused on economically important reef fishes (e.g. sea basses, snappers, groupers, porgies, and grunts), which are found most commonly in live/hard-bottom habitats of the continental shelf and shelf edge. In addition, MARMAP has a soft-bottom habitat component focused on tilefish off the continental slope. Housed at the Marine Resources Research Institute (MRRI) at the South Carolina Department of Natural Resources (SCDNR), the overall mission of the MARMAP program has been to determine the distribution, relative abundance, critical habitat, and life history parameters of economically and ecologically important fishes off the southeastern US Atlantic coast, and relate this information to environmental factors and exploitation activities. MARMAP research provides critical information for stock assessments and evaluation of management plans for the southeast region. Since the mid-1980s, MARMAP has utilized trap and longline gears to sample a diverse array of species and fish sizes throughout the southeastern continental shelf and developed a consistent deployment strategy for each gear by the 1990s.

Until 2009, the MARMAP program was the only long-term fishery-independent program that collected data to develop regional indices of relative abundance and life history analyses for species in the South Atlantic Fisheries Management Council's (SAFMC) snapper-grouper complex. In 2009 and 2010, two complementary fishery-independent programs, the Southeast Area Monitoring and Assessment Program – South Atlantic (SEAMAP-SA) Reef Fish Survey and the Southeast Fishery-Independent Survey (SEFIS), respectively, began cooperating with MARMAP (both in terms of sampling efforts and funding) to enhance MARMAP's traditional survey into a more comprehensive regional survey using the standardized sampling protocols developed by MARMAP. Since 2009, the collective reef fish monitoring in this region is accomplished via the combined efforts of these three fishery-independent programs and called the Southeast Reef Fish Survey (SERFS).

SEAMAP-SA, which is housed at the MRRI at SCDNR, began participating in reef fish surveys in the 2009 field season. In particular, the SEAMAP-SA Reef Fish Survey has allowed MARMAP to identify and document additional hard-bottom habitat on the fringes of the historic survey area, which in turn allowed for the inclusion of additional sampling sites to the survey (**Figure 1**). In addition, the SEAMAP-SA Reef Fish Survey allows for more extensive sampling in marine protected areas (MPAs) for monitoring purposes as well as the continuation of sampling with short and long bottom longlines.

In 2010, the National Oceanographic and Atmospheric Administration's Fisheries program (NOAA Fisheries) initiated the SEFIS program, housed at the Southeast Fishery Science Center (SEFSC) laboratory in Beaufort, NC. This fishery-independent survey was designed to complement the MARMAP / SEAMAP-SA Reef Fish Survey. SEFIS has been pivotal in the further identification of previously un-surveyed hard-bottom habitats, in particular off the coast of Florida, Georgia, and North Carolina. Hard-bottom areas

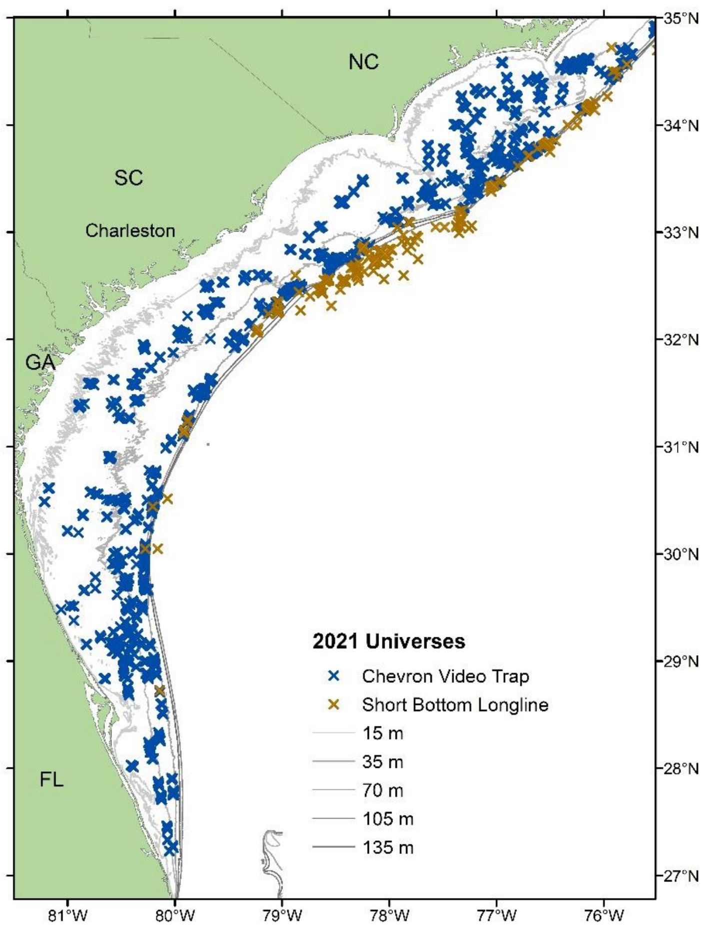


Figure 1. Map of all monitoring stations within the SERFS sampling universe for the 2021 season for chevron traps and short bottom longlines (SBLLs). Long bottom longline deployments were conducted in ~15 nmi blocks off GA and SC (not shown here).

identified during SEFIS and SEAMAP-SA cruises have been added to the universe of areas monitored by SERFS (**Figure 1**). These sites are now monitored by the three fishery-independent survey programs for sampling in each subsequent year. In addition, the supplemental funding for reef fish monitoring through SEFIS allowed the introduction of underwater video for monitoring fish populations that do not enter the traps as readily or to complement trap catches. MARMAP utilized underwater TV, video, and photography in the past, but there had not been a consistent, long-term effort to use video for monitoring purposes.

MARMAP and SERFS have been conducting the fishery-independent monitoring using a variety of gears deployed using a highly standardized methodology. Gear deployment is very similar on the various vessels utilized by SERFS, and staff is cross-trained to limit significant differences in deployment methods. Currently, the chevron trap (CHV; 1990-present) is the primary fish sampling gear, while short bottom longline (SBLL; 1996-present) and the long bottom longline (LBLL; 1996-2007, 2009-2011, 2015-2016, and 2019) also have been used. These longline gears are used to sample deeper areas with relatively high vertical relief or soft bottom habitat, respectively. Note that the deployment of the longline gears was sporadic due to funding sources through the years, though SBLL was more consistent because of the ability to opportunistically sample aboard CHV trips, while LBLL required specific vessels and equipment, limiting it to only targeted trips.

Of note, 2020 sampling was severely limited due to the Coronavirus 2019 (COVID-19) pandemic. A few days of CHV deployments were conducted for a specific research project and a few days of SBLL deployments were conducted to explore potential new stations following standard procedures. No LBLL sampling was conducted in 2020. 2020 was therefore not included in CHV analyses presented here, but was included for SBLL analyses.

Survey Region

The continental shelf off the southeastern U.S. Atlantic coast extends from West Palm Beach, FL to Cape Hatteras, NC, comprising a total area of approximately 90,600 km^2 (Menzel 1993; Fautin et al. 2010). Shelf width varies from 5 km off Palm Beach, FL, and Cape Hatteras, NC, to 150 km off Georgia and South Carolina. Despite the generally subtle slope (~ 1 m/km), ridges and depressions often lead to localized high relief areas (Menzel 1993; Fautin et al. 2010). Hydrographically, the dominant feature of the region is the Gulf Stream, which allows a mix of cold-temperate, warm-temperate, and tropical species to co-exist within the region (Fautin et al. 2010). Immediately inshore of the shelf break, bottom waters are relatively warm (18-22°C) and saline (36.0-36.2 psu) year round, whereas coastal waters and waters offshore of the shelf break vary seasonally due to cool-water upwelling events and warm Gulf Stream intrusions (Fautin et al. 2010).

The dominant geological feature of continental shelf is soft-bottom habitat (mud and sand < 1 m deep) underlain by carbonate sandstone (Henry et al. 1981; Riggs et al. 1996). Secondary to wide expanses of soft-bottom habitat are patchy areas of sand-veneered and rocky outcrop hard-bottom areas (Powles and Barans 1980; Sedberry and Van Dolah 1984), including hard grounds, reefs, and rock outcroppings (Riggs et al. 1996). Hard-bottom is prominent along the shelf break in depths from 45 to 60 m relative to the remainder of the shelf (Fautin et al. 2010). Hard-bottom areas provide substrate for benthic communities, such that hard-bottom habitats often are synonymized with “live-bottom” habitats (Riggs et al. 1996). The term “live-bottom” was first used by Cummins et al. (1962) to describe the most productive trawling areas of hard-bottom between Cape Lookout, NC, to Cape Canaveral, FL. The habitat in these areas was composed of many species of invertebrates, including cnidarians, poriferans, bryozoans and ascidians, attached to naturally occurring hard formations of varying relief and type (Struhsaker 1969; Wenner et al. 1983; Barans and Henry 1984; Sedberry and Van Dolah 1984; Thompson et al. 1999). Though the true percentage of hard-bottom area within the SAB is unknown, various authors have estimated its extent as 4 to 30% of the total shelf area (Fautin et al. 2010).

Hard-bottom areas are ecologically important resources in that they are necessary to the life history of many ecologically and economically important fish communities (Powles and Barans 1980; Grimes et al. 1982; Barans and Henry 1984; Collins and Sedberry 1991; Sedberry et al. 2001; Sedberry et al. 2006). These fish assemblages include economically valuable snappers (Lutjanidae), groupers (Serranidae), grunts (Haemulidae), porgies (Sparidae), as well as a diverse array of tropical fish families such as wrasses (Labridae) and damselfishes (Pomacentridae; Fautin et al. 2010). Managed as the snapper-grouper complex (SAFMC 1991), many of these species are, or have been, subjected to intense fishing pressure. Examples of such species are Red Snapper, Black Sea Bass, Red Porgy, Vermilion Snapper, and Gag Grouper. Due to the extent of management actions in this region, fishery-independent monitoring for these species is essential for assessments. In addition, studies on various aspects of the life history of reef fish species which can often only be obtained through concerted fishery-independent efforts provide essential inputs for increasingly complex stock assessment models (e.g. Sedberry and Van Dolah 1984; Low et al. 1985; Vaughan et al. 1995; Harris and McGovern 1997; McGovern et al. 1998; Harris and Collins 2000; Harris et al. 2002; Harris et al. 2004; Harris et al. 2007; Schobernd and Sedberry 2009; Bubley and Pashuk 2010; Stratton 2011).

Objective

This report presents a summary of the fishery-independent monitoring and analyses for 23 species from the snapper-grouper complex in the region (**Table 1**) derived from CHV trap and longline catch data collected from 1990 through 2021 by the three monitoring programs (MARMAP, SEAMAP-SA, and SEFIS) involved in SERFS. Specifically, it presents updated annual standardized abundance for the monitoring gears currently in use (referred to as an index of abundance). Standardization is applied to account for the effects of potential covariates on the abundance for a given gear type. Species distribution maps and annual length information of captured fish for each gear type also is provided. Data presented in this report are based on a database maintained by SCDNR which houses data from all SERFS partners that was accessed in February 2022.

Table 1. Species included in this report by gear. CHV = chevron trap, SBLL = short bottom longline, and LBLL = long bottom longline

			Gear	
Common Name	**Scientific Name**	**CHV**	**SBLL**	**LBLL**
	Balistidae			
Gray Triggerfish	*Balistes capriscus*	X		
	Carangidae			
Almaco Jack	*Seriola rivoliana*	X*	X*	
Greater Amberjack	*Seriola dumerili*	X*	X*	
	Haemulidae			
Tomtate	*Haemulon aurolineatum*	X		
White Grunt	*Haemulon plumierii*	X		
	Lutjanidae			
Red Snapper	*Lutjanus campechanus*	X		
Vermilion Snapper	*Rhomboplites aurorubens*	X		
	Malacanthidae			
Blueline Tilefish	*Caulolatilus microps*	X*	X	
Golden Tilefish	*Lopholatilus chamaeleonticeps*		X*	X*
	Sebastidae			
Blackbelly Rosefish	*Helicolenus dactylopterus*		X*	
	Serranidae			
Bank Sea Bass	*Centropristis ocyurus*	X		
Black Sea Bass	*Centropristis striata*	X		
Gag	*Mycteroperca microlepis*	X	X*	
Red Grouper	*Epinephelus morio*	X	X*	
Sand Perch	*Diplectrum formosum*	X		
Scamp	*Mycteroperca phenax*	X	X*	
Snowy Grouper	*Hyporthodus niveatus*	X	X	
Speckled Hind	*Epinephelus drummondhayi*	X*	X*	
	Sparidae			
Knobbed Porgy	*Calamus nodosus*	X		
Pinfish	*Lagodon rhomboides*	X		
Red Porgy	*Pagrus pagrus*	X	X*	
Spottail Pinfish	*Diplodus holbrookii*	X		
Stenotomus spp.	*Stenotomus* spp.	X		

* - Did not meet criteria to standardize an index of abundance or the index could not be developed due to limited data. Raw catch information provided.

Methods

Sample Collection

Given the close coordination and consistent sampling methodology used by each of the fishery-independent sampling programs involved in SERFS, no adjustments to raw catch, effort, or length data were needed prior to the analyses presented in this report. Note that the number of CHV deployed in recent years has increased on average two- to three-fold from historical numbers (**Table 2**). The short and long bottom longline surveys are conducted by SCDNR only, whichever funding source is used, using identical methodologies as in previous years. **Table 2** summarizes the annual gear deployments for each gear type.

Table 2. Number of gear deployments, by year and gear type, during fishery-independent sampling of live/hard bottom stations or soft-bottom blocks. This includes both randomly and opportunistically selected monitoring stations/reconnaissance converted ("included" collections) and reconnaissance stations.

Year	Chevron Trap	Short Bottom Longline	Long Bottom Longline	Hydrographic
1990	354	–	–	78
1991	305	–	–	62
1992	324	–	–	58
1993	542	–	–	99
1994	468	–	–	72
1995	545	–	–	70
1996	642	20	17	111
1997	532	34	21	104
1998	523	33	10	106
1999	347	44	30	83
2000	383	40	11	81
2001	325	36	14	65
2002	336	22	20	64
2003	286	54	16	64
2004	343	48	5	66
2005	357	58	16	76
2006	332	96	7	75
2007	361	74	25	97
2008	354	58	–	71
2009	464	71	38	113
2010	1051	135	40	270
2011	1010	142	30	178
2012	1393	28	–	249
2013	1561	42	–	285
2014	1520	60	–	286
2015	1523	103	45	498
2016	1537	78	30	325
2017	1574	54	–	292
2018	1784	77	–	322
2019	1745	39	4	299
2020	19	32	–	34
2021	2025	144	–	399

The current SERFS sampling area includes waters of the continental shelf and shelf edge between Cape Hatteras, NC, and St. Lucie Inlet, FL, though historically, the majority of sampling occurred between Cape Lookout, NC, and Ft. Pierce, FL (**Figure 1** and **Figure 2**). With the addition of SEFIS and SEAMAP-SA, recent efforts have expanded the range farther north and south towards the desired boundaries at Cape Hatteras, NC and St. Lucie Inlet, FL, respectively. Throughout this range, randomly-selected monitoring stations (confirmed hard bottom) are sampled by either CHV ir SBLL from mid-April through mid-October each year, depending on weather conditions. Criteria for random selection include that no station in a given year is closer than 200 m to any other selected station. Non-selected stations can be sampled as alternates if a selected station is not available or accessible so long as the 200 m buffer is adhered to. Additionally, reconnaissance locations (suspected hard bottom) are sampled as time and funding allows when potential habitat is identified. If catch or videos indicate hard bottom at reconnaissance locations, these deployments can be converted to sampling stations in subsequent years and treated identically as all other stations in the sampling universe in terms of selection, sampling, and analyses. Stations are designated for sampling for either CHV (low to medium relief) or SBLL (medium to high relief), but not both gears. Due to the length of the LBLL gear and target habitat, predetermined areas (so-called “blocks”) over soft bottom habitat are used for sampling rather than (point) stations.

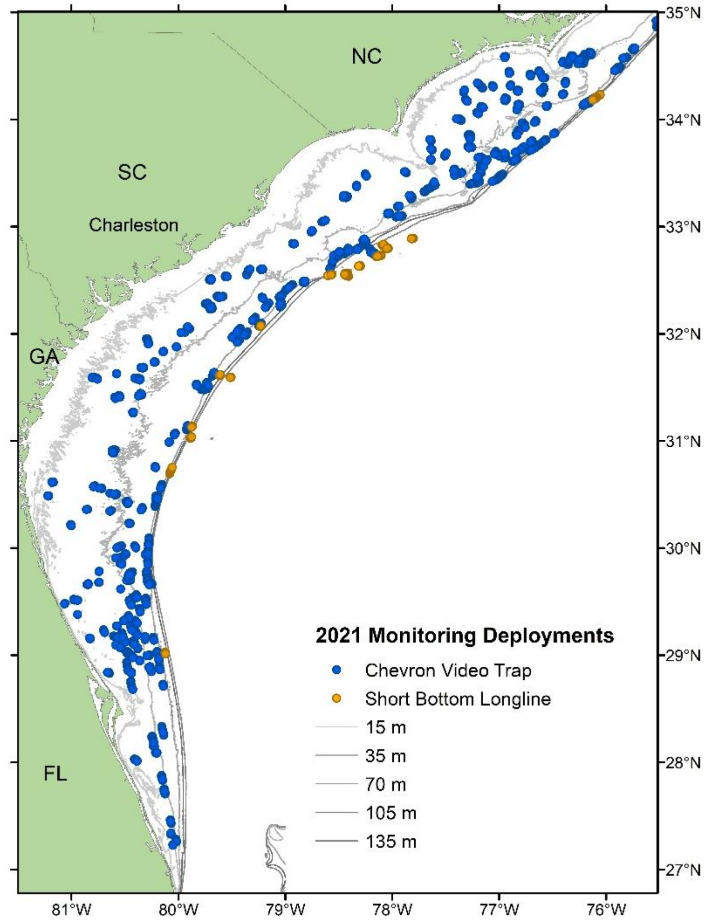


Figure 2. Map of all monitoring stations sampled in 2021, the most recent sampling year. Note that each symbol may represent multiple sampling events due to proximity of locations and scale of the map

Chevron Traps

<u>Background</u>

The MARMAP program began using CHVs in 1988 after a commercial fisherman introduced the use of this trap design in the Atlantic waters off the Southeastern United States (Collins 1990). Subsequently, in

1988 and 1989, CHVs were used simultaneously with blackfish and Florida Antillean traps to compare the efficiency of the three different trap designs at capturing reef fishes on hard-bottom habitats (Collins 1990). The CHV was considered most effective overall for species of commercial and recreational interest in terms of both total weight and numbers of individuals (Collins 1990).

Beginning in 1990, MARMAP used CHVs for reef fish monitoring purposes in lieu of blackfish or Florida Antillean traps. Until 2009, each year between 500 and 700 stations were selected randomly from a database of approximately 2,200 known low to moderate relief hard-bottom areas identified for monitoring via fish traps. Sampling efforts, in particular the number of sea days, were confounded by available MARMAP funding over time. With the inclusion of the two additional fishery-independent groups composing SERFS, and the associated substantial increase in overall survey funding, the number of stations selected has increased, reaching over 2,400 randomly selected stations per year in 2021, while the universe of available trap stations has grown to approximately 4,300. Note that the normal effort in the last 10 years is 1,500 randomly selected stations. 2021 efforts were expanded for just that year due to the availability of carry-over funds not used for sea days in 2020 due to COVID-19. Station depths range between 14 and110 m. In the most recent years, the R/V *Palmetto,* R/V *Savannah,* and NOAA Ship *Pisces* serve as the research platforms for CHV deployment.

<u>Gear Description</u>

CHVs are arrowhead shaped, with a total interior volume of 0.91 m^3, constructed using 35 x 35 mm square mesh plastic-coated wire, and possess a single entrance funnel (“horse neck”), one release panel to remove the catch, and one release panel with dissolvable (“7-day pop-up”) zinc fasteners to prevent ghost fishing (**Figure 3**; Collins 1990, MARMAP 2009).

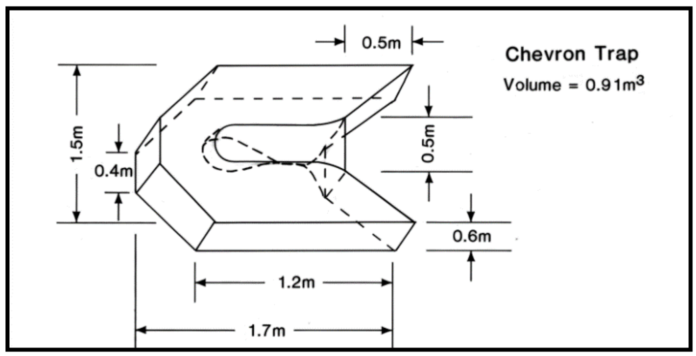


Figure 3. Diagram of the chevron trap used for monitoring purposes by MARMAP/SERFS from 1990-2018 (from Collins 1990)

Prior to deployment, CHVs are baited with a combination of whole or cut clupeids (*Brevoortia* or *Alosa* spp., family Clupeidae), with menhaden most often used. To bait, four whole clupeids are suspended on each of four stringers within the trap and 8 additional clupeids, with their abdomen sliced open, are placed loose in the trap (**Figure 4**). Subsequently, an appropriate length of 8 mm (5/16 in) polypropylene anchor line is attached to an individual trap and buoyed to the surface using a polyball buoy. A 10m trailer line is attached to this anchor line on one end and to a Hi-Flyer or second polyball buoy on the other. Traps are deployed generally in sets of six (MARMAP 2009). Traps are retrieved in chronological order of deployment, using a hydraulic pot hauler, after an approximately 90-minute soak time.

utilized cameras (still and video) mounted on top of CHVs intermittently to document bottom habitat, trap behavior, and to observe reef fish species since 1990. Since 2007, CHVs were increasingly outfitted with cameras, either still or video. By 2009, all survey traps were fitted with at least one type of camera and from 2011 on, all traps had video cameras per SEFIS protocols. Catch data from traps equipped with cameras were treated the same as all other data, as it is assumed that the cameras likely do not impact catchability of the traps.

Figure 4. Chevron trap baited with Menhaden, ready for deployment. Note, iron sashes were used to weigh the trap down, thus promoting the proper orientation, and stabilizing the trap, on the bottom

Short bottom longline

Background

Although there were some trial deployments in 1979, 1987, and 1989, the MARMAP program initiated the SBLL survey in its current configuration in 1996, with an initial goal of sampling snapper-grouper species inhabiting hard-bottom areas with considerable vertical relief, mostly in depths greater than 75 m. This gear replaced the previously used Kali pole longline gear (see Russell et al. 1988) for sampling reef fishes in these habitats. In previous reports, the MARMAP program referred to this gear as a “vertical longline” since it was commonly draped over vertical relief. This name was changed to SBLL in 2009, following the Southeast Area Fisheries-Independent Survey Workshop (Williams and Carmichael 2009) in Beaufort, NC, to avoid confusion with “true” vertical longlines with hooks suspended in the water column.

Due to a lack of funding, the SBLL program was limited to opportunistic sampling in 2012 and 2013 with funding provided by SEAMAP-SA and MARFIN recently (**Table 2**). Annually, up to 300 SBLL stations are selected randomly from a sampling universe of ~330 previously identified SBLL monitoring stations. An expansion of the survey universe has been undertaken with the recent MARFIN funding. Station depths range between 75 and 315 m. Deployment of SBLL gear for monitoring purposes have been made by the SCDNR using the R/V *Palmetto* and R/V *Lady Lisa.*

Gear Description

The SBLL consists of 25.6 m (~84 ft) of 6.4-mm diameter treated solid braid Dacron (polyester) ground line dipped in green copper naphthenate. Twenty gangions with non-offset circle hooks (almost exclusively #5 Eagle claw size, but in some years some #7 were used) are placed 1.2 m (~4 ft) apart on the ground line. The gangions consist of an AK snap, 0.5 m of 90 kg monofilament and a non-offset circle hook and are baited with a double-hooked whole squid (*Illex* sp. or *Loligo* sp.). Weights totaling 10-11 kg are clipped to the ground line at either end. The ground line is tethered to the surface using an 8-mm (5/16 in) polypropylene anchor line with a polyball buoy attached at the opposite end. A 10 m trailer line is attached to this anchor line on one end and to a Hi-Flyer or second polyball buoy on the other. Soak time is approximately 90 minutes, and the gear is retrieved utilizing a pot hauler. Up to six SBLLs are deployed at one time.

Long bottom longline

Background

The LBLL survey was initiated in the early 1980s to sample the snapper-grouper species in soft bottom habitats, which are often inhabited by tilefishes. Only data from the years 1996-2007, 2009-2011, 2015-2016, and 2019 were used in the sampling and length summaries. Annual abundance was not standardized for LBLL due to sporadic funding.

Due to a reduction in funding, the LBLL program was suspended in 2012 until funding was provided through SEAMAP-SA and MARMAP in 2015 and 2016 to resume sampling, with another suspension due to lack of funding in 2017 (**Table 2**). Identification of potential LBLL sampling areas was based on information provided by commercial and recreational fishermen, fathometry data, previous exploratory surveys (Low et al., 1983), and Kali pole surveys conducted during 1985 and 1986. Subsequently, identified sampling locations were divided into 17 sampling blocks (~15 nmi^2) based on the LORAN grid, 15 off SC and GA and 2 off FL. Since 1996, the goal has been to deploy the gear along two parallel lines within each block each year with a minimum distance of 200 m between each deployment. Sampling depths range between 178 and 231 m.

LBLL sampling generally is conducted from August through October, with MARMAP/SEAMAP-SA staff using the R/V *Lady Lisa* as the primary research platform. The number of successful deployments has varied over the years, mostly due to weather conditions and current speeds. Currents exceeding 2 knots can affect safe deployment and retrieval of the gear, as well as catchability. Sampling generally is halted if current speed exceeds 2 knots.

Reduced catchability of Golden Tilefish at low bottom temperatures has been reported and attributed to decreased feeding activity (Bigelow and Schroeder 1953; Low et al. 1983). Due to these observations, from 1996 to 2005, CTD casts were collected prior to each LBLL deployment, rather than during deployment as with other gear types. If the bottom temperature was below 9°C, no sampling was conducted, and the vessel moved to another location either within the block or to an adjacent block to attempt sampling. In 2006, this assumption was revisited by MARMAP staff because of low or no catches in 2004 and 2005, despite temperatures greater than 9°C. Beginning in 2006, MARMAP started sampling tilefish habitat even if the temperature was below 9°C. These efforts indicated that Golden Tilefish are caught, even below this temperature, as long as the appropriate habitat (soft bottom) and depth range (150 - 250 m) was targeted. Highest catches generally occurred between depths of 200 and 230 m. Nevertheless, in the development of abundance estimates of Golden Tilefish, it is prudent to take into account bottom temperature given the early literature suggesting bottom temperature affects catchability and to account for the change in sampling strategy.

Gear Description

From 1996 on, LBLLs were constructed of 3.2-mm galvanized cable (1,525 m long; approximately 5,003 ft), deployed from a longline reel with 1,220 m (~4003 ft) of cable used as ground line and the remaining 305 m (~1,000 ft) buoyed to the surface as an anchor line. When setting the gear, weights totaling 10-11 kg are attached to the ground line, dropped into the water, and 100 gangions (comprised of an AK snap, approximately 0.5 m of 90 kg monofilament and a #5 non-offset circle hook) are attached to the ground line as it pays out. Hooks are baited with double-hooked whole squid (*Illex* sp. or *Loligo* sp.). Gangions are attached in 12 m (~39 ft) intervals to the ground line. After the attachment of all 100 gangions another 10-11 kg of weights are attached at the terminal end of the ground line (buoy end). The anchor line is buoyed to the surface with 1 or 2 polyball buoys followed by a 10 m Dacron (polyester) trailer line and another polyball buoy. LBLLs generally are deployed while running with the current at a speed of 4-5 knots, with each line being soaked for 90 minutes and subsequently retrieved using a hydraulic pot hauler. Typically, two LBLLs are deployed at one time.

Hydrographic Data

CTD casts recorded water column depth, temperature, and salinity. Typically, a CTD cast is conducted between the deployment of the last piece of gear in a set and retrieval of the first piece of gear, while the gear soaks. In the case of LBLLs prior to 2005, the single CTD cast was made prior to deployment of the set to check bottom temperature. Data obtained from the single CTD cast is associated with the deployed gear set. A set is composed of up to six (generally six) CHVs or SBLLs deployed at the same time in the same general geographic area. For LBLLs, a set consists of one or two LBLLs deployed at the same time in the same general geographic area.

From 1990 through 1992, an Applied Microsystem's STD-12 model CTD was employed (depth, temperature, salinity, and dissolved oxygen) for gear deployments mentioned above. From 1993 through the current sampling year (2021), we used Sea-Bird models SBE-19 or SBE-25 Plus. All CTD's are calibrated by authorized dealers/personnel according to the manufacturer's guidelines annually. For this report, only temperature was included in analyses as it displayed more variability across the region. Specifically for temperature, the value at the deepest point of the cast is included here (bottom temperature). While depth was included in the analyses, it was taken from fathometer readings for each individual gear deployment and not the CTD due to potential variability among stations within a set.

Since 2015, Vemco data loggers were used in place of CTD casts to gather bottom temperature data for LBLL and since 2020 for SBLL on the R/V *Lady Lisa*. Data loggers were attached to the ground line of at least one longline per set via a gangion close to the anchor line. These were set to record temperature at 10-minute intervals. Since 2012, data loggers also were attached to 2 or 3 traps or SBLL per set as a backup source of bottom temperature data in the event of CTD failure.

Nominal Abundance Estimation

After collection, all fishes are sorted to species, weighed (total weight in grams, per species, per trap or longline), and all individual fish are measured. Fish lengths are presented in mm maximum total length (TL), meaning that the caudal fin is "pinched" while measuring the fish length. From this length frequency work-up, the number per species per deployment is summed to produce number caught or abundance. Estimates of abundance included only gear deployments with a soak time between 45 and 150 minutes. Data from monitoring stations or reconnaissance collections converted to monitoring stations were included, but if a gear malfunctioned or the catch was otherwise compromised, that collection was not included. As such, only trap collections with no catch (catch code 0), catch with finfish (catch code 1), and catch with no finfish but other organisms (catch code 2) were used. The first year that samples from reconnaissance converted stations were included in the indices for the report was 2015 and those nominal abundance values from previous reports have been adjusted. Tagging efforts in which the full length-frequency work-up was not performed also were excluded from analyses. Continuing quality assurance/quality control of historical data resulted in some adjustments to the database over time to account for data collected during activities other than monitoring, such as these tagging studies, and uncertainties regarding the catch composition of certain traps. Some of these data were included in previous trends reports for abundance calculations, explaining some minor differences between values found in this report compared to values in prior trends reports. Finally, collections which were missing covariate information were excluded from analyses (e.g. depth or bottom temperature). The collections under these constraints/criteria are referred to as, “included collections” below. The unit of effort for each gear and species is: CHV = # fish* $trap^{-1}$ *$hour^{-1}$ and SBLL = # fish*$line^{-1}$*$hour^{-1}$ for the nominal indices. Because no LBLL deployments were made 2017-2018 or 2020, and limited deployments in 2019, please refer to the trends report for the 2016 sampling season to obtain nominal and standardized indices of abundance for Golden Tilefish in this gear.

Annual nominal mean abundance for each species was calculated by determining the numbers of individuals caught per hour of soak time, divided by the total number of gear deployments for that year (Equation 1).

Equation 1.

$$\text{Annual abundance} = \sum \frac{\#\, fish\ caught * 60\ minutes}{deployment\ duration\ (minutes)} / \#\ gear\ deployments$$

The abundance was then normalized by dividing the annual abundance by the mean abundance for the time series. This not only normalized trends among species, but also provides a reference point for individual years in relation to the time series as a whole, with a value of 1 being the long-term mean.

Abundance Standardization

Species selected for abundance standardization had a proportion positive ≥ 1.5% and no more than 3 years with zero catch over the time series. Previous trends reports have utilized a delta-GLM standardization method (Lo et al. 1992), but as with many ecological count data sets (Zuur et al. 2009), abundance data from these surveys often were zero-inflated. This led us to examine other model structures which may improve fit, reduce bias in the standard errors, and reduce overdispersion caused by excessive zeros (Zuur et a. 2009). See Ballenger et al. (2014), and Ballenger et al. (2017) for a more thorough description of the rationale for using this model structure specific to SERFS data. Model structures considered include Poisson GLM, negative binomial GLM, zero-inflated Poisson GLM (ZIP), and zero-inflated negative binomial GLM (ZINB). Through preliminary analyses, the ZINB performed better than the other 3 model structures in terms of fit and limiting overdispersion in the vast majority of species, so gear-specific abundance was standardized among years with the ZINB method unless otherwise noted.

Standardization procedures were based on Ballenger et al. (2017), using modified R scripts and methodology. The abundance was modeled as catch per deployment, compared to the traditional method of calculating catch per deployment per hour that was done with the nominal catch. The natural log of the time the gear was fishing in the water (soak time), was included as an offset term to account for effort. Year was included in the model, as this was the desired response variable to examine temporal trends. The covariates examined were depth, latitude, bottom temperature, and day of year (**Table 3** and **Table 4**). They were included in the models as continuous variables modeled with polynomials. Maximum allowed order for each polynomial was based on preliminary generalized additive models (GAMs). Unless noted otherwise, the polynomial order was limited to a maximum fourth order under the assumption that higher order polynomials would not have biological relevance based on the covariates in this analysis. Because of widely differing scales of the covariates, they were centered by subtracting the individual covariate mean and scaled, by dividing the centered values by their standard deviation prior to the GAMs. This was done to improve model stability for fitting purposes. There were two components of the model: presence/absence and abundance.

Catch abundance was modeled versus all covariates to inform the polynomial order for the count sub-model of the standardization model. The presence/absence data also was modeled versus all covariates for the zero-inflation sub-model. Model selection was based on Bayesian information criteria to increase the penalty associated with adding parameters to the model. A two-step optimization process was utilized due to computational demands. All covariates were removed from the zero-inflation sub-model and the count sub-model was optimized for all covariates. Then, the count sub-model optimal values were fixed, and the covariate structure of the zero-inflation sub-model was optimized. We allowed for the possibility that different covariates can be included in the zero-inflated sub-model and catch sub-model. All analyses were performed in R (R Development Core Team 2020). The zero-inflated models in R were developed using the function zeroinfl available in the package *pscl* (Jackman 2011; Zeileis et al. 2008). Annual year effect coefficients of variation (CVs) were computed using bootstrapping procedures of 5,000 iterations. Confidence intervals for figures are plotted using CVs, but in rare cases (years with zero catch) those CVs are extremely high and are not represented in the plots because they are applied to a value of 0.

The standardized index also was normalized by dividing the annual standardized abundance by the mean standardized abundance for the time series. This not only normalized trends among species, but also provides a reference point for individual years in relation to the time series as a whole, with a value of 1 being the mean.

Table 3. Chevron trap sampling summary for all collections included in abundance analyses

Year	Included Collections	Depth (m)		Latitude (°N)		Temperature (°C)		Day of Year	
		Avg	Range	Avg	Range	Avg	Range	Avg	Range
1990	310	34	17-93	32.5	30.4-33.8	22	18.2-27.8	150	114-222
1991	259	34.3	17-95	32.6	30.8-34.6	24.9	15.9-27.5	216	163-268
1992	286	34	17-62	32.8	30.4-34.3	21.3	15.3-24.5	155	92-227
1993	380	34.9	16-94	32.4	30.4-34.3	22.8	17.7-28.5	176	131-226
1994	340	39.4	16-93	32.3	30.7-33.8	22.7	18.2-26.9	174	130-300
1995	336	33.4	16-60	32.1	29.9-33.7	24.6	20.1-28.3	199	124-299
1996	323	36.9	14-100	32.5	30.0-34.3	22.1	15.6-27.0	185	121-261
1997	345	39.2	15-97	32.2	27.9-34.6	22.8	15.0-28.0	194	126-273
1998	373	38.8	14-92	32	27.4-34.6	21.5	9.5-28.6	176	126-231
1999	213	35.8	15-59	31.9	27.3-34.6	23	17.9-28.8	201	153-272
2000	272	35.2	15-91	32.2	29.0-34.3	24	18.5-28.5	202	138-294
2001	231	38.3	14-91	32.3	27.9-34.3	23.6	16.0-29.2	204	144-298
2002	225	38.4	13-94	31.8	27.9-34.0	24	15.2-28.3	205	169-268
2003	206	40.7	16-92	32	27.4-34.3	18.8	13.4-25.1	203	155-266
2004	259	40.8	14-91	32.2	30.0-34.0	20.8	16.7-25.8	176	127-303
2005	278	38.9	16-69	32	27.3-34.3	23	18.0-28.5	192	124-273
2006	281	38.7	15-94	32.2	27.3-34.4	22.4	15.0-26.7	203	158-272
2007	317	38.5	15-92	32.1	27.3-34.3	23.2	15.3-28.9	202	142-268
2008	277	39	15-92	32.1	27.3-34.6	21.8	15.2-27.2	195	127-275
2009	404	36.3	14-91	32.2	27.3-34.6	22.6	15.4-27.2	203	127-282
2010	732	38.6	14-92	31.3	27.3-34.6	22.2	12.3-29.4	222	125-301
2011	731	40.7	14-93	30.9	27.2-34.5	21.6	14.8-28.8	210	140-300
2012	1174	40.8	15-106	31.9	27.2-35.0	22.1	12.9-27.8	195	116-285
2013	1358	38.3	15-110	31.3	27.2-35.0	22	12.4-28.1	197	115-278
2014	1473	39.3	15-110	31.9	27.2-35.0	23.3	16.1-29.3	192	114-295
2015	1464	39.3	16-110	31.9	27.3-35.0	22.6	13.6-28.5	187	112-296
2016	1485	40.9	17-115	32.1	27.2-35.0	23.8	15.5-29.3	217	126-301
2017	1541	40.5	15-114	32	27.2-35.0	22.6	14.8-28.2	187	117-273
2018	1736	40.3	16-114	32	27.2-35.0	22.5	13.6-28.3	177	116-278
2019	1665	40.2	16-113	32	27.2-35.0	23.3	15.0-29.5	185	121-269
2020	-	-	-	-	-	-	-	-	-
2021	1832	38.3	16-110	31.8	27.2-35.0	23.3	17.9-28.1	191	119-274

Table 4. Short bottom longline sampling summary for all collections included in abundance analyses

		Depth (m)		Latitude (°N)		Temperature (°C)		Day of Year	
Year	Included Collections	Avg	Range	Avg	Range	Avg	Range	Avg	Range
1996	12	155.6	73-220	32.4	32.1-32.7	14.2	7.9-20.8	206	124-236
1997	33	193.2	181-209	32.6	32.5-32.7	15.6	14.2-16.3	261	260-262
1998	31	191.2	174-212	32.7	32.5-32.9	11.3	8.9-15.4	181	126-232
1999	36	119.3	73-198	33.4	32.5-34.2	18.3	14.5-21.2	191	159-273
2000	34	160	70-198	32.9	32.5-33.9	16	12.8-23.7	212	173-230
2001	29	158	75-212	33.1	32.5-34.2	15.4	11.2-20.0	216	171-264
2002	19	85.8	71-113	32.9	32.1-33.4	17.4	16.4-18.6	194	191-200
2003	51	165.2	88-210	32.7	32.2-33.2	12.7	10.8-17.2	229	198-239
2004	21	131.6	72-215	32.1	32.1-32.3	15.5	11.6-18.4	167	128-219
2005	42	114	69-208	33.1	32.1-33.8	17.3	13.5-21.3	181	140-203
2006	50	153.8	65-219	33	32.5-34.2	12.9	9.8-18.5	205	174-271
2007	52	102.2	71-201	33.2	32.1-33.9	19.4	12.5-22.7	189	159-236
2008	29	152.8	72-198	32.5	32.1-32.7	16.8	15.1-20.4	220	172-242
2009	43	102.1	71-200	33.1	32.1-34.2	18.5	12.9-24.7	235	217-261
2010	77	128.4	66-205	32.7	32.1-33.8	14.6	10.2-18.8	170	127-266
2011	61	123.5	66-227	33	32.1-34.2	15.1	8.6-19.9	188	145-243
2012	21	173.8	71-201	32.9	32.7-34.6	14.7	13.7-22.6	218	197-244
2013	41	137.2	83-210	33.2	32.5-33.8	16.4	10.3-20.6	207	176-234
2014	57	148.3	72-212	32.8	32.1-33.8	16	12.7-20.9	198	128-282
2015	75	155.1	65-225	32.8	32.1-34.2	14.6	10.0-19.7	226	140-284
2016	62	144.7	72-218	32.7	32.1-33.5	14.1	10.6-20.0	270	225-295
2017	48	103.7	72-203	32.9	32.1-33.8	19.7	13.6-26.2	199	173-223
2018	66	145.3	65-211	32.8	32.3-33.8	14.8	10.6-22.0	185	125-243
2019	25	193.8	179-230	32.6	32.5-32.6	11.9	11.2-12.4	177	177-178
2020	20	111.2	76-221	32.3	32.1-32.6	23	15.1-26.8	272	269-276
2021	108	155.5	85-218	32.7	30.7-34.2	21.3	17.5-25.2	249	161-288

Length Compositions

Species mean length, as well as length frequency distribution for each gear were determined using the same collections used in the abundance calculations. Historically, fish lengths were measured in either maximum total length (TL) or fork length (FL) depending on species. Beginning in 2012, all fish were measured in TL. For any species for which measurement type changed over time, lengths were converted to TL based on FL/TL conversion equations compiled from the MARMAP database in 2019 (**Table 5**). Because of this conversion, resolution of cm size bins, and rounding, these species contain some empty size bins during years that are converted from FL to TL.

Table 5. Length-length conversion equations by species. All conversions are based on individual specimen data from the combined MARMAP and SERFS database (1973-2018). TL = total length (cm) and FL = fork length (cm). Note that Bank Sea Bass, Black Sea Bass, and Snowy Grouper do not have a forked tail, and so there is no conversion for those species

Species	Equation	n	r^2
	Balistidae		
Gray Triggerfish	TL = 1.111 * FL - 1.799	17,321	0.964
	Carangidae		
Almaco Jack	TL = 1.142 * FL + 0.266	112	0.996
Greater Amberjack	TL = 1.103 * FL + 4.037	2,057	0.975
	Haemulidae		
Tomtate	TL = 1.109 * FL + 0.772	4,391	0.983
White Grunt	TL = 1.115 * FL +0.307	13,912	0.995
	Lutjanidae		
Red Snapper	TL = 1.070 * FL + 0.155	9,324	0.999
Vermilion Snapper	TL = 1.110 * FL + 0.044	32,557	0.996
	Malacanthidae		
Blueline Tilefish	TL = 1.047 * FL + 0.680	1,419	0.991
Golden Tilefish	TL = 1.082 * FL - 1.425	3,891	0.998
	Sebastidae		
Blackbelly Rosefish	TL = 1.029 * FL + 0.150	2,349	0.996
	Serranidae		
Bank Sea Bass	N/A	-	-
Black Sea Bass	N/A	-	-
Gag Grouper	TL = 1.036 * FL - 0.126	4,125	0.998
Red Grouper	TL = 1.058 * FL - 0.978	1,906	0.997
Sand Perch	TL = 1.110 * FL + 0.679	1,448	0.974
Scamp Grouper	TL = 1.126 * FL - 2.021	5,143	0.99
Snowy Grouper	N/A	-	-
Speckled Hind	TL = 1.018 * FL + 0.187	1,026	0.998
	Sparidae		
Knobbed Porgy	TL = 1.086 * FL + 1.910	2,000	0.985
Pinfish	TL = 1.173 * FL - 0.549	38	0.994
Red Porgy	TL = 1.132 * FL + 0.719	38,358	0.993
Spottail Pinfish	TL = 1.139 * FL + 0.207	61	0.995
Stenotomus spp.	TL = 1.162 * FL - 0.250	366	0.994

Species Distributions

Individual species distributions within the survey for the most recent 5 years of sampling were produced by interpolation in ArcGIS 10.6.1. Interpolations were fit to nominal abundance by inverse distance weighting. To minimize representing unsampled areas as sampled, interpolations were fit to a mask developed for either the CHV station universe or the SBLL station universe by applying a 10-km buffer around stations and then dissolving connected buffers. This method still over-represents the sampled area, but is needed to allow visualization of the abundance distribution. If species did not occur in high enough frequency to develop an index of abundance for a given gear, a distribution was not developed for that gear. Interpolated abundance is represented as quantiles to allow for comparison among species and with previous years' reports, effectively creating a relative heat map of abundance.

Results

Gear Summary

Chevron Trap

From 1990 to 2021 (excluding 2020), there were a total of 24,846 CHV gear deployments for routine sampling (**Table 2** and **Table 6**), averaging 801 collections per year (range: 286 – 2,025). Of these collections 21,513 (86.6% of total), were included in the development of annual abundance estimates, representing an average of 694 collections per year (range: 224 – 1,832, **Table 6**, **Figure 1**, and **Figure 2**). Due to COVID restrictions in 2020 on SCDNR scientific vessels, overnight trips were not permitted, which limited spatial extent of sampling, so standard monitoring deployments did not take place. The remaining collections not used in the development of annual abundance estimates (n = 3,333), were excluded due to isolated, or a combination of, the following factors: reconnaissance trap deployments not converted to monitoring stations the following year, stations sampled more than once a year or too close to another sampled station, soak times outside of specified range (≥45 or ≤150 m), damaged or lost gear or otherwise compromised catches, specified tagging cruises (1990, 1993-2000, 2002, and 2006), or a lack of complete environmental data.

Initially the emphasis of the expansion of sampling efforts since 2009, was to identify previously unsampled reef fish habitats and expand the geographic and depth range coverage. In 2010 and 2011, the increase in total CHV deployments was not reflected proportionally in the number of collections included in index development due to the large number of reconnaissance stations, some of which were not selected for inclusion into the sampling universe the following year (**Table 6**). The number of included collections relative to total collections since SEFIS and SEAMAP-SA efforts were included was initially lower than the series average, but has been increasing due to fewer reconnaissance collections to identify stations (**Figure 2**). The number of included CHV collections in 2021 represented a 453% increase in collections included for analyses compared to 2009 due to the high number of sea days completed because of carry-over 2020 funds (**Table 6** and **Figure 2**).

Of the 23 species considered in this report, 17 were caught in numbers sufficient to develop a nominal abundance and a standardized annual abundance from CHVs (**Table 1**). We provide individual abundance and length summaries for each of these species below. Details and discussion of individual covariates included in the final ZINB models and diagnostic plots are available upon request.

Table 6. Number of chevron trap collections made by the fishery-independent reef fish surveys by year, and the number of included collections in the abundance analyses. Included collections were from either randomly/opportunistically selected monitoring stations or reconnaissance converted deployments using standard sampling techniques that had a soak time between 45 and 150 minutes, included all sampling and environmental data, and with catch codes indicative of proper gear behavior and fish processing for monitoring purposes (no catch (catch code 0), catch with finfish (catch code 1), catch with no finfish but other organisms (catch code 2), and sub-sampled finfish catch (catch code 8)). Please note that the SEAMAP-SA Reef Fish and SEFIS fishery-independent research projects did not begin until 2009 and 2010, respectively.

	MARMAP/ SEAMAP-SA Reef Fish		SEFIS		Total	
Year	**All**	**Included**	**All**	**Included**	**All**	**Included**
1990	354	313	–	–	354	313
1991	305	272	–	–	305	272
1992	324	288	–	–	324	288
1993	542	392	–	–	542	392
1994	468	387	–	–	468	387
1995	545	361	–	–	545	361
1996	642	361	–	–	642	361
1997	532	406	–	–	532	406
1998	523	426	–	–	523	426
1999	347	233	–	–	347	233
2000	383	298	–	–	383	298
2001	325	245	–	–	325	245
2002	336	244	–	–	336	244
2003	286	224	–	–	286	224
2004	343	282	–	–	343	282
2005	357	303	–	–	357	303
2006	332	297	–	–	332	297
2007	361	337	–	–	361	337
2008	354	303	–	–	354	303
2009	464	404	–	–	464	404
2010	567	409	484	316	1051	725
2011	464	264	546	462	1010	726
2012	448	368	945	806	1393	1174
2013	544	518	1017	842	1561	1360
2014	519	498	1001	974	1520	1472
2015	577	554	946	909	1523	1463
2016	528	485	1009	999	1537	1484
2017	520	508	1054	1033	1574	1541
2018	680	665	1104	1071	1784	1736
2019	675	605	1070	1019	1745	1624
2020	19	0	–	–	19	0
2021	848	810	1177	1022	2025	1832

Short Bottom Longline

From 1996 to 2021, a total of 1,611SBLL gear deployments were made **Table 2** and **Table 7**), averaging 62 collections a year (range: 20 – 144). Catch data from 1,214 (75% of total) collections could be used in the development of annual abundance estimates (**Table 7**, **Figure 1**, and **Figure 2**), or on average, 47 collections a year (range: 12 – 108). The remaining collections not used in the development of annual abundance estimates (n= 479) were excluded due to isolated, or a combination of, the following factors: reconnaissance SBLL deployments not converted to monitoring stations the following year, stations sampled more than once a year or too close to another sampled station, soak times outside of specified range (≥45 or ≤150 m), damaged or lost gear or otherwise compromised catches, or a lack of complete environmental data.

The number of SBLL collections per year has fluctuated since its inception as a MARMAP gear. Traditionally, all fishery-independent SBLL collections for monitoring purposes were conducted under the MARMAP project, thus all included collections from 1996-2008 were MARMAP collections (**Table 7**). Beginning in 2009, additional fishery-independent reef fish survey funding through SEAMAP-SA resulted in an increase in annual SBLL gear deployments, particularly in 2010 and 2011 (**Table 7**). In 2010 and 2011, the total number of SBLL deployments was more than double the series average, at 135 and 142, respectively, with the number of included collections also increasing (**Table 7**). These increases were followed abruptly by a suspension of the program due to a 40% funding reduction to MARMAP funding in 2012. Although we were able to do some limited opportunistic sampling in 2012 and early 2013 through SEAMAP-SA, SEAMAP-SA funding allowed resumption of the SBLL survey to a greater degree in July of 2014. In 2019, a Marine Fisheries Initiative (MARFIN) program project was funded to expand the sampling effort and range of the SBLL gear, with sampling beginning in 2020 and lasting for up to 3 years.

Of the 23 species considered in this report, we caught 2 in sufficient numbers to develop an annual nominal and standardized abundance estimate through 2021 for SBLL (**Table 1**). We provide individual abundance and length summaries for each of these species below. Detailed discussion of individual covariates included in the final ZINB/Poisson models, as well as diagnostic plots are available upon request.

Table 7. Number of short bottom longline collections made by the fishery-independent Reef Fish surveys by year, and the number of included collections in the abundance analyses. Included collections were from either randomly/opportunistically selected monitoring stations or reconnaissance converted deployments using standard sampling techniques that had a soak time between 45 and 150 minutes, included all environmental data, and SBLL collections with no catch (catch code 0), catch with finfish (catch code 1), catch with no finfish but other organisms (catch code 2), and sub-sampled finfish catch (catch code 8). Please note that the SEAMAP-SA Reef Fish and SEFIS fishery-independent research projects did not begin until 2009 and 2010, respectively, and MARFIN not until 2020 (deployments included under MARMAP/SEAMAP-SA).

	MARMAP/SEAMAP-SA Reef Fish		**SEFIS**		**Total**	
Year	**All**	**Included**	**All**	**Included**	**All**	**Included**
1996	20	15	–	–	20	12
1997	34	33	–	–	34	33
1998	33	31	–	–	33	31
1999	44	36	–	–	44	36
2000	40	34	–	–	40	34
2001	36	29	–	–	36	29
2002	22	19	–	–	22	19
2003	54	51	–	–	54	51
2004	48	34	–	–	48	21
2005	58	42	–	–	58	42
2006	96	50	–	–	96	50
2007	74	53	–	–	74	52
2008	58	29	–	–	58	29
2009	71	43	–	–	71	43
2010	124	83	11	–	135	78
2011	142	109	–	–	142	61
2012	28	21	–	–	28	21
2013	42	41	–	–	42	41
2014	60	57	–	–	60	57
2015	103	75	–	–	103	75
2016	78	62	–	–	78	62
2017	54	48	–	–	54	47
2018	77	66	–	–	77	66
2019	39	25	–	–	39	25
2020	32	20	–	–	32	20
2021	144	108	–	–	144	108

Long Bottom Longline

From 1996-2007, 2009-2011, 2015-2016, and 2019, a total of 379 LBLL deployments were undertaken (**Table 2** and **Table 8**), averaging 21 (range: 4 – 45) collections per year when the survey occurred. Sampling efforts have been concentrated off the South Carolina and Georgia coast. The CRP project allowed for a continuance of sampling in 2019, but no sampling could occur in 2020 due to COVID-19 and no funding was available for 2021. As minimal additional data were available, we are referring to previous trends reports for indices of abundance for this gear.

Table 8. Number of long bottom longline collections made by the fishery-independent surveys by year, and the number of included collections in the abundance analyses. Included collections were from either randomly/opportunistically selected or reconnaissance converted monitoring stations using standard sampling techniques that had a soak time of between 45 and 150 minutes, included all environmental data, and LBLL collections with no catch (catch code 0), catch with finfish (catch code 1), catch with no finfish but other organisms (catch code 2), and sub-sampled finfish catch (catch code 8).

	MARMAP/SEAMAP-SA Reef Fish	
Year	**All**	**Included**
1996	17	17
1997	21	20
1998	10	8
1999	30	27
2000	11	8
2001	14	13
2002	20	18
2003	16	13
2004	5	5
2005	16	16
2006	7	7
2007	25	22
2008	–	–
2009	38	36
2010	40	39
2011	30	27
2012	–	–
2013	–	–
2014	–	–
2015	45	37
2016	30	25
2017	–	–
2018	–	–
2019	4	–
2020	–	–
2021	–	–

Species

For each of the 23 species included in this report, we summarize catch and data availability below for any gear types in which that species was collected. Results also are presented for 17 species collected in sufficient numbers to develop annual nominal abundance estimates and ZINB standardized abundance estimates.

Balistidae

Gray Triggerfish (*Balistes capriscus*)

Chevron Trap

The nominal and standardized abundance of Gray Triggerfish caught with chevron traps in 2021 showed a decrease relative to 2019, but with both values below the time series mean (**Table 9** and **Figure 5A**). Mean lengths of Gray Triggerfish in 2021 were slightly increased relative to 2019 (**Figure 5B**). The spatial distribution of Gray Triggerfish is widespread and relatively homogeneous throughout the region in recent years (**Figure 6**).

Table 9. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Gray Triggerfish and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	**Included Collections**	**Positive**	**Proportion Positive**	**Total Fish**	**Normalized**	**Normalized**	**CV**
1990	310	35	0.11	70	0.23	0.24	0.21
1991	259	123	0.47	369	1.47	1.28	0.13
1992	286	84	0.29	192	0.69	0.82	0.14
1993	380	111	0.29	276	0.75	0.76	0.11
1994	340	134	0.39	396	1.2	1.12	0.11
1995	336	148	0.44	647	1.98	1.4	0.1
1996	323	128	0.4	572	1.82	1.52	0.11
1997	345	157	0.46	693	2.07	2.27	0.12
1998	373	110	0.29	494	1.36	1.91	0.13
1999	213	59	0.28	187	0.9	0.9	0.16
2000	272	81	0.3	245	0.93	0.71	0.19
2001	231	80	0.35	214	0.95	0.9	0.12
2002	225	86	0.38	285	1.31	1.38	0.15
2003	206	26	0.13	49	0.25	0.62	0.25
2004	259	63	0.24	164	0.65	1.08	0.15
2005	278	90	0.32	326	1.21	0.8	0.13
2006	281	64	0.23	147	0.54	0.65	0.17
2007	317	98	0.31	302	0.98	0.79	0.13
2008	277	64	0.23	322	1.2	0.9	0.16
2009	404	80	0.2	257	0.66	0.61	0.15
2010	732	175	0.24	469	0.66	0.59	0.12
2011	731	149	0.2	537	0.76	0.76	0.11
2012	1174	326	0.28	1082	0.95	0.99	0.08
2013	1358	361	0.27	1250	0.95	1.19	0.08
2014	1473	457	0.31	1647	1.15	1.27	0.08
2015	1464	409	0.28	1100	0.77	0.9	0.08
2016	1485	510	0.34	2101	1.46	1.28	0.09
2017	1541	451	0.29	1558	1.04	1.17	0.07
2018	1736	396	0.23	1263	0.75	0.87	0.09
2019	1665	365	0.22	1408	0.87	0.83	0.11
2020	-	-	-	-	-	-	-
2021	1832	288	0.16	862	0.48	0.48	0.13

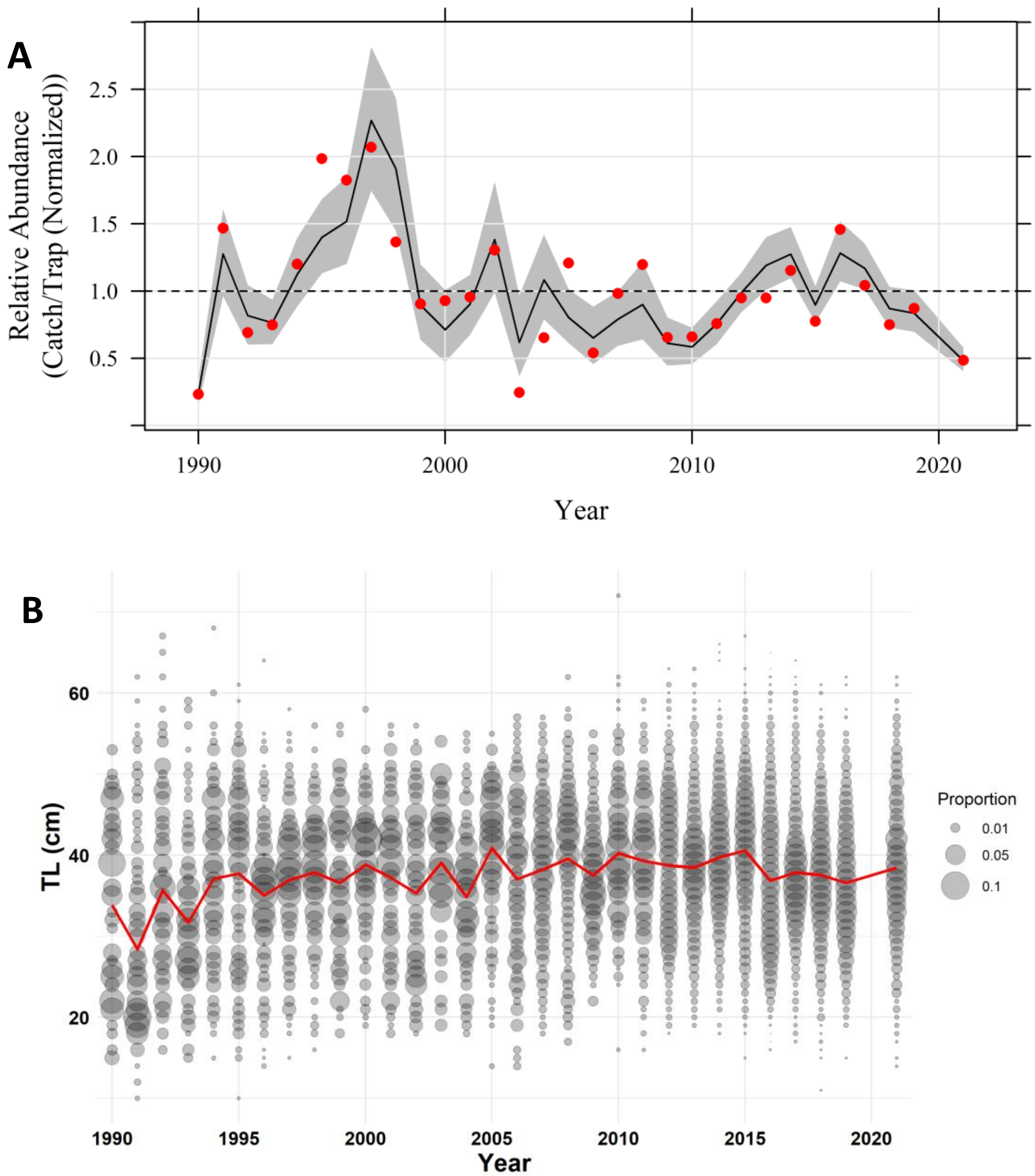


Figure 5. Chevron trap index of abundance and length composition characterization for Gray Triggerfish A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length from a given year, while the bubble diameter represents the proportion caught of that length by year.

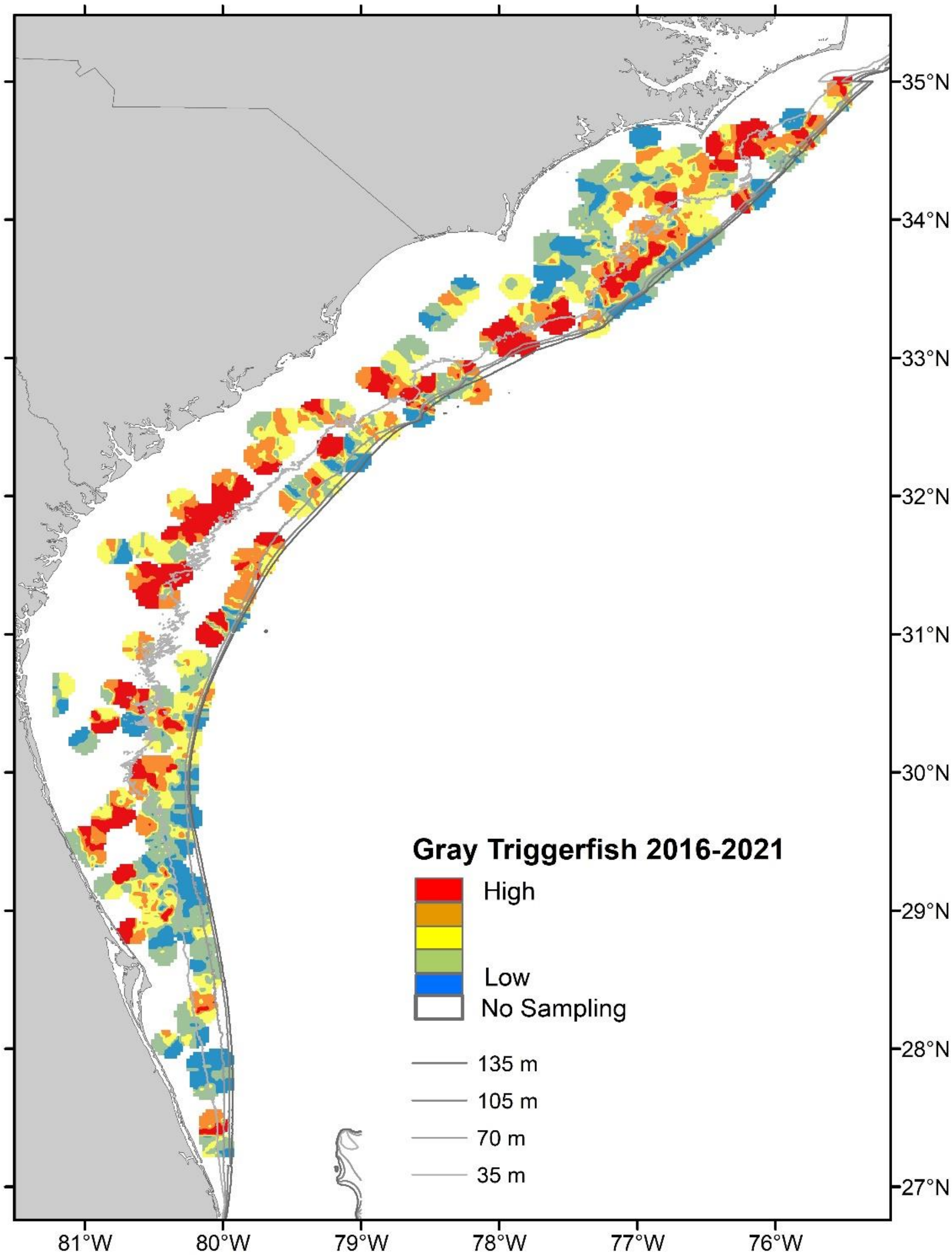


Figure 6. Distribution map of Gray Triggerfish catch by SERFS from chevron traps in 2016-2021. Colors indicate quartiles of catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Carangidae

Almaco Jack (*Seriola rivoliana*)

Chevron Trap
Almaco Jack were not caught with CHVs in large enough numbers or consistently enough for development of an index of relative abundance (**Table 10**). The mean length of Almaco Jack caught in CHVs decreased in 2021 relative to 2019 (**Figure 7**).

Table 10. Chevron trap catch of Almaco Jack and information associated with chevron trap sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1990	310	1	0.00	1
1991	259	0	0.00	0
1992	286	1	0.00	1
1993	380	0	0.00	0
1994	340	5	0.01	7
1995	336	2	0.01	3
1996	323	1	0.00	1
1997	345	1	0.00	1
1998	373	2	0.01	2
1999	213	0	0.00	0
2000	272	3	0.01	4
2001	231	0	0.00	0
2002	225	0	0.00	0
2003	206	0	0.00	0
2004	259	0	0.00	0
2005	278	1	0.00	2
2006	281	0	0.00	0
2007	317	3	0.01	3
2008	277	2	0.01	2
2009	404	5	0.01	11
2010	732	2	0.00	2
2011	731	0	0.00	0
2012	1174	14	0.01	17
2013	1358	17	0.01	32
2014	1473	13	0.01	14
2015	1464	33	0.02	41
2016	1485	39	0.03	70
2017	1541	46	0.03	74
2018	1736	42	0.02	60
2019	1665	63	0.04	133
2020	-	-	-	-
2021	1832	18	0.01	21

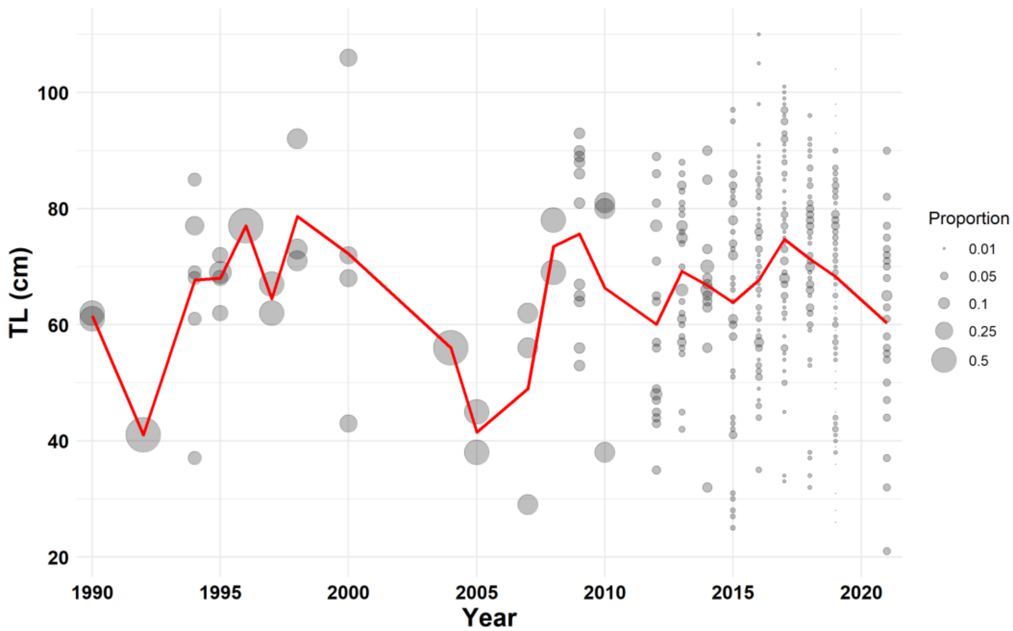


Figure 7. Almaco Jack total lengths (cm) caught with chevron trap by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

Short Bottom Longline

Almaco Jack were not caught with SBLL in large enough numbers or consistently enough for development of an index of relative abundance (**Table 11**). Mean length of Almaco Jack caught using SBLL decreased in 2021 relative to 2018 (**Figure 8**). The spatial distribution of Almaco Jack is in deeper waters off Northern Florida to mid-South Carolina in recent years, as they showed up in both CHV and SBLL catch, but caution should be taken at the deeper areas as that is where the majority of SBLL stations have been sampled (**Figure 9**).

Table 11. Short bottom longline catch of Almaco Jack and information associated with SBLL. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1996	12	0	0	0
1997	33	0	0	0
1998	31	0	0	0
1999	36	0	0	0
2000	34	0	0	0
2001	29	2	0.07	3
2002	19	3	0.16	3
2003	51	2	0.04	3
2004	21	0	0	0
2005	42	0	0	0
2006	50	1	0.02	2
2007	52	14	0.27	46
2008	29	1	0.03	2
2009	43	7	0.16	10
2010	77	9	0.12	11
2011	61	9	0.15	13
2012	21	0	0	0
2013	41	7	0.17	10
2014	57	4	0.07	4
2015	75	1	0.01	1
2016	62	6	0.1	14
2017	48	2	0.04	2
2018	66	6	0.09	8
2019	30	0	0	0
2020	20	0	0	0
2021	108	9	0.08	16

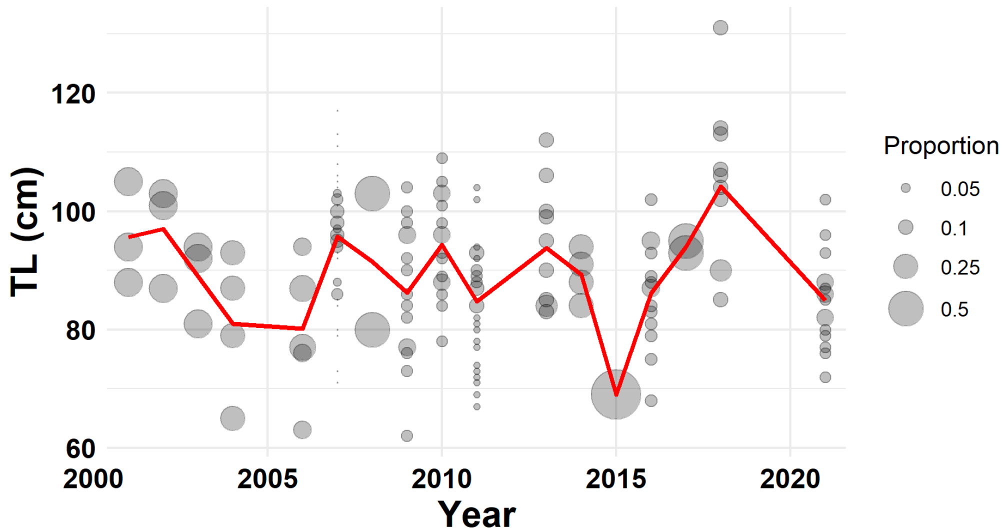


Figure 8. Almaco Jack total lengths (cm) caught with short bottom longline by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

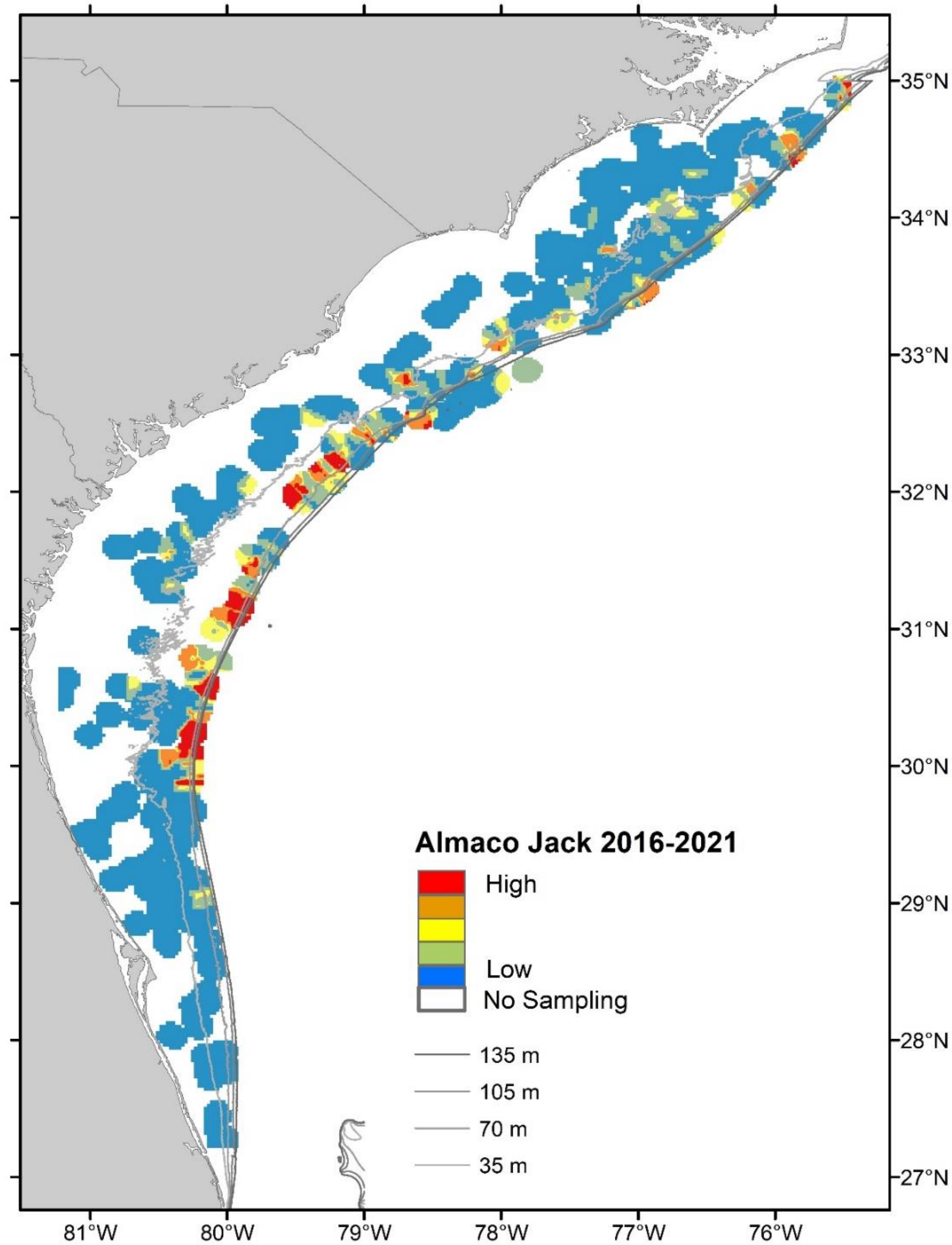


Figure 9. Distribution map of Almaco Jack catch by SERFS from CHV and SBLL in 2016-2021. Colors indicate quartiles by catch per trap/SBLL hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Greater Amberjack (*Seriola dumerili*)

Chevron Trap

Greater Amberjack were not caught with CHVs in large enough numbers or consistently enough for development of an index of relative abundance (**Table 12**). The mean length of Greater Amberjack caught in CHVs decreased 2021 relative to 2019 (**Figure 10**).

Table 12. Chevron trap catch of Greater Amberjack and information associated with chevron trap sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1990	310	0	0.00	0
1991	259	0	0.00	0
1992	286	0	0.00	0
1993	380	0	0.00	0
1994	340	0	0.00	0
1995	336	0	0.00	0
1996	323	1	0.00	1
1997	345	6	0.01	7
1998	373	9	0.02	12
1999	213	1	0.00	1
2000	272	3	0.01	4
2001	231	5	0.02	5
2002	225	0	0.00	0
2003	206	2	0.01	2
2004	259	1	0.00	1
2005	278	0	0.00	0
2006	281	1	0.00	1
2007	317	2	0.01	2
2008	277	0	0.00	0
2009	404	0	0.00	0
2010	732	4	0.01	4
2011	731	1	0.00	1
2012	1174	2	0.00	2
2013	1358	8	0.01	9
2014	1473	5	0.00	6
2015	1464	8	0.01	8
2016	1485	13	0.01	16
2017	1541	8	0.01	10
2018	1736	3	0.00	3
2019	1665	10	0.01	10
2020	-	-	-	-
2021	1832	4	0.00	4

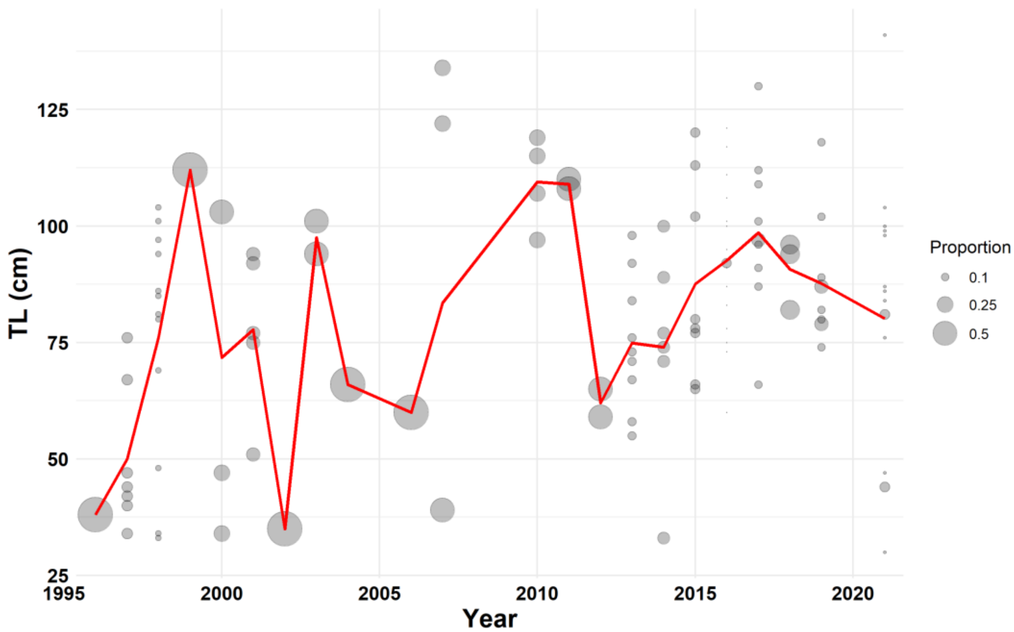


Figure 10. Greater Amberjack total lengths (cm) caught with chevron traps by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

Short Bottom Longline

Greater Amberjack were not caught with SBLL in large enough numbers or consistently enough for development of an index of relative abundance (**Table 13**). The mean length of Greater Amberjack caught by SBLL decreased in 2021 relative to 2019 (**Figure 11**). The spatial distribution of Greater Amberjack is in deeper waters wherever SBLL stations have been sampled, with very limited catch in chevron traps, so only SBLL catch is included here (**Figure 12**).

Table 13. Short bottom longline catch of Greater Amberjack and information associated with the catch. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1996	12	0	0.00	0
1997	33	0	0.00	0
1998	31	0	0.00	0
1999	36	5	0.14	9
2000	34	4	0.12	9
2001	29	3	0.10	5
2002	19	2	0.11	2
2003	51	2	0.04	2
2004	21	2	0.06	3
2005	42	9	0.21	27
2006	50	3	0.06	5
2007	52	8	0.15	14
2008	29	0	0.00	0
2009	43	8	0.19	11
2010	77	3	0.04	6
2011	61	3	0.03	3
2012	21	0	0.00	0
2013	41	1	0.02	1
2014	57	3	0.05	4
2015	75	1	0.01	1
2016	62	1	0.02	1
2017	48	1	0.02	1
2018	66	7	0.11	11
2019	30	3	0.10	3
2020	20	2	0.10	3
2021	108	15	0.14	27

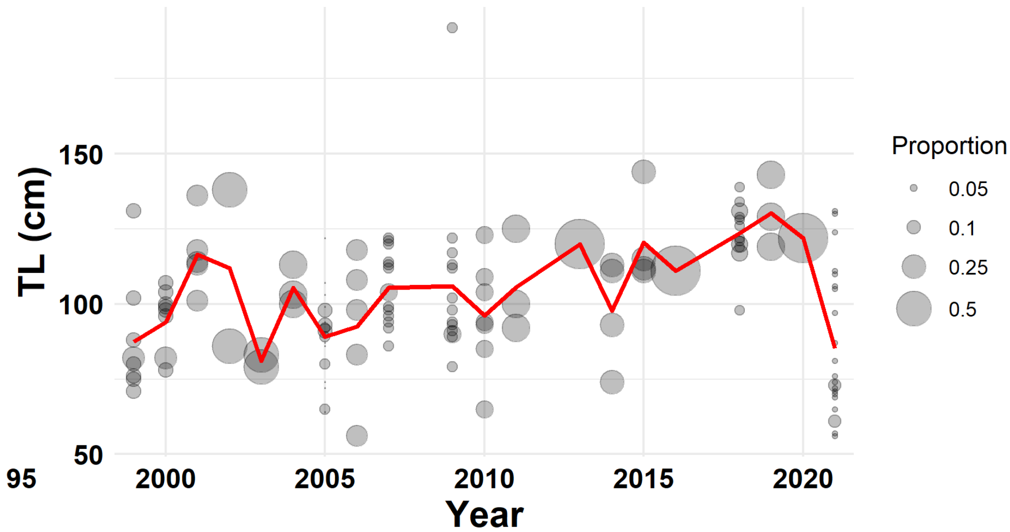


Figure 11. Greater Amberjack total lengths (cm) caught with short bottom longline by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

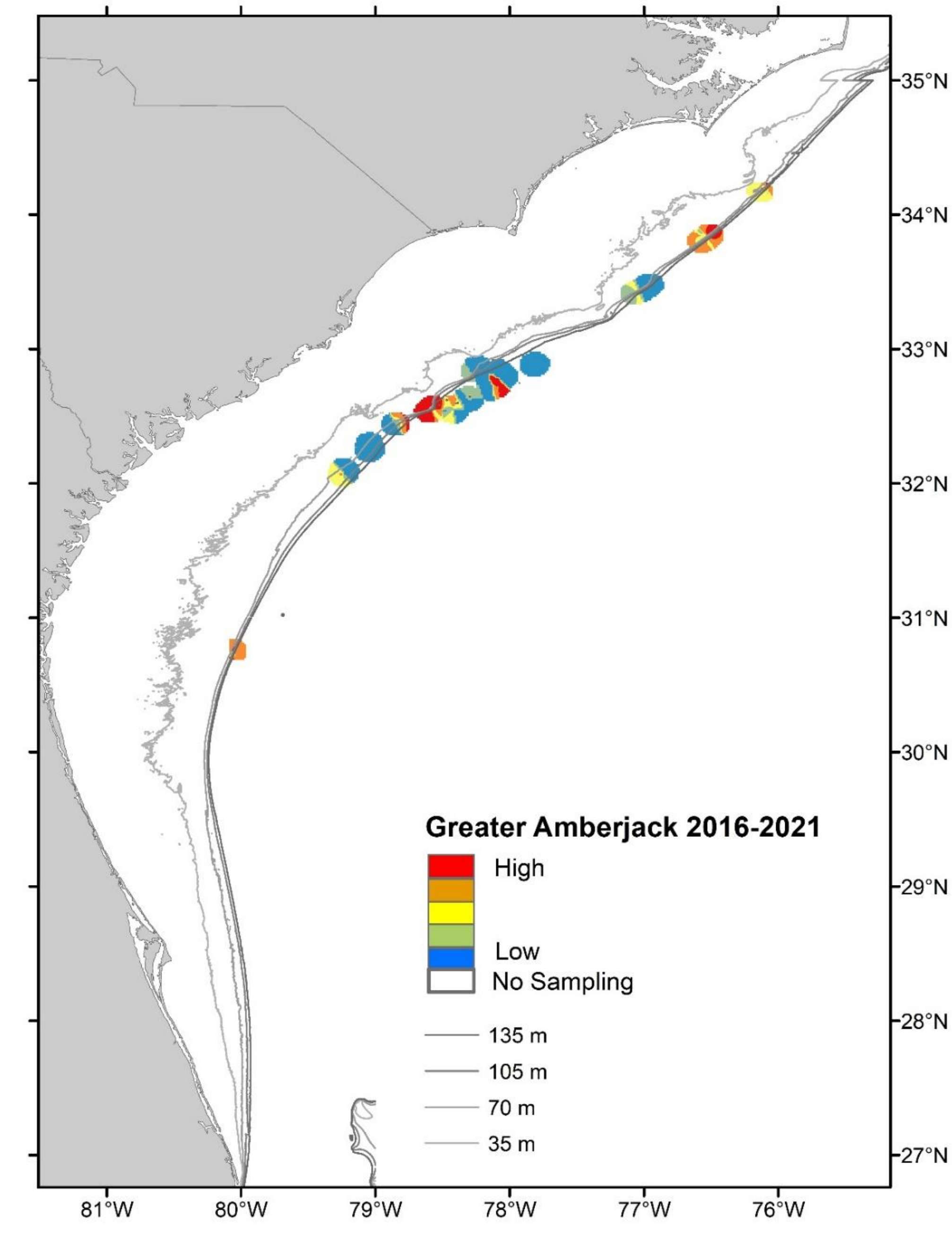


Figure 12. Distribution map of <u>Greater Amberjack</u> catch by SERFS from SBLL in 2016-2021. Colors indicate quartiles by catch per SBLL hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Haemulidae

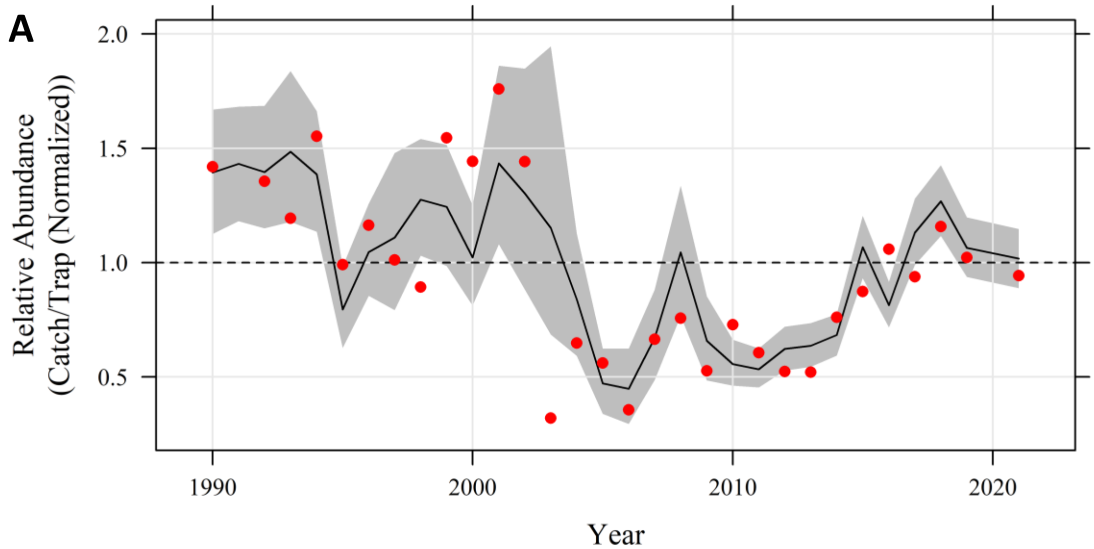
Tomtate (*Haemulon aurolineatum*)

Chevron Trap

Nominal abundance and standardized abundance of Tomtate caught with CHVs decreased in 2021 relative to 2019, but the standardized value was above the time series mean in 2021 (**Table 14** and **Figure 13A**). Mean lengths of Tomtate caught in CHVs slightly decreased in 2021 relative to 2019, but has remained relatively consistent throughout the time series and the core length composition has not varied since 2010 (**Figure 13B**). The spatial distribution of Tomtate is widespread and relatively homogeneous throughout the shallower depths in the region in recent years (**Figure 14**).

Table 14. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Tomtate and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	150	0.48	5177	1.42	1.39	0.1
1991	259	164	0.63	6888	2.26	1.43	0.09
1992	286	166	0.58	4562	1.36	1.4	0.1
1993	380	202	0.53	5340	1.19	1.49	0.11
1994	340	192	0.56	6214	1.55	1.39	0.1
1995	336	190	0.57	3921	0.99	0.79	0.11
1996	323	176	0.54	4423	1.16	1.05	0.1
1997	345	151	0.44	4108	1.01	1.11	0.16
1998	373	181	0.49	3922	0.89	1.27	0.1
1999	213	114	0.54	3874	1.55	1.24	0.11
2000	272	135	0.5	4618	1.44	1.02	0.11
2001	231	117	0.51	4782	1.76	1.43	0.14
2002	225	128	0.57	3817	1.44	1.3	0.19
2003	206	70	0.34	777	0.32	1.15	0.29
2004	259	79	0.31	1976	0.65	0.84	0.16
2005	278	99	0.36	1836	0.56	0.47	0.15
2006	281	80	0.28	1179	0.36	0.45	0.19
2007	317	99	0.31	2482	0.67	0.67	0.15
2008	277	102	0.37	2469	0.76	1.04	0.14
2009	404	123	0.3	2503	0.53	0.66	0.14
2010	732	271	0.37	6279	0.73	0.56	0.09
2011	731	278	0.38	5211	0.61	0.53	0.08
2012	1174	385	0.33	7238	0.52	0.62	0.08
2013	1358	471	0.35	8330	0.52	0.64	0.08
2014	1473	599	0.41	13191	0.76	0.68	0.07
2015	1464	573	0.39	15054	0.87	1.07	0.07
2016	1485	588	0.4	18510	1.06	0.81	0.06
2017	1541	580	0.38	17020	0.94	1.13	0.06
2018	1736	634	0.37	23653	1.16	1.27	0.06
2019	1665	607	0.36	20029	1.02	1.06	0.06
2020	-	-	-	-	-	-	-
2021	1832	661	0.36	20333	0.94	1.02	0.06



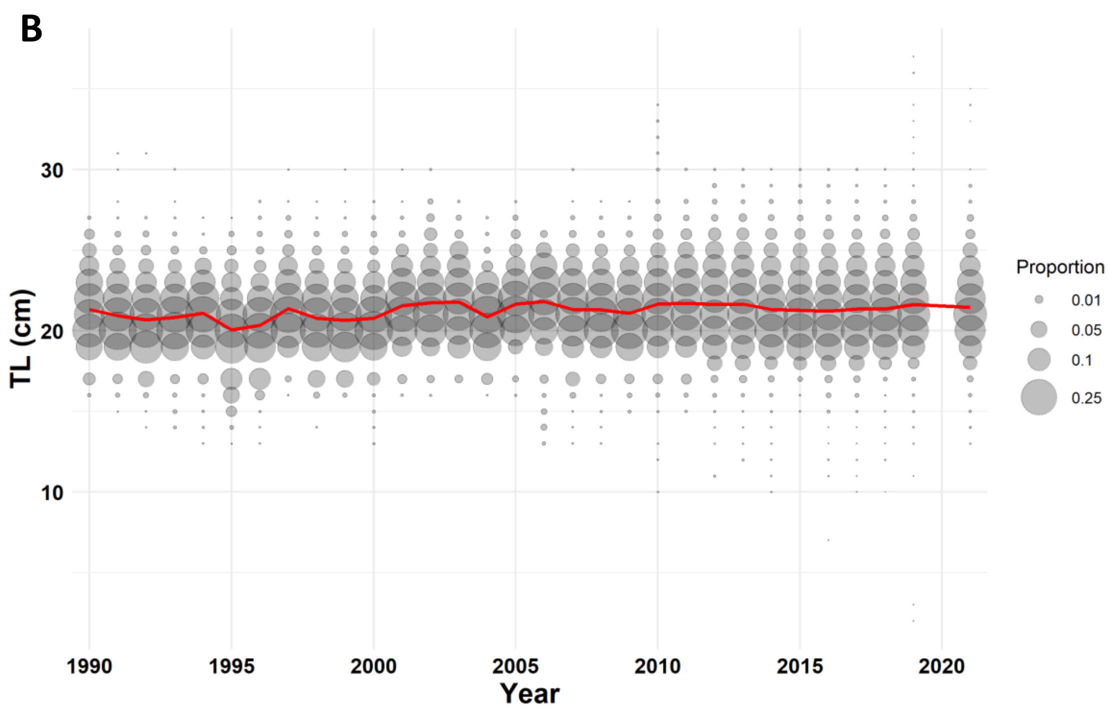


Figure 13.Chevron trap index of abundance and length composition characterization for Tomtate. A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

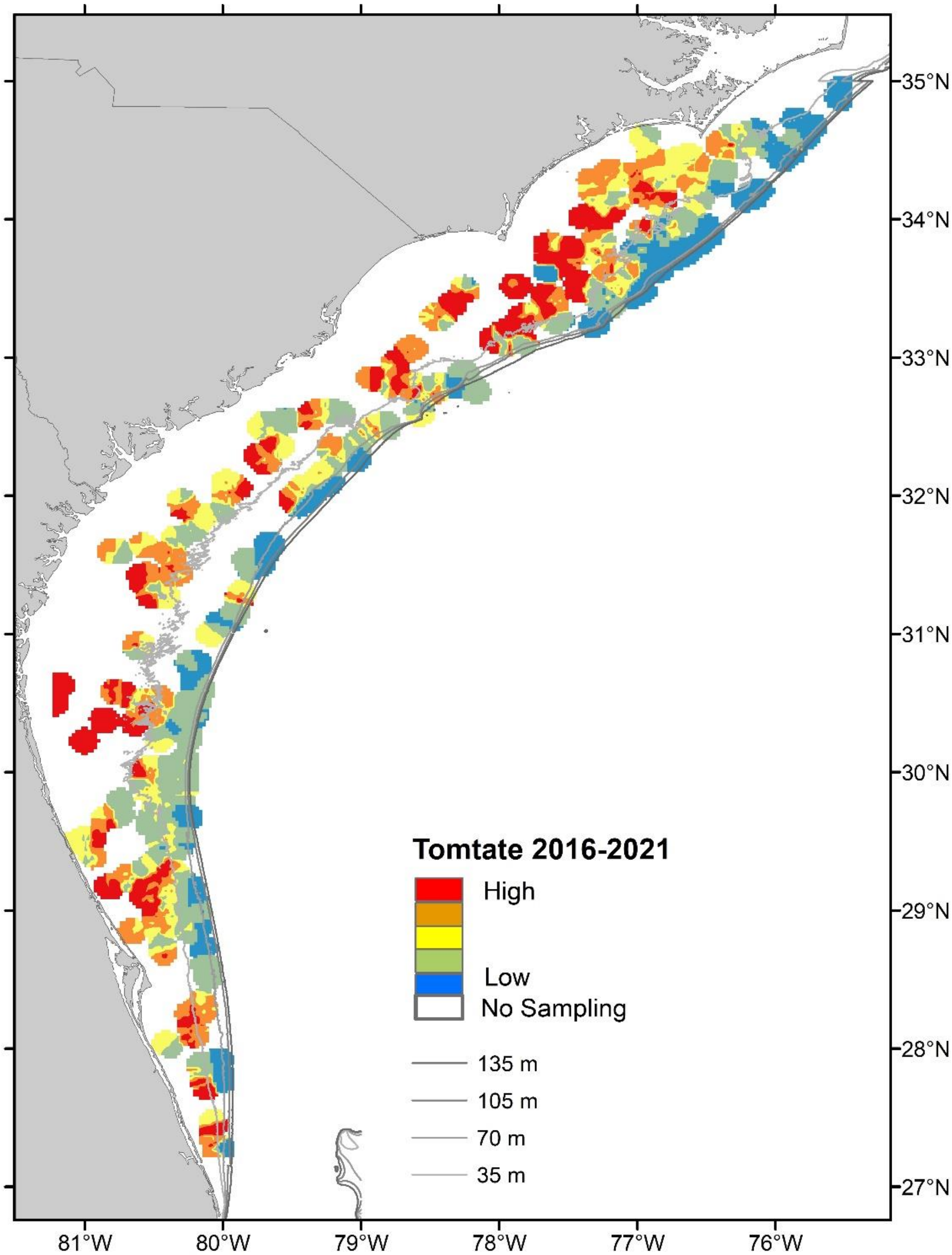


Figure 14. Distribution map of Tomtate catch by SERFS from CHV in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

White Grunt (*Haemulon plumierii*)

Chevron Trap

The nominal and standardized abundance of White Grunt caught in CHVs in 2021 showed a decrease relative to 2019 with both values being below the time series mean for the first time since 2016 (**Table 15** and **Figure 15A**). Mean lengths of White Grunt caught in CHVs in 2020 decreased slightly relative to 2019 (**Figure 15B**). The spatial distribution of White Grunt is centered mainly in the shallower waters off the northern portion of the region, with highest abundances off of North Carolina in recent years (**Figure 16**).

Table 15. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for White Grunt and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	41	0.13	324	1.41	1.19	0.26
1991	259	55	0.21	440	2.3	1.6	0.29
1992	286	81	0.28	485	2.3	2.52	0.29
1993	380	54	0.14	321	1.14	1.86	0.26
1994	340	33	0.1	212	0.84	0.9	0.25
1995	336	46	0.14	175	0.71	1.32	0.25
1996	323	70	0.22	314	1.32	1.45	0.15
1997	345	48	0.14	173	0.68	1.17	0.18
1998	373	59	0.16	321	1.17	1.09	0.17
1999	213	28	0.13	116	0.74	0.7	0.21
2000	272	35	0.13	225	1.12	0.93	0.25
2001	231	39	0.17	206	1.21	1.02	0.18
2002	225	33	0.15	232	1.4	1.09	0.21
2003	206	30	0.15	80	0.53	0.82	0.22
2004	259	30	0.12	270	1.41	1.08	0.21
2005	278	33	0.12	101	0.49	0.86	0.28
2006	281	30	0.11	66	0.32	0.34	0.31
2007	317	30	0.09	92	0.39	0.42	0.2
2008	277	25	0.09	86	0.42	0.48	0.26
2009	404	40	0.1	153	0.51	0.48	0.25
2010	732	38	0.05	90	0.17	0.32	0.2
2011	731	51	0.07	109	0.2	0.55	0.18
2012	1174	102	0.09	327	0.38	0.59	0.14
2013	1358	105	0.08	519	0.52	0.92	0.21
2014	1473	304	0.21	1836	1.69	0.95	0.1
2015	1464	220	0.15	1264	1.17	0.98	0.11
2016	1485	242	0.16	1270	1.16	0.74	0.1
2017	1541	242	0.16	1666	1.46	1.44	0.12
2018	1736	261	0.15	1962	1.53	1.31	0.11
2019	1665	267	0.16	2170	1.76	1.27	0.13
2020	-	-	-	-	-	-	-
2021	1832	176	0.1	770	0.57	0.62	0.14

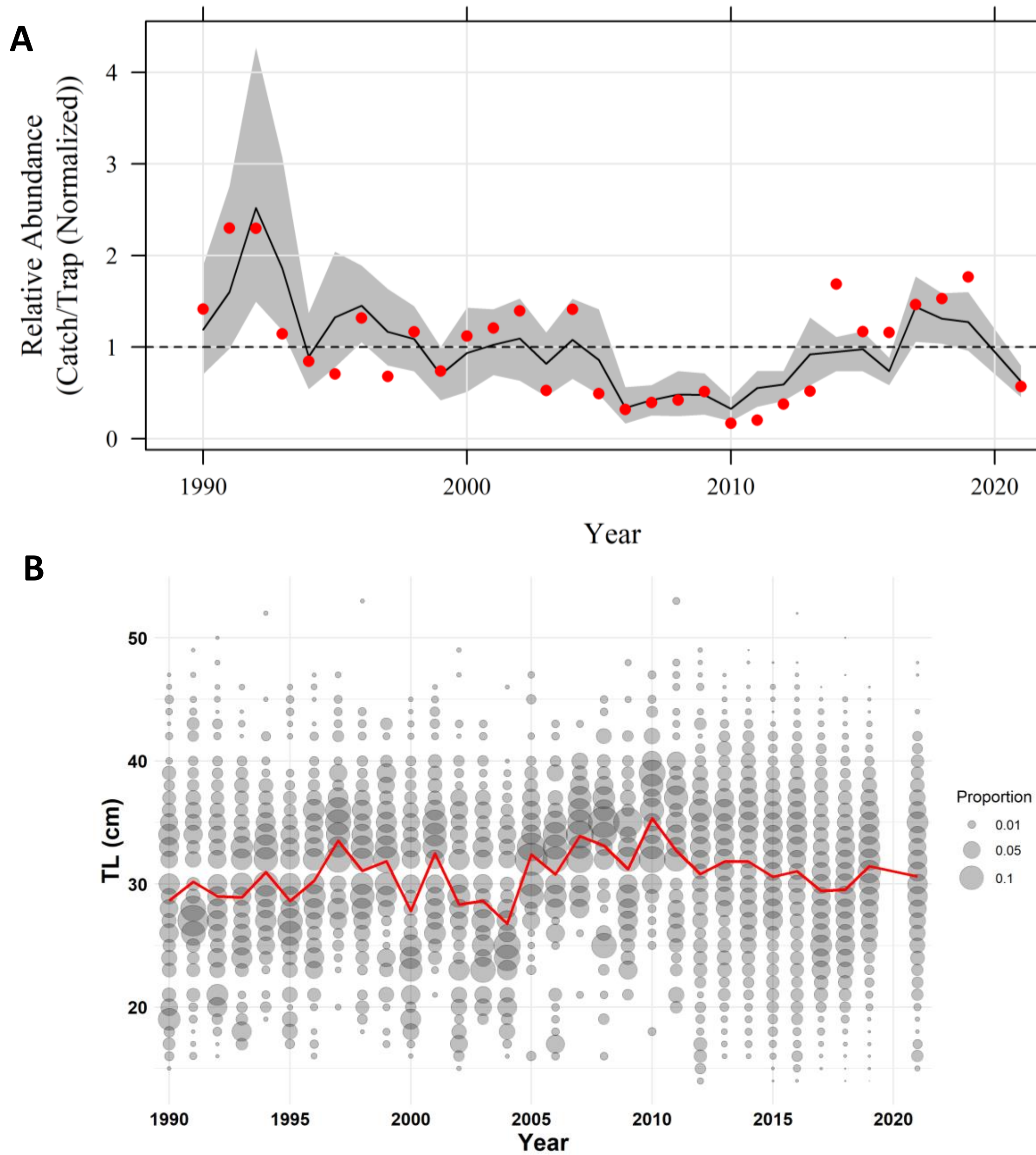


Figure 15. <u>Chevron trap</u> index of abundance and length composition characterization for <u>White Grunt</u> A) Chevron trap normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI) for White Grunt. B) White Grunt total lengths (cm) caught in chevron traps by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

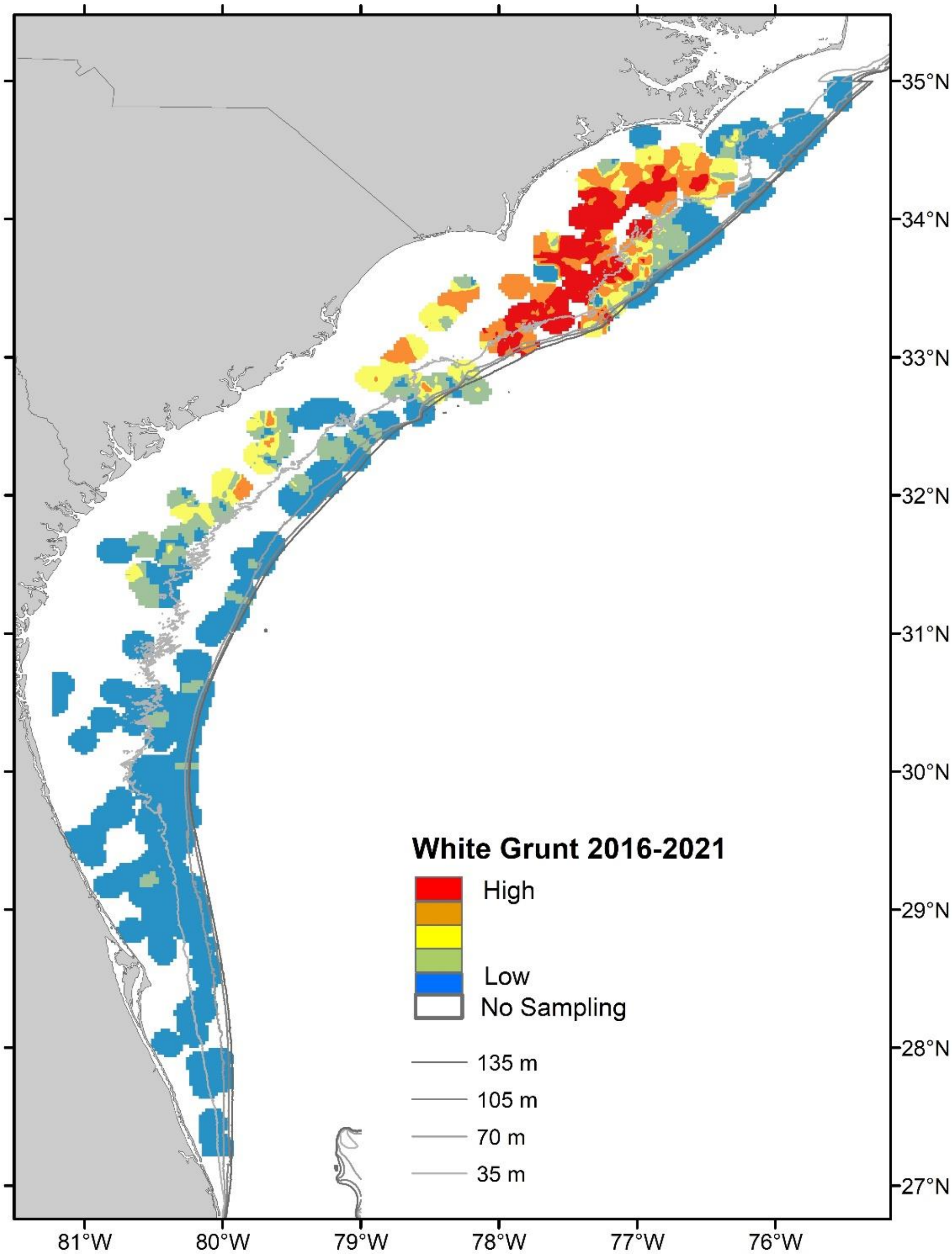


Figure 16. Distribution map of <u>White Grunt</u> catch by SERFS from CHV in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Lutjanidae

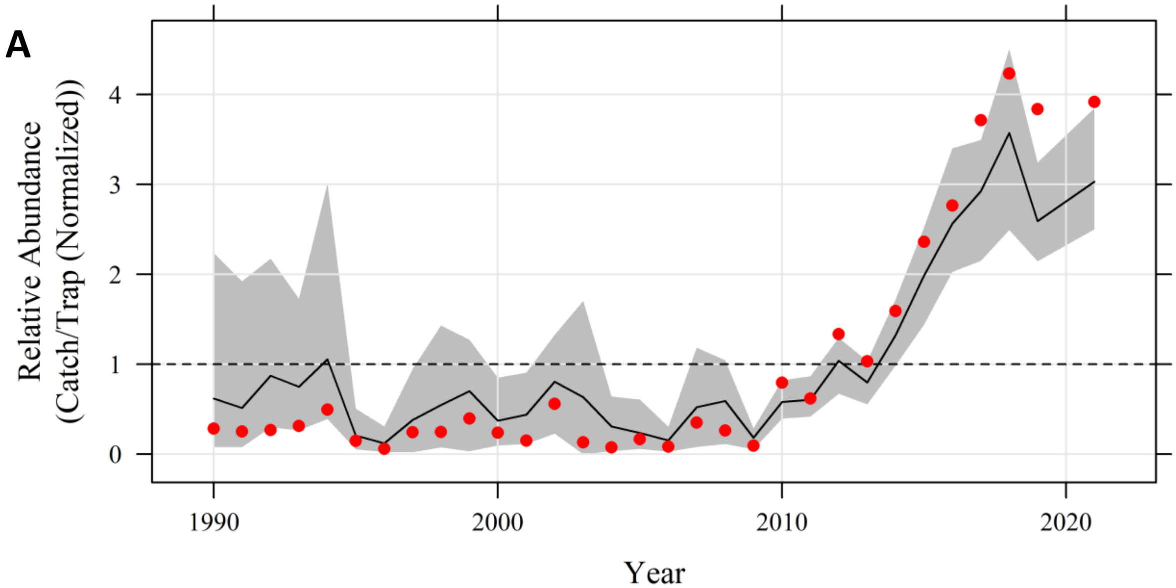
Red Snapper (*Lutjanus campechanus*)

Chevron Trap

Both nominal and standardized abundance of Red Snapper caught with CHVs in 2021 showed an increase from 2019 (**Table 16** and **Figure 17A**). The mean length of Red Snapper caught in CHVs increased slightly in 2021 relative to 2019 (**Figure 17B**). The spatial distribution of Red Snapper is centered mainly in the southern portion of the region, with highest abundances off Florida. There also are relatively high abundances in the most northerly area in recent years (**Figure 18**).

Table 16. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Red Snapper and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	7	0.02	23	0.28	0.62	0.9
1991	259	6	0.02	17	0.25	0.51	0.95
1992	286	8	0.03	20	0.27	0.87	0.55
1993	380	12	0.03	31	0.31	0.75	0.51
1994	340	18	0.05	44	0.49	1.05	0.66
1995	336	7	0.02	13	0.15	0.21	0.58
1996	323	5	0.02	5	0.06	0.12	0.59
1997	345	5	0.01	22	0.24	0.38	0.64
1998	373	7	0.02	24	0.25	0.55	0.67
1999	213	4	0.02	22	0.39	0.7	0.43
2000	272	8	0.03	17	0.24	0.37	0.53
2001	231	7	0.03	9	0.15	0.44	0.47
2002	225	13	0.06	33	0.56	0.8	0.35
2003	206	1	0	7	0.13	0.63	0.74
2004	259	4	0.02	5	0.07	0.31	0.53
2005	278	7	0.03	12	0.16	0.24	0.59
2006	281	5	0.02	6	0.08	0.15	0.45
2007	317	8	0.03	29	0.35	0.52	0.57
2008	277	7	0.03	19	0.26	0.59	0.41
2009	404	8	0.02	10	0.09	0.18	0.33
2010	732	65	0.09	152	0.79	0.58	0.19
2011	731	67	0.09	118	0.62	0.6	0.19
2012	1174	145	0.12	410	1.33	1.04	0.15
2013	1358	140	0.1	367	1.03	0.8	0.15
2014	1473	150	0.1	614	1.59	1.32	0.14
2015	1464	159	0.11	905	2.36	1.99	0.14
2016	1485	213	0.14	1075	2.76	2.57	0.14
2017	1541	245	0.16	1499	3.71	2.93	0.12
2018	1736	275	0.16	1925	4.23	3.57	0.15
2019	1665	287	0.17	1673	3.84	2.59	0.11
2020	-	-	-	-	-	-	-
2021	1832	353	0.19	1880	3.92	3.03	0.11



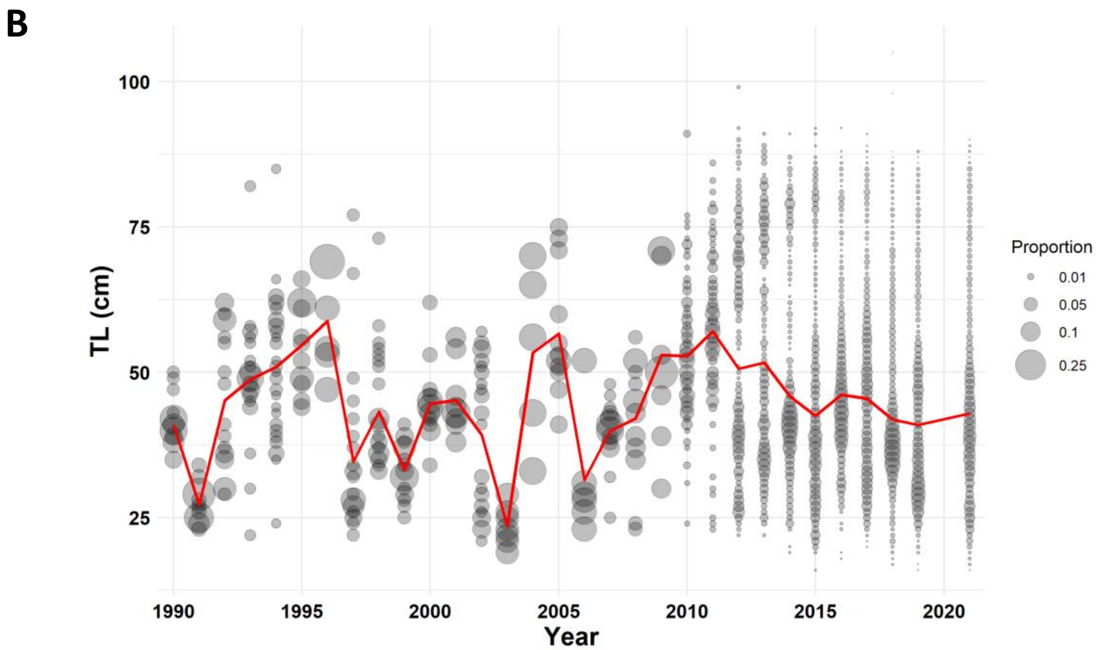


Figure 17. <u>Chevron trap</u> index of abundance and length composition characterization for <u>Red Snapper</u> A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) caught by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

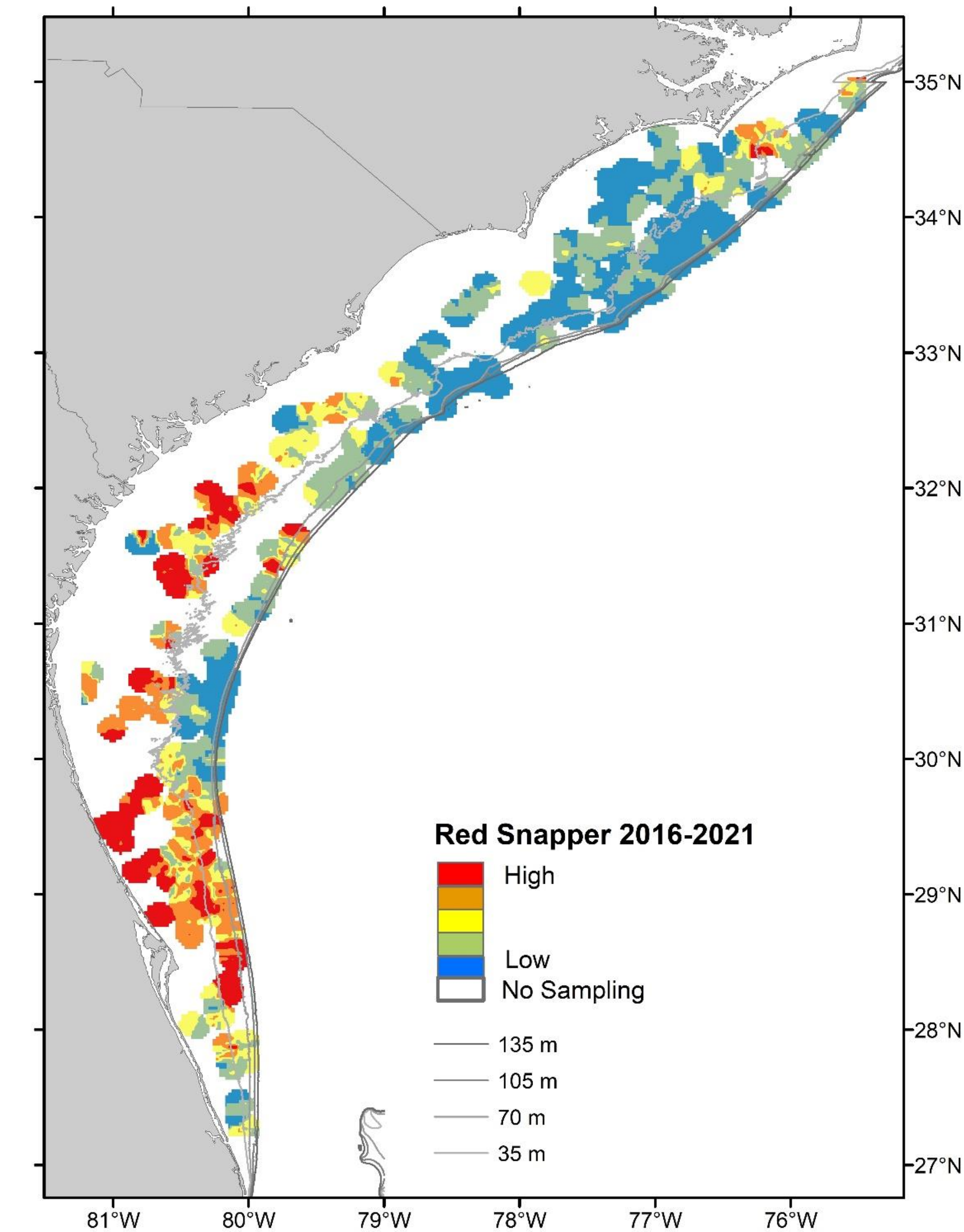


Figure 18. Distribution map of Red Snapper catch by SERFS from CHV in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Vermilion Snapper (*Rhomboplites aurorubens*)

Chevron Trap

Nominal abundance and standardized abundance of Vermilion Snapper caught with CHVs decreased in 2021 relative to 2019. Both values were below the time series mean (**Table 17** and **Figure 19A**). The mean length of Vermilion Snapper caught in CHVs in 2021 decreased slightly relative to 2019 (**Figure 19B**). The spatial distribution of Vermilion Snapper is centered in the middle portion of the region but still prevalent throughout the region in recent years (**Figure 20**).

Table 17. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Vermilion Snapper and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	85	0.27	591	0.55	0.56	0.19
1991	259	140	0.54	2889	3.19	2.08	0.14
1992	286	105	0.37	1505	1.51	1.47	0.19
1993	380	124	0.33	1308	0.99	1	0.12
1994	340	156	0.46	3144	2.65	2.76	0.12
1995	336	123	0.37	1677	1.43	1.46	0.14
1996	323	107	0.33	2106	1.87	1.28	0.19
1997	345	86	0.25	1329	1.1	0.88	0.17
1998	373	98	0.26	1114	0.86	1.04	0.18
1999	213	70	0.33	680	0.91	1.27	0.33
2000	272	101	0.37	1658	1.75	1.47	0.16
2001	231	75	0.32	1120	1.39	1.26	0.26
2002	225	94	0.42	1489	1.89	1.92	0.19
2003	206	30	0.15	153	0.21	0.34	0.32
2004	259	64	0.25	320	0.35	0.5	0.21
2005	278	76	0.27	649	0.67	0.67	0.2
2006	281	53	0.19	346	0.35	0.45	0.25
2007	317	78	0.25	1193	1.08	0.81	0.17
2008	277	70	0.25	1017	1.05	0.94	0.17
2009	404	97	0.24	1489	1.06	1.19	0.2
2010	732	194	0.27	2156	0.84	0.58	0.15
2011	731	147	0.2	1957	0.77	0.56	0.16
2012	1174	172	0.15	1020	0.25	0.4	0.16
2013	1358	178	0.13	1110	0.23	0.26	0.14
2014	1473	223	0.15	1363	0.26	0.38	0.15
2015	1464	291	0.2	2132	0.42	0.75	0.14
2016	1485	378	0.25	4322	0.83	0.92	0.1
2017	1541	337	0.22	3606	0.67	0.97	0.12
2018	1736	339	0.2	3209	0.53	0.9	0.12
2019	1665	393	0.24	4967	0.85	1.34	0.11
2020	-	-	-	-	-	-	-
2021	1832	335	0.18	3143	0.49	0.61	0.11

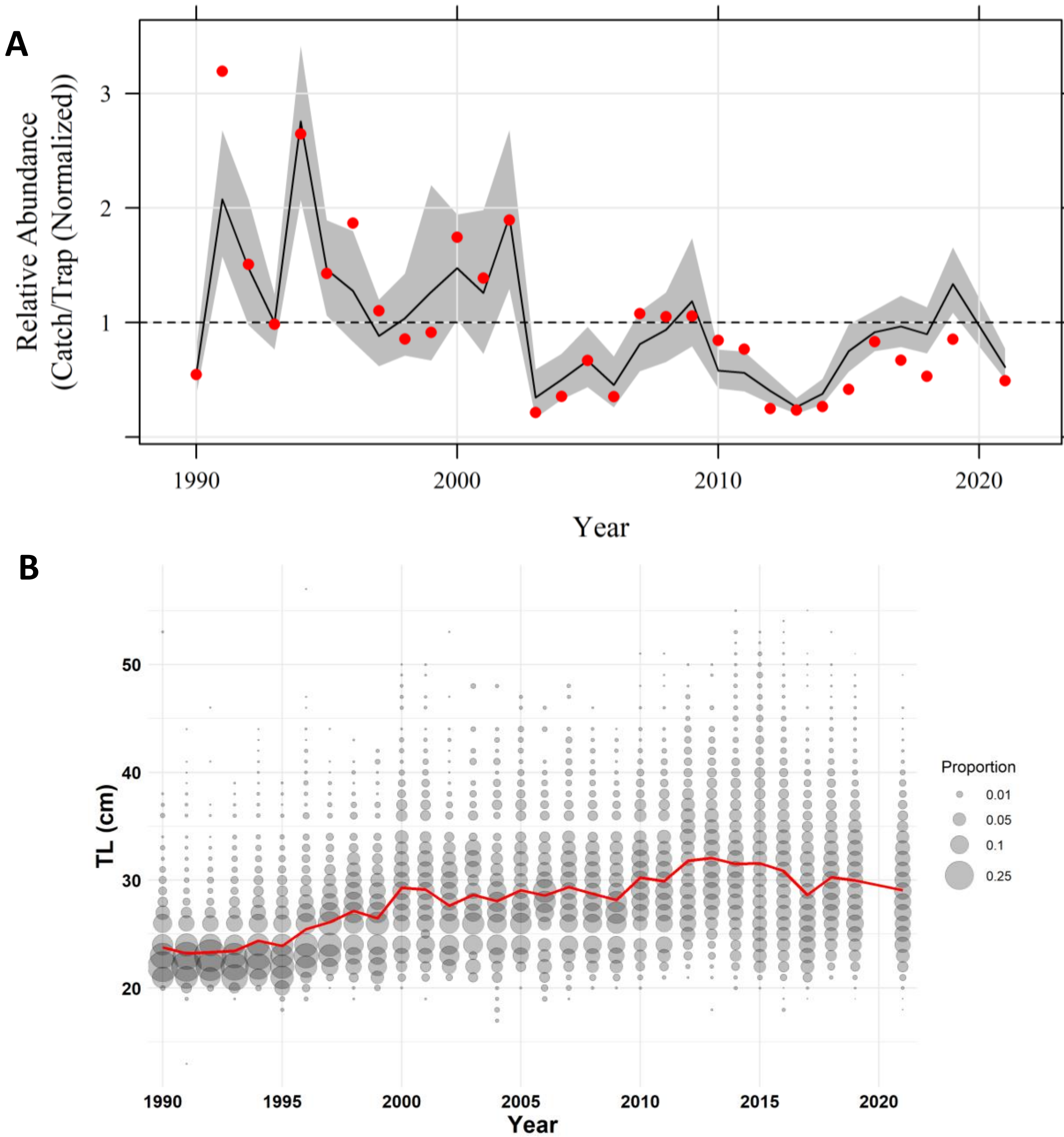


Figure 19. Chevron trap index of abundance and length composition characterization for Vermilion Snapper A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) caught in chevron traps by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

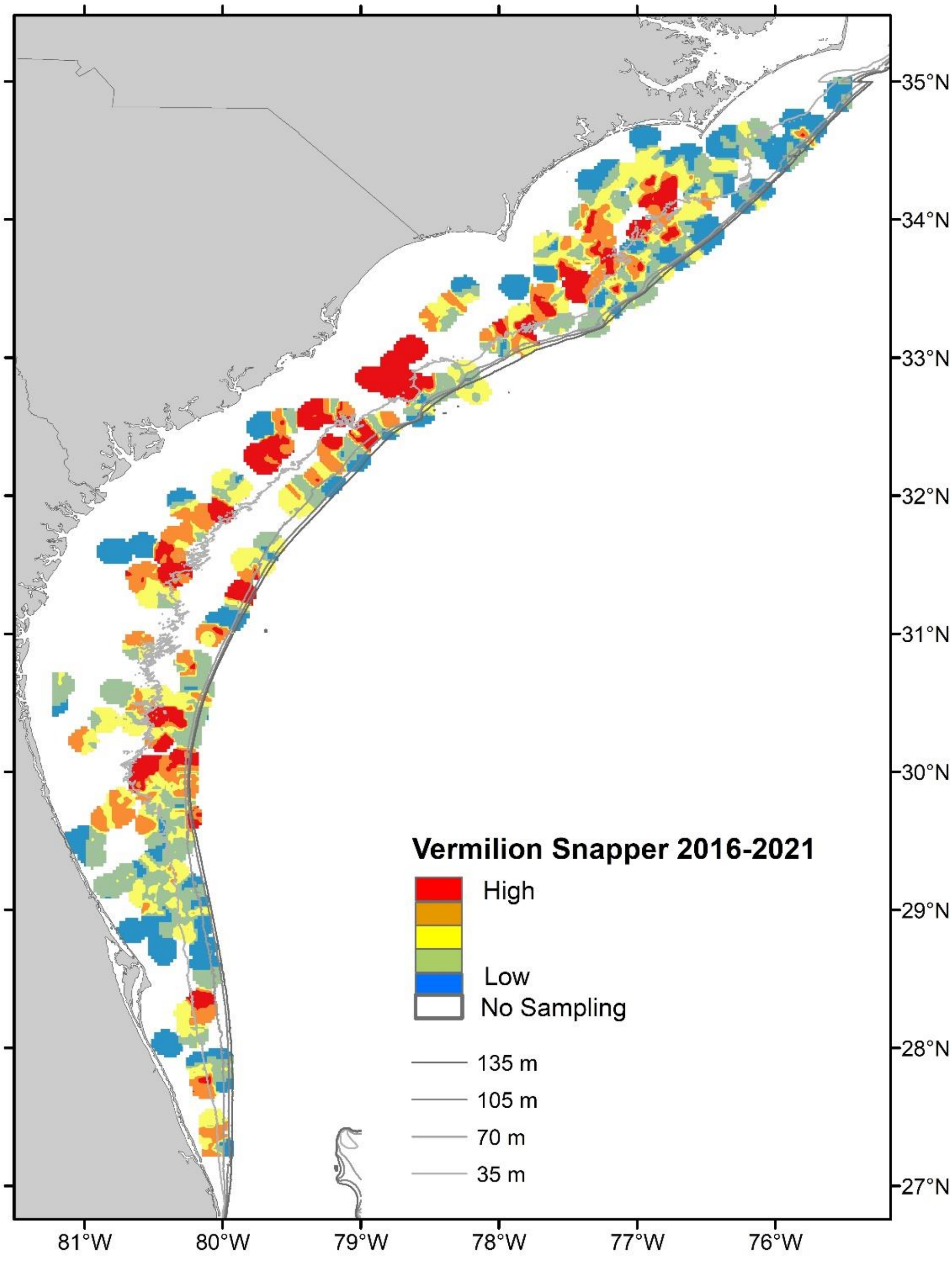


Figure 20. Distribution map of Vermilion Snapper catch by SERFS from CHV in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Malacanthidae

Blueline Tilefish (*Caulolatilus microps*)

Chevron Trap
Blueline Tilefish were not caught with CHVs in large enough numbers or consistently enough for development of an index of relative abundance (**Table 18**). The mean length of Blueline Tilefish caught in CHVs in 2021 increased relative to 2019 (**Figure 21**).

Table 18. Chevron trap catch of Blueline Tilefish and information associated with chevron trap sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1990	310	2	0.01	2
1991	259	1	0.00	1
1992	286	0	0.00	0
1993	380	0	0.00	0
1994	340	2	0.01	2
1995	336	0	0.00	0
1996	323	3	0.01	6
1997	345	1	0.00	1
1998	373	1	0.00	1
1999	213	0	0.00	0
2000	272	1	0.00	1
2001	231	2	0.01	4
2002	225	1	0.00	2
2003	206	2	0.01	3
2004	259	2	0.01	3
2005	278	0	0.00	0
2006	281	2	0.01	2
2007	317	3	0.01	5
2008	277	0	0.00	0
2009	404	1	0.00	1
2010	732	1	0.00	1
2011	731	7	0.01	11
2012	1174	17	0.01	32
2013	1358	10	0.01	14
2014	1473	17	0.01	30
2015	1464	5	0.00	12
2016	1485	13	0.01	31
2017	1541	22	0.01	36
2018	1736	11	0.01	16
2019	1665	6	0.00	11
2020	-	-	-	-
2021	1832	2	0.00	4

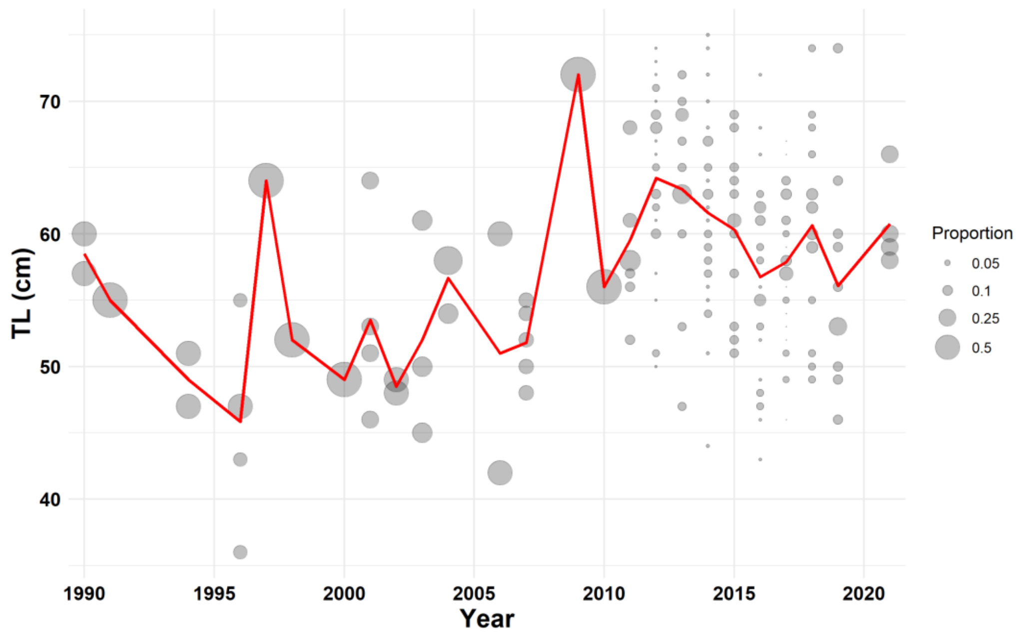


Figure 21. Blueline Tilefish total lengths (cm) caught with chevron trap by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

Short bottom longline

Nominal and standardized (zero-inflated Poisson distribution) abundance in 2021 of Blueline Tilefish caught with SBLLs increased from 2019, with both being above the time series mean (**Table 19** and **Figure 22A**) Blueline Tilefish mean lengths caught on SBLL decreased from 2019 (**Figure 22B**). The spatial distribution of Blueline Tilefish is in deeper waters off South Carolina in recent years, but caution should be taken as that is where the majority of SBLL stations have been sampled (**Figure 23**).

Table 19. Short bottom longline nominal abundance and zero-inflated poisson (ZIP) standardized abundance for Blueline Tilefish and information associated with SBLL sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*20 hooks^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZIP Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1996	12	0	0	0	0	0	>2.0
1997	33	9	0.27	12	2.46	1.75	0.39
1998	31	1	0.03	1	0.22	0.14	0.95
1999	36	1	0.03	1	0.19	0.32	0.96
2000	34	7	0.21	8	1.59	1.09	0.35
2001	29	3	0.1	4	0.93	0.84	0.64
2002	19	0	0	0	0	0	>2.0
2003	51	6	0.12	9	1.2	1.03	0.44
2004	21	0	0	0	0	0	>2.0
2005	42	4	0.1	5	0.81	0.96	0.5
2006	50	3	0.06	4	0.54	0.58	0.61
2007	52	1	0.02	1	0.13	0.35	0.95
2008	29	3	0.1	4	0.93	0.8	0.59
2009	43	2	0.05	2	0.31	0.96	0.82
2010	77	6	0.08	6	0.53	0.79	0.41
2011	61	6	0.1	10	1.11	2.34	0.42
2012	21	10	0.48	11	3.55	1.97	0.25
2013	41	10	0.24	12	1.98	2.61	0.27
2014	57	9	0.16	12	1.43	1.17	0.28
2015	75	14	0.19	16	1.44	1.21	0.27
2016	62	9	0.15	12	1.31	2.01	0.36
2017	48	2	0.04	2	0.28	0.8	0.86
2018	66	14	0.21	20	2.05	1.69	0.33
2019	30	3	0.1	3	0.68	0.35	0.61
2020	20	0	0	0	0	0	>2.0
2021	108	26	0.24	37	2.32	2.24	0.27

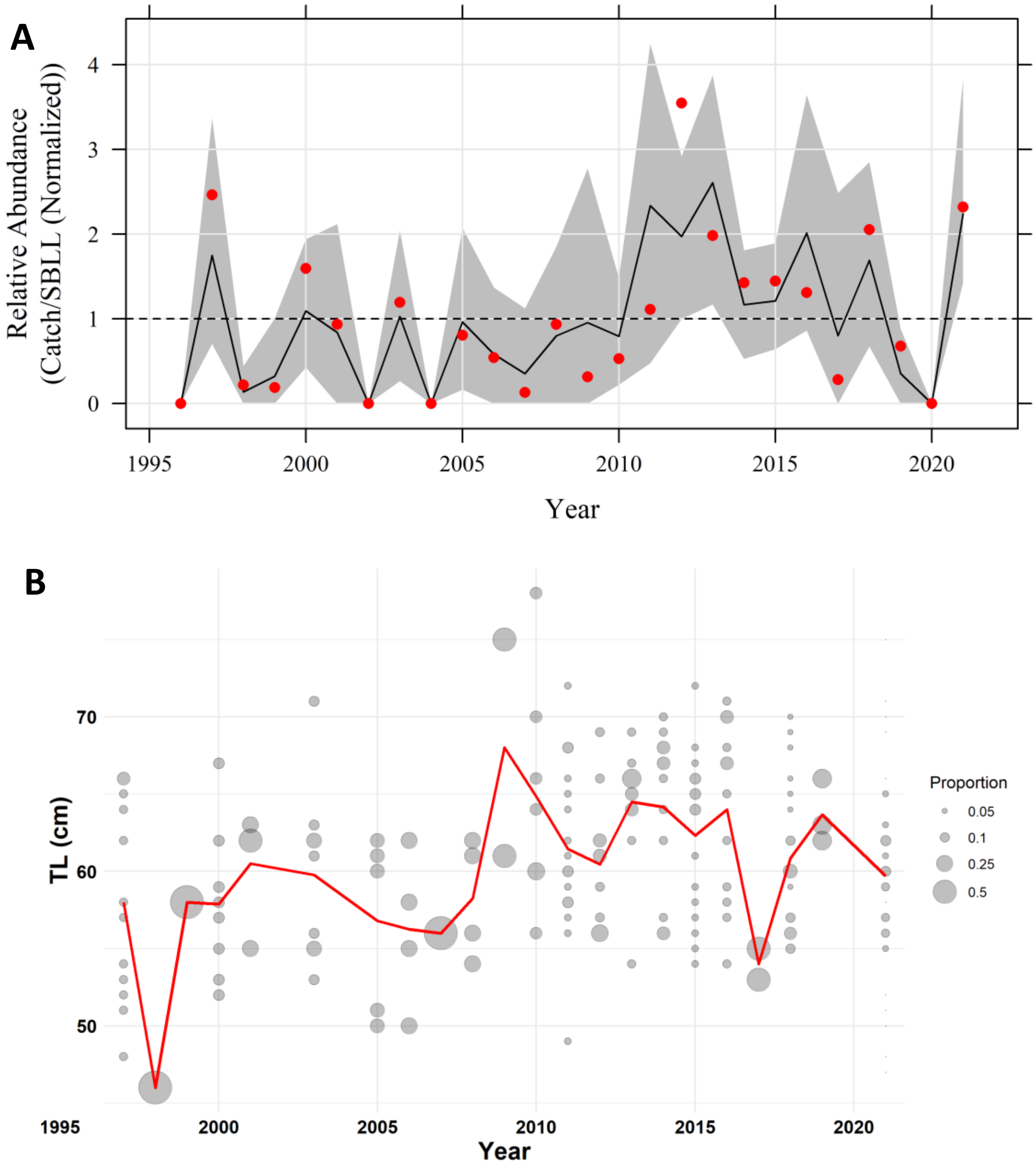


Figure 22. Short bottom longline index of abundance and length composition characterization for Blueline Tilefish A) Normalized nominal (red dot) and zero-inflated Poisson (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) caught by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

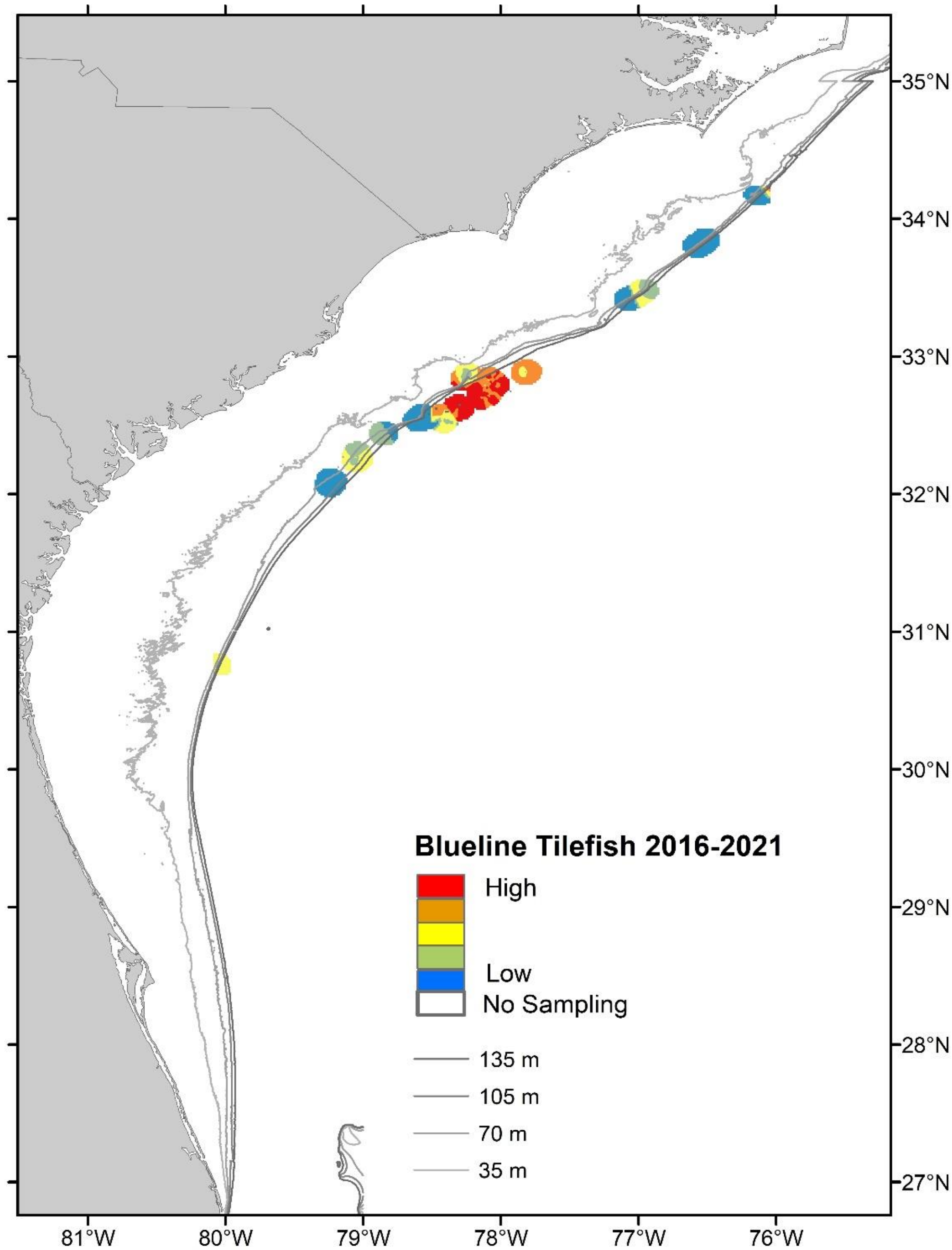


Figure 23. Distribution map of <u>Blueline Tilefish</u> catch by SERFS from SBLL in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Golden Tilefish (*Lopholatilus chamaeleonticeps*)

Short bottom longline
Golden Tilefish were not caught with SBLL in large enough numbers or consistently enough for development of an index of relative abundance (**Table 20**). Golden Tilefish mean lengths caught on SBLL increased slightly relative to 2019 (**Figure 24**).

Table 20. Short bottom longline catch of Golden Tilefish and information associated with SBLL sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1996	12	1	0.08	1
1997	33	5	0.15	6
1998	31	4	0.13	5
1999	36	2	0.06	5
2000	34	6	0.18	8
2001	29	7	0.24	17
2002	19	0	0.00	0
2003	51	5	0.10	6
2004	21	0	0.00	0
2005	42	1	0.02	1
2006	50	11	0.22	18
2007	52	0	0.00	0
2008	29	1	0.03	1
2009	43	5	0.12	9
2010	77	6	0.08	8
2011	61	1	0.02	1
2012	21	0	0.00	0
2013	41	4	0.10	7
2014	57	4	0.07	5
2015	75	10	0.13	12
2016	62	5	0.08	5
2017	48	0	0.00	0
2018	66	2	0.03	2
2019	30	1	0.03	1
2020	20	1	0.05	1
2021	108	2	0.02	3

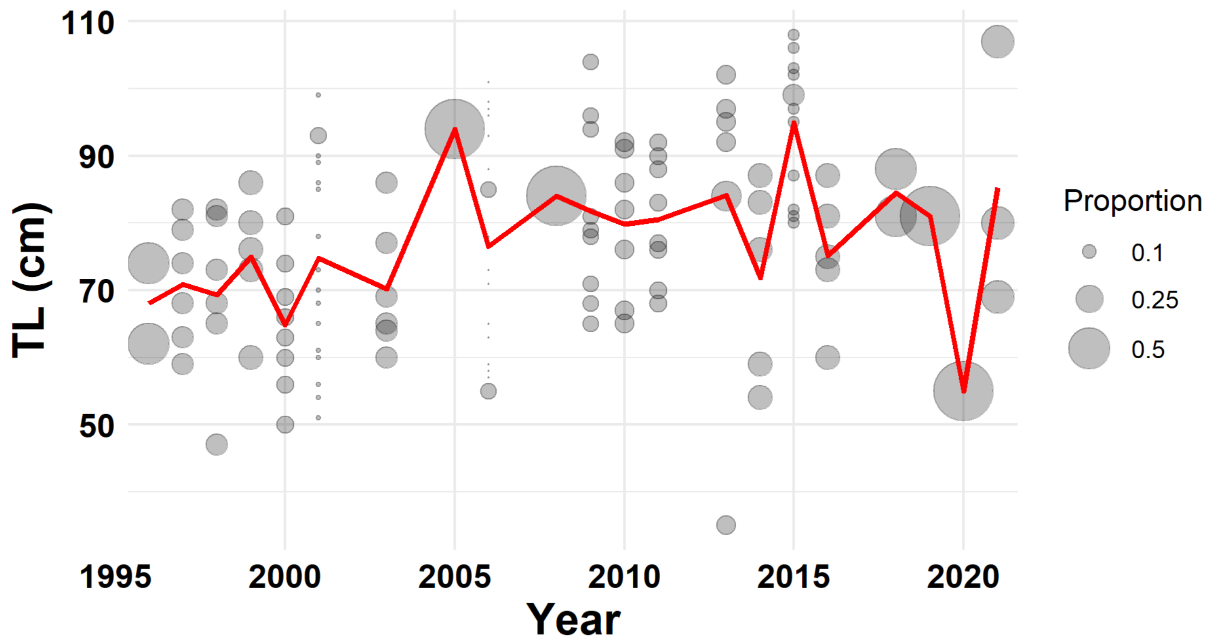


Figure 24. Golden Tilefish total lengths (cm) caught with short bottom longline by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

Long bottom longline

Golden Tilefish were not caught with LBLL in large enough numbers or consistently enough for development of an index of relative abundance. The previous index is available in the 2016 trends report (**Table 21**).

Table 21. Long bottom longline catch of Golden Tilefish and information associated with LBLL sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1996	17	4	0.24	48
1997	20	11	0.55	120
1998	8	4	0.50	25
1999	25	15	0.60	123
2000	8	4	0.50	19
2001	13	8	0.62	48
2002	18	8	0.44	18
2003	13	3	0.23	5
2004	5	0	0.00	0
2005	16	7	0.44	41
2006	7	2	0.29	5
2007	22	5	0.23	34
2008	-	-	-	-
2009	36	21	0.58	208
2010	39	23	0.59	125
2011	27	15	0.56	124
2012	-	-	-	-
2013	-	-	-	-
2014	-	-	-	
2015	34	5	0.15	8
2016	24	7	0.29	19
2017	-	-	-	-
2018	-	-	-	-
2019	2	2	1.00	4
2020	-	-	-	-
2021	-	-	-	-

Sebastidae

<u>Blackbelly Rosefish (*Helicolenus dactylopterus*)</u>

Short bottom longline

Blackbelly Rosefish were not caught with SBLL in large enough numbers or consistently enough for development of an index of relative abundance (**Table 22**). Blackbelly Rosefish mean lengths in SBLL catches for 2021 increased from 2019 (**Figure 25**). The spatial distribution of Blackbelly Rosefish is in deeper waters off of South Carolina in recent years, but caution should be taken as that is where the majority of SBLL stations have been sampled in recent years (**Figure 26**).

Table 22. <u>Short bottom longline</u> catch of <u>Blackbelly Rosefish</u> and information associated with SBLL sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1996	12	6	0.5	19
1997	33	12	0.36	21
1998	31	14	0.45	44
1999	36	4	0.11	5
2000	34	14	0.41	29
2001	29	13	0.45	20
2002	19	0	0	0
2003	51	27	0.53	57
2004	21	0	0	0
2005	42	0	0	0
2006	50	18	0.36	35
2007	52	3	0.06	3
2008	29	4	0.14	5
2009	43	1	0.02	1
2010	77	1	0.01	1
2011	61	9	0.15	14
2012	21	1	0.05	1
2013	41	1	0.02	1
2014	57	4	0.07	4
2015	75	11	0.15	15
2016	62	10	0.16	16
2017	48	1	0.02	1
2018	66	18	0.27	40
2019	30	10	0.33	14
2020	20	2	0.1	3
2021	108	11	0.1	20

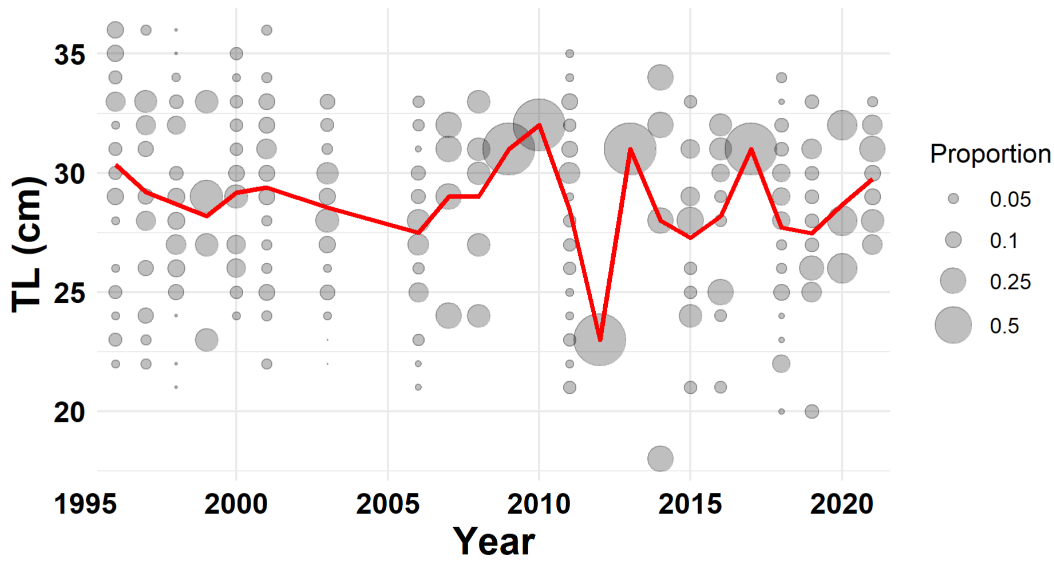


Figure 25. Blackbelly Rosefish total lengths (cm) caught with short bottom longline by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

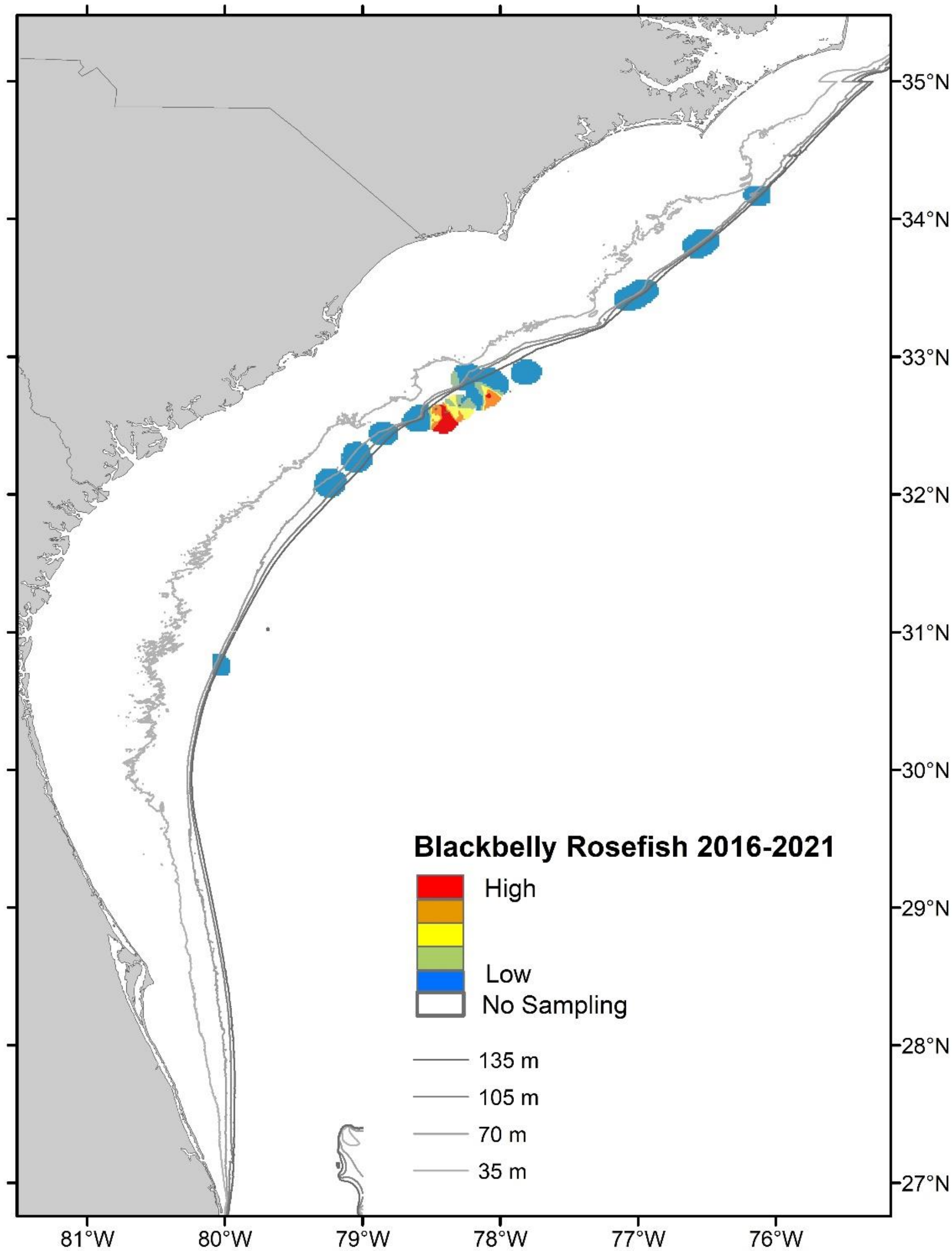


Figure 26. Distribution map of Blackbelly Rosefish catch by SERFS from SBLL in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Serranidae

Bank Sea Bass (*Centropristis ocyurus*)

Chevron Trap
Nominal and standardized abundance of Bank Sea Bass caught with CHVs in 2021 decreased relative to 2019 and was well below the time series mean (**Table 23** and **Figure 27A**). Bank Sea Bass mean lengths caught in CHVs decreased in 2021 relative to 2019 (**Figure 27B**). The spatial distribution of Bank Sea Bass is relatively homogeneous in the shallow waters throughout the survey range, but less frequent in the most southern portion of the sampling region in recent years (**Figure 28**).

Table 23. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Bank Sea Bass and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	136	0.44	823	2.25	1.34	0.15
1991	259	127	0.49	535	1.75	1.09	0.1
1992	286	120	0.42	429	1.27	0.72	0.12
1993	380	150	0.39	670	1.49	1.1	0.11
1994	340	153	0.45	725	1.8	1.5	0.1
1995	336	110	0.33	538	1.35	1.34	0.11
1996	323	157	0.49	979	2.56	1.75	0.1
1997	345	129	0.37	670	1.64	1.72	0.11
1998	373	108	0.29	485	1.1	1.37	0.15
1999	213	67	0.31	276	1.1	2.19	0.21
2000	272	81	0.3	378	1.18	1.74	0.16
2001	231	61	0.26	236	0.86	0.86	0.14
2002	225	47	0.21	115	0.43	0.45	0.16
2003	206	57	0.28	289	1.19	1.21	0.17
2004	259	70	0.27	210	0.69	0.84	0.15
2005	278	69	0.25	242	0.74	0.98	0.18
2006	281	74	0.26	328	0.99	0.95	0.18
2007	317	54	0.17	215	0.57	0.78	0.2
2008	277	57	0.21	179	0.55	0.52	0.16
2009	404	113	0.28	532	1.11	1.14	0.12
2010	732	231	0.32	1096	1.27	1.39	0.14
2011	731	253	0.35	1438	1.66	2.04	0.09
2012	1174	280	0.24	977	0.7	0.78	0.09
2013	1358	215	0.16	639	0.4	0.43	0.1
2014	1473	220	0.15	587	0.34	0.39	0.1
2015	1464	256	0.17	741	0.43	0.43	0.09
2016	1485	225	0.15	719	0.41	0.5	0.11
2017	1541	255	0.17	705	0.39	0.47	0.09
2018	1736	246	0.14	774	0.38	0.49	0.1
2019	1665	222	0.13	500	0.25	0.3	0.09
2020	-	-	-	-	-	-	-
2021	1832	162	0.09	348	0.16	0.2	0.11

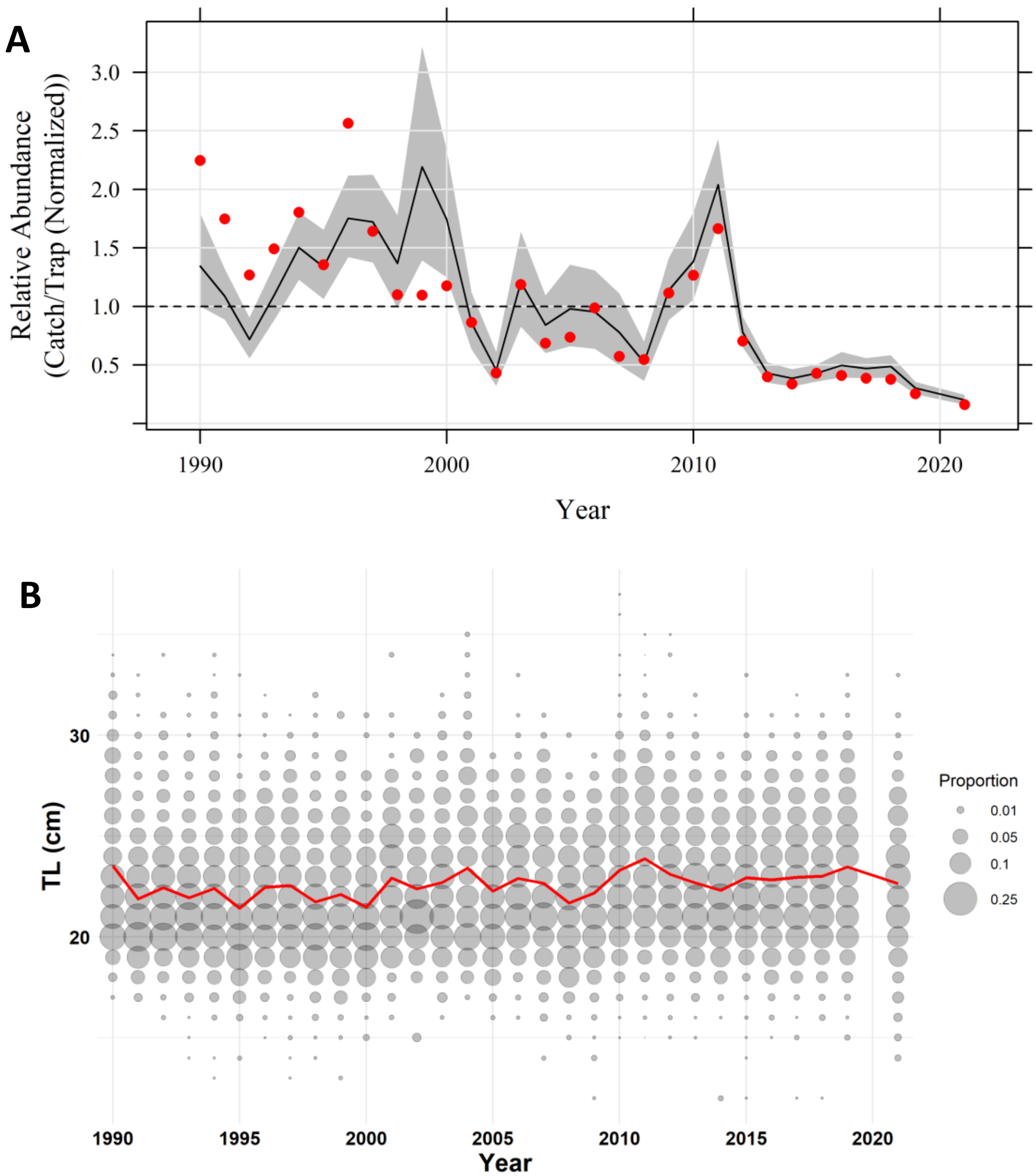


Figure 27. Chevron trap index of abundance and length composition characterization for Bank Sea Bass A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) caught in chevron traps by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

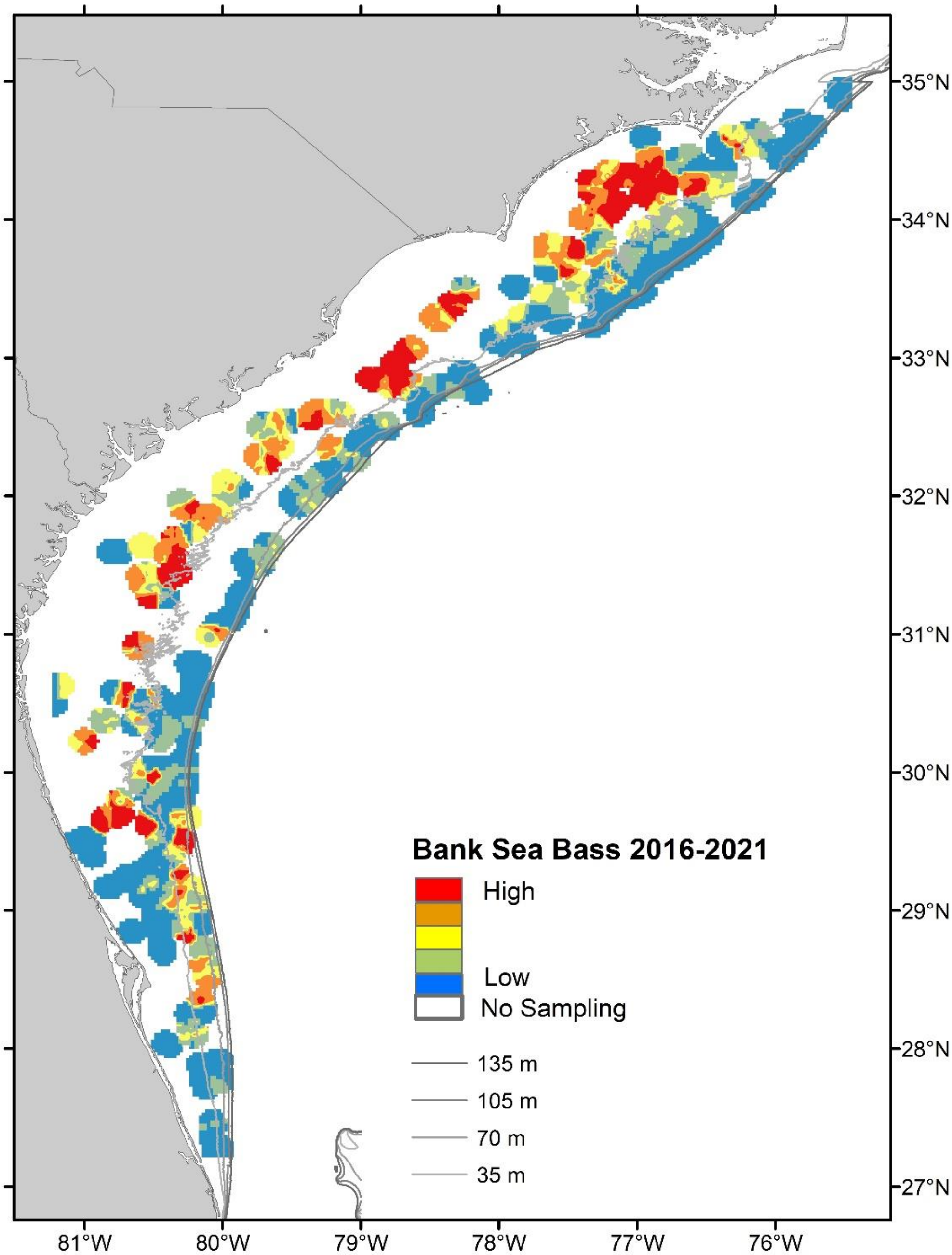


Figure 28. Distribution map of Bank Sea Bass catch by SERFS from CHV in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Black Sea Bass (*Centropristis striata*)

Chevron Trap
Nominal and standardized abundance of Black Sea Bass caught with CHVs in 2021 decreased compared to 2019 and is the lowest value recorded during the time series (**Table 24** and **Figure 29A**). Black Sea Bass mean length in CHVs decreased slightly relative to 2019 (**Figure 29B**). The spatial distribution of Black Sea Bass is relatively homogeneous in the shallow waters throughout the range in recent years (**Figure 30**).

Table 24. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Black Sea Bass and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	190	0.61	5609	1.63	1.21	0.08
1991	259	154	0.59	3897	1.36	1.08	0.08
1992	286	178	0.62	4171	1.32	0.95	0.09
1993	380	193	0.51	3208	0.76	0.67	0.09
1994	340	139	0.41	3223	0.86	0.85	0.09
1995	336	163	0.49	3164	0.85	0.63	0.08
1996	323	164	0.51	3291	0.92	0.75	0.1
1997	345	157	0.46	4108	1.08	0.95	0.11
1998	373	168	0.45	4197	1.02	0.98	0.08
1999	213	96	0.45	4338	1.84	1.9	0.14
2000	272	110	0.4	4401	1.46	1.14	0.11
2001	231	86	0.37	3807	1.49	1.48	0.15
2002	225	77	0.34	2141	0.86	0.75	0.14
2003	206	58	0.28	1585	0.7	0.66	0.13
2004	259	86	0.33	3364	1.17	1.37	0.14
2005	278	101	0.36	2980	0.97	0.97	0.12
2006	281	112	0.4	2941	0.95	1.02	0.13
2007	317	96	0.3	2561	0.73	0.72	0.14
2008	277	97	0.35	2348	0.77	0.87	0.11
2009	404	162	0.4	3771	0.84	0.58	0.11
2010	732	336	0.46	9194	1.13	1.61	0.12
2011	731	403	0.55	14736	1.82	2.23	0.08
2012	1174	678	0.58	18967	1.46	1.66	0.05
2013	1358	766	0.56	22366	1.49	1.52	0.05
2014	1473	705	0.48	15603	0.96	1.28	0.06
2015	1464	651	0.44	13046	0.8	0.91	0.06
2016	1485	537	0.36	7624	0.46	0.71	0.07
2017	1541	547	0.35	7472	0.44	0.57	0.07
2018	1736	567	0.33	7636	0.4	0.49	0.07
2019	1665	496	0.3	5789	0.31	0.34	0.07
2020	-	-	-	-	-	-	-
2021	1832	371	0.2	3247	0.16	0.16	0.08

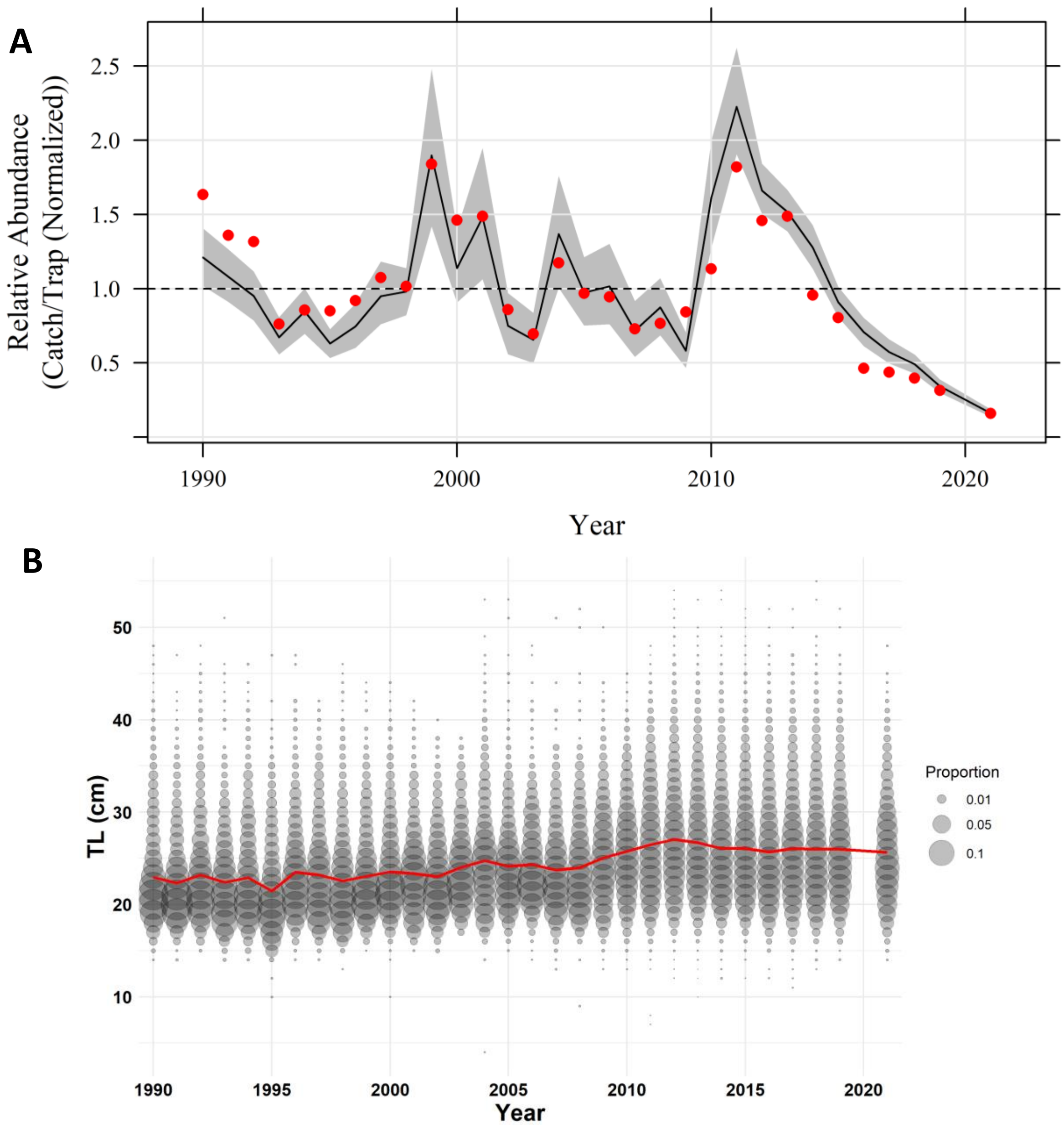


Figure 29. Chevron trap index of abundance and length composition characterization for Black Sea Bass A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

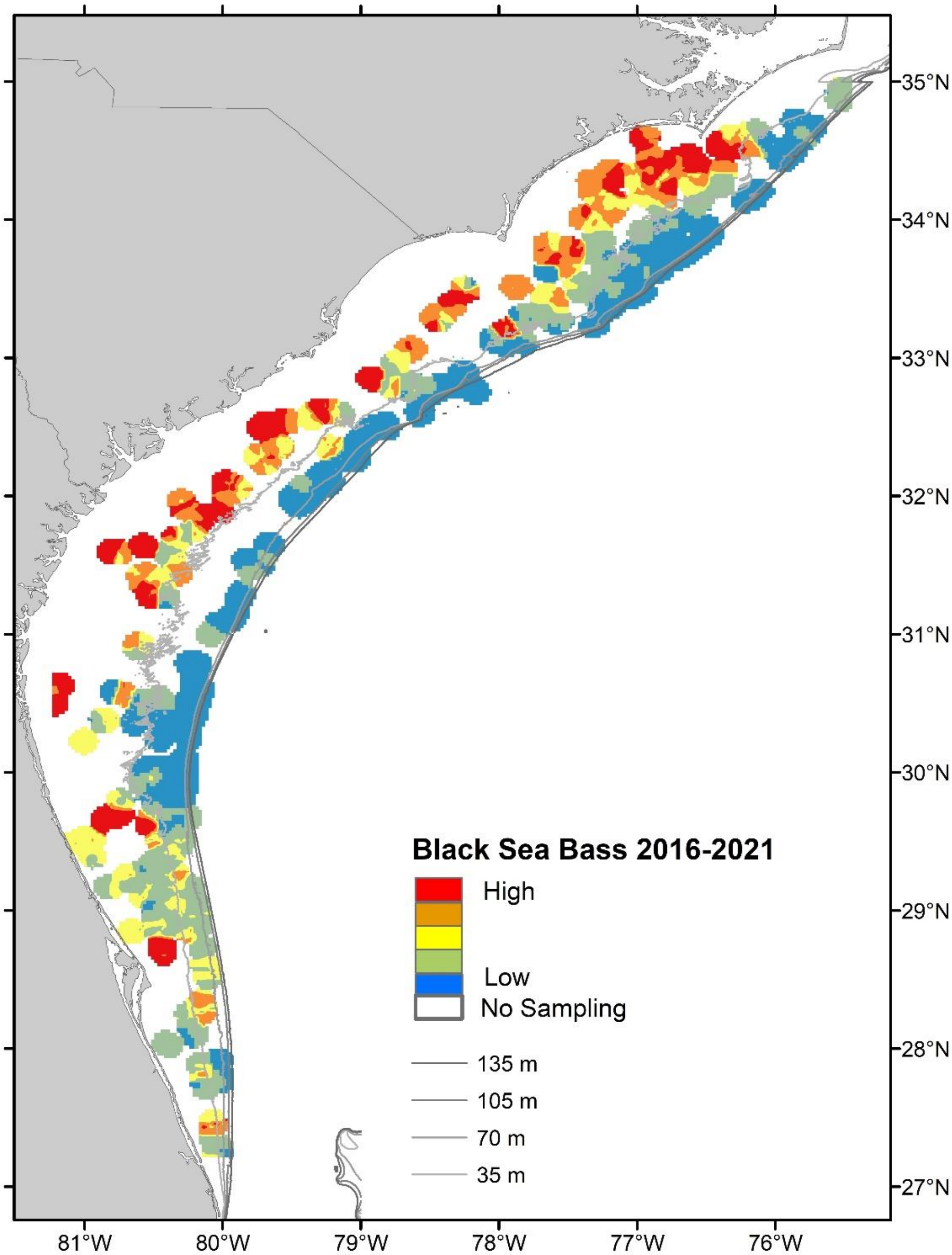


Figure 30. Distribution map of Black Sea Bass catch by SERFS from CVT in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Gag (*Mycteroperca microlepis*)

Chevron Trap

Nominal and standardized abundance of Gag caught with CHV in 2021 have decreased slightly compared to 2019 with both values being below the time series mean (**Table 25** and **Figure 31A**). The mean lengths of Gag caught with CHVs increased relative to 2019 (**Figure 31B**). The spatial distribution of Gag is mainly centered in the shallower waters off the northern portion of the region, with highest abundances off of North Carolina in recent years (**Figure 32**).

Table 25: Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Gag and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	16	0.05	22	3.91	5.32	0.25
1991	259	7	0.03	7	1.49	0.93	0.46
1992	286	6	0.02	7	1.35	2.4	0.46
1993	380	6	0.02	8	1.16	1.39	0.48
1994	340	7	0.02	10	1.62	1.96	0.46
1995	336	5	0.01	5	0.82	0.91	0.5
1996	323	6	0.02	7	1.19	1.19	0.48
1997	345	4	0.01	4	0.64	0.6	0.54
1998	373	4	0.01	4	0.59	0.56	0.59
1999	213	5	0.02	5	1.29	0.86	0.52
2000	272	7	0.03	9	1.82	1.99	0.47
2001	231	4	0.02	4	0.95	1.01	0.57
2002	225	1	0	1	0.24	0.26	1.2
2003	206	0	0	0	0	0	0.8
2004	259	2	0.01	2	0.43	0.61	0.64
2005	278	3	0.01	3	0.59	0.61	0.62
2006	281	1	0	1	0.2	0.18	1.16
2007	317	3	0.01	3	0.52	0.55	0.66
2008	277	0	0	0	0	0	>2.0
2009	404	2	0	2	0.27	0.18	0.71
2010	732	15	0.02	16	1.2	2.14	0.3
2011	731	21	0.03	27	2.03	2.62	0.32
2012	1174	30	0.03	39	1.83	0.83	0.28
2013	1358	16	0.01	23	0.93	0.62	0.29
2014	1473	23	0.02	28	1.05	0.69	0.32
2015	1464	15	0.01	17	0.64	0.42	0.34
2016	1485	24	0.02	31	1.15	0.56	0.29
2017	1541	19	0.01	20	0.71	0.37	0.25
2018	1736	17	0.01	21	0.67	0.38	0.28
2019	1665	21	0.01	30	0.99	0.5	0.28
2020	-	-	-	-	-	-	-
2021	1832	21	0.01	23	0.69	0.37	0.24

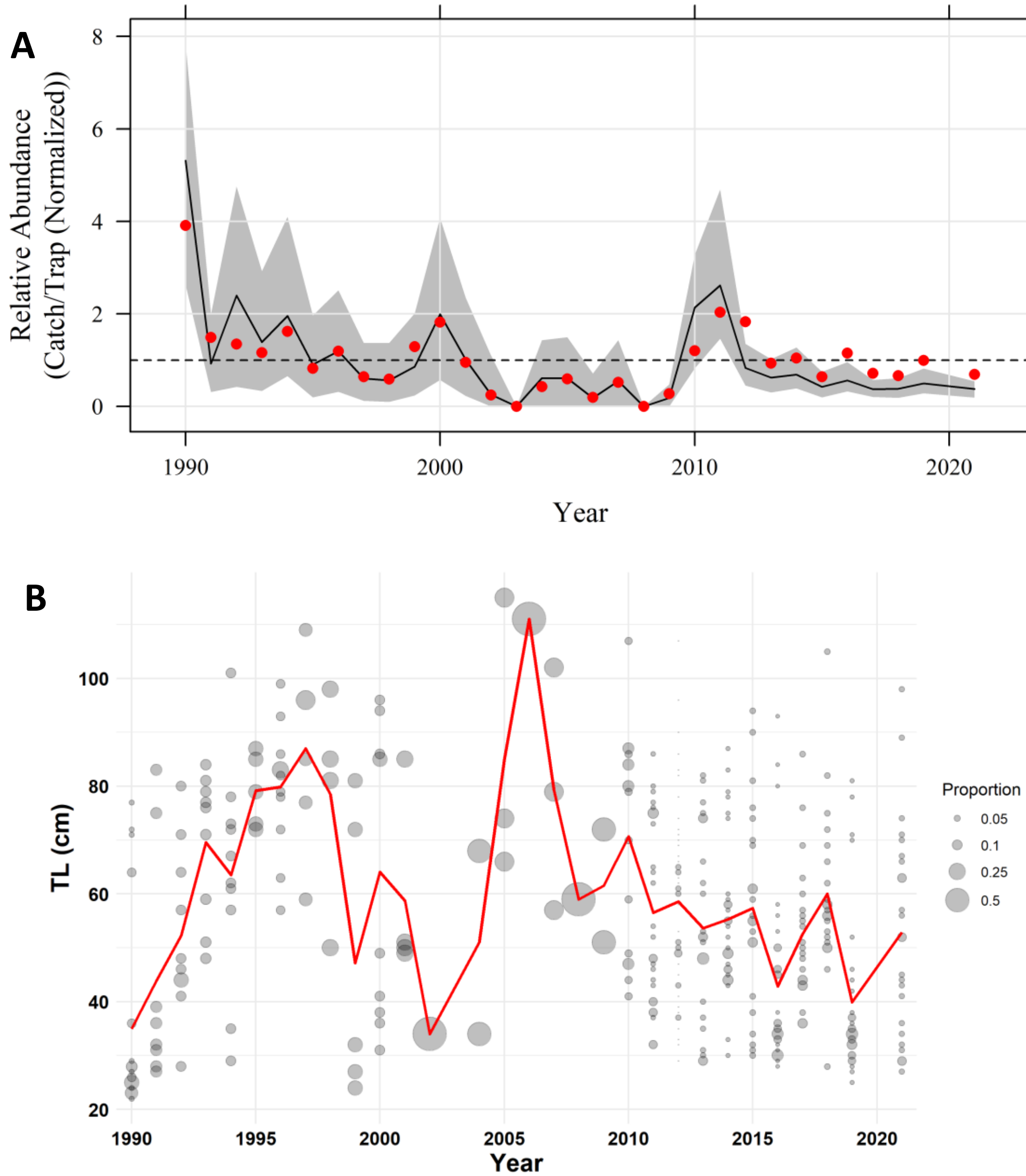


Figure 31. Chevron trap index of abundance and length composition characterization for Gag A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

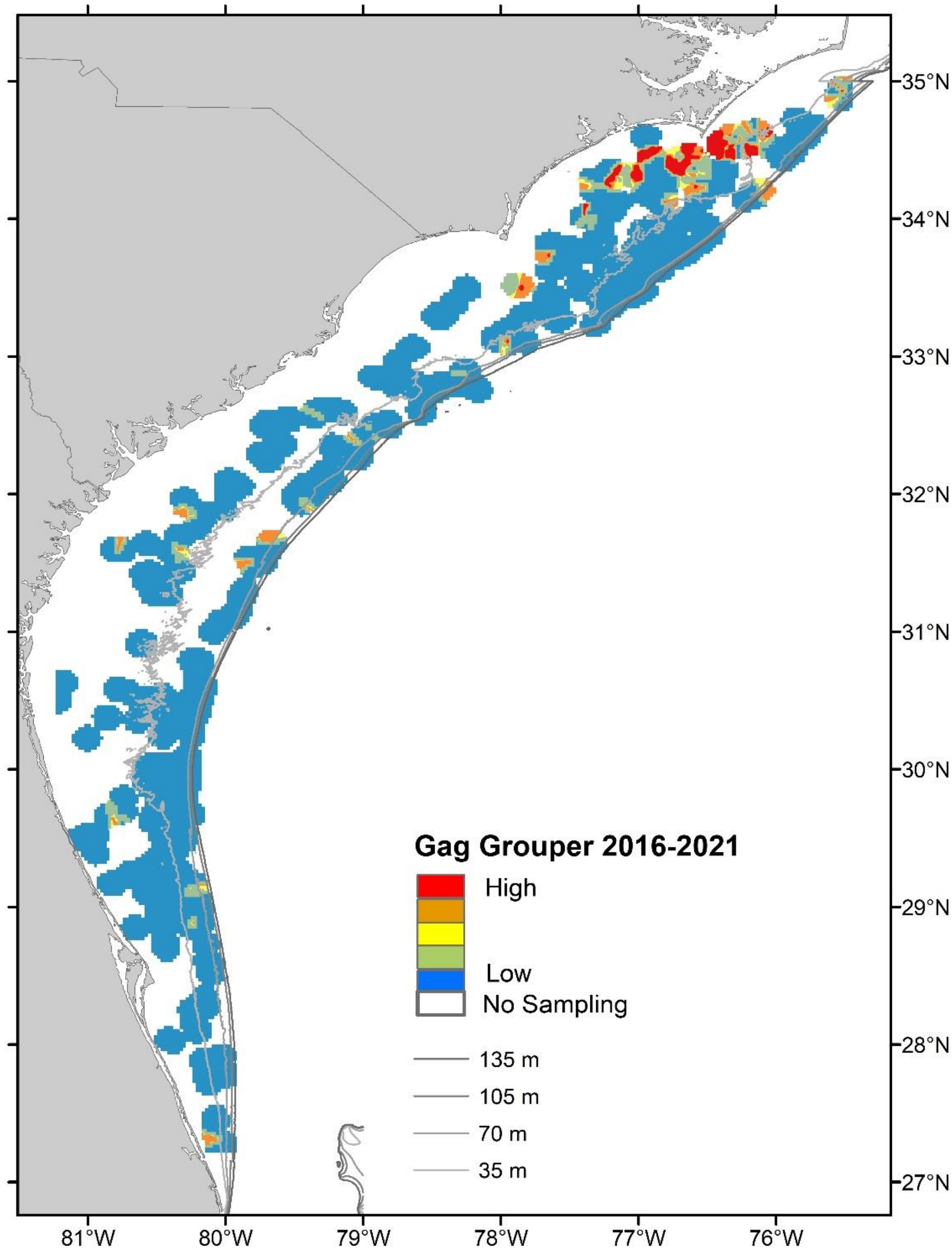


Figure 32. Distribution map of Gag catch by SERFS from CVT in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Short bottom longline
Gag were not caught with SBLL in large enough numbers or consistently enough for development of an index of relative abundance (**Table 26**). The mean length of Gag caught by SBLLs decreased in 2021 relative to 2019, but caution should be taken due to small sample size (**Figure 33**).

Table 26. Short bottom longline catch of Gag and information associated with SBLL sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1996	12	0	0.00	0
1997	33	0	0.00	0
1998	31	0	0.00	0
1999	36	3	0.08	3
2000	34	0	0.00	0
2001	29	0	0.00	0
2002	19	2	0.11	2
2003	51	1	0.02	1
2004	21	0	0.00	0
2005	42	4	0.10	4
2006	50	0	0.00	0
2007	52	6	0.12	8
2008	29	0	0.00	0
2009	43	1	0.02	1
2010	77	2	0.03	2
2011	61	3	0.05	3
2012	21	0	0.00	0
2013	41	2	0.05	3
2014	57	0	0.00	0
2015	75	0	0.00	0
2016	62	1	0.02	1
2017	48	1	0.02	1
2018	66	1	0.02	1
2019	30	0	0.00	0
2020	20	0	0.00	0
2021	108	1	0.01	2

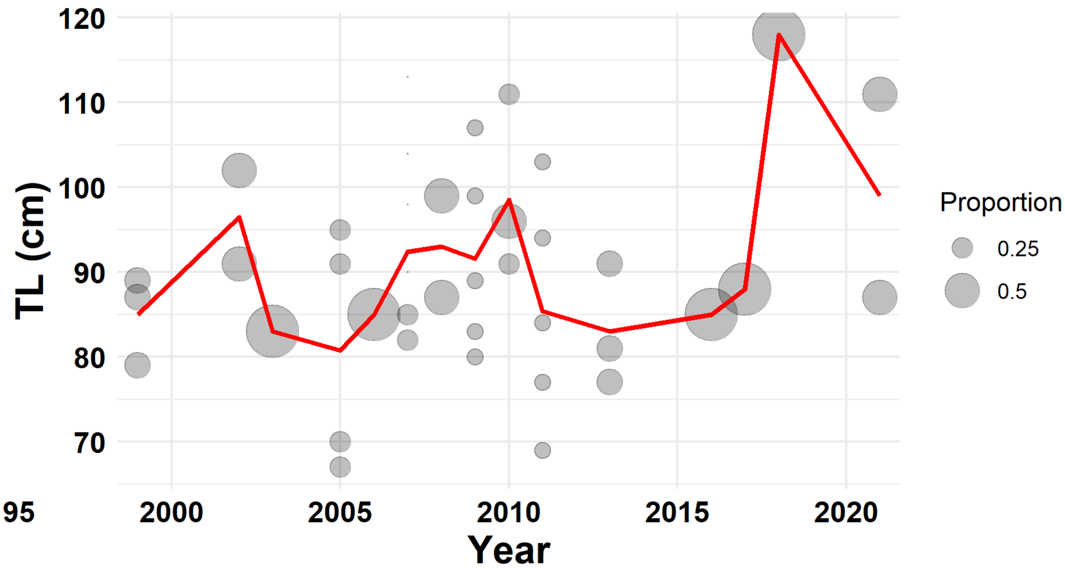


Figure 33. Gag total lengths (cm) caught with short bottom longline by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

Red Grouper (*Epinephelus morio*)

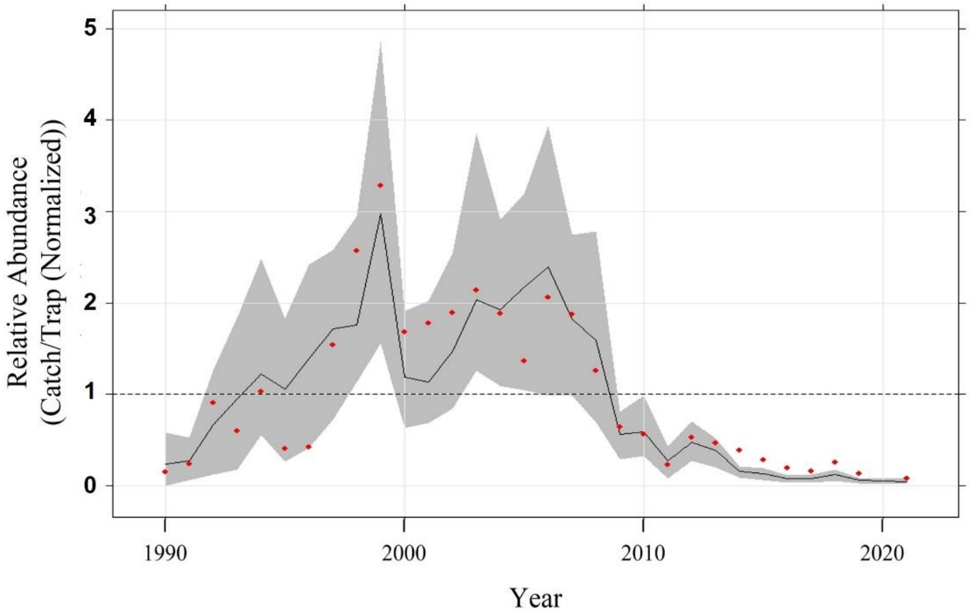
Chevron Trap

Nominal and standardized abundance of Red Grouper caught with CHVs decreased slightly to another all-time low in 2021 following a pronounced decline to below the time series mean starting in 2009 (**Table 27** and **Figure 34A**). Red Grouper mean lengths caught in CHVs decreased in 2021 from 2019 (**Figure 34B**) Red Grouper show a disjunct population in the region with nearly all catches in CHVs occurring off of North Carolina and Florida in recent years (**Figure 35**).

Table 27. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Red Grouper and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	3	0.01	3	0.15	0.24	0.6
1991	259	4	0.02	4	0.23	0.28	0.44
1992	286	5	0.02	17	0.9	0.67	0.43
1993	380	6	0.02	15	0.6	0.95	0.46
1994	340	8	0.02	23	1.03	1.23	0.39
1995	336	6	0.02	9	0.41	1.06	0.38
1996	323	8	0.02	9	0.42	1.39	0.36
1997	345	17	0.05	35	1.54	1.72	0.28
1998	373	19	0.05	63	2.57	1.76	0.26
1999	213	19	0.09	46	3.28	2.98	0.28
2000	272	17	0.06	30	1.68	1.19	0.27
2001	231	16	0.07	27	1.78	1.13	0.3
2002	225	15	0.07	28	1.89	1.47	0.3
2003	206	15	0.07	29	2.14	2.04	0.34
2004	259	17	0.07	32	1.88	1.93	0.24
2005	278	21	0.08	25	1.37	2.17	0.25
2006	281	16	0.06	38	2.06	2.4	0.32
2007	317	18	0.06	39	1.87	1.82	0.25
2008	277	12	0.04	23	1.26	1.6	0.34
2009	404	16	0.04	17	0.64	0.57	0.23
2010	732	21	0.03	27	0.56	0.59	0.29
2011	731	11	0.02	11	0.23	0.27	0.33
2012	1174	37	0.03	41	0.53	0.48	0.23
2013	1358	39	0.03	42	0.47	0.39	0.21
2014	1473	37	0.03	38	0.39	0.16	0.2
2015	1464	21	0.01	27	0.28	0.13	0.24
2016	1485	18	0.01	19	0.19	0.08	0.25
2017	1541	15	0.01	16	0.16	0.08	0.28
2018	1736	27	0.02	29	0.25	0.13	0.24
2019	1665	15	0.01	15	0.14	0.06	0.27
2020	-	-	-	-	-	-	-
2021	1832	9	0	10	0.08	0.05	0.35

A



B

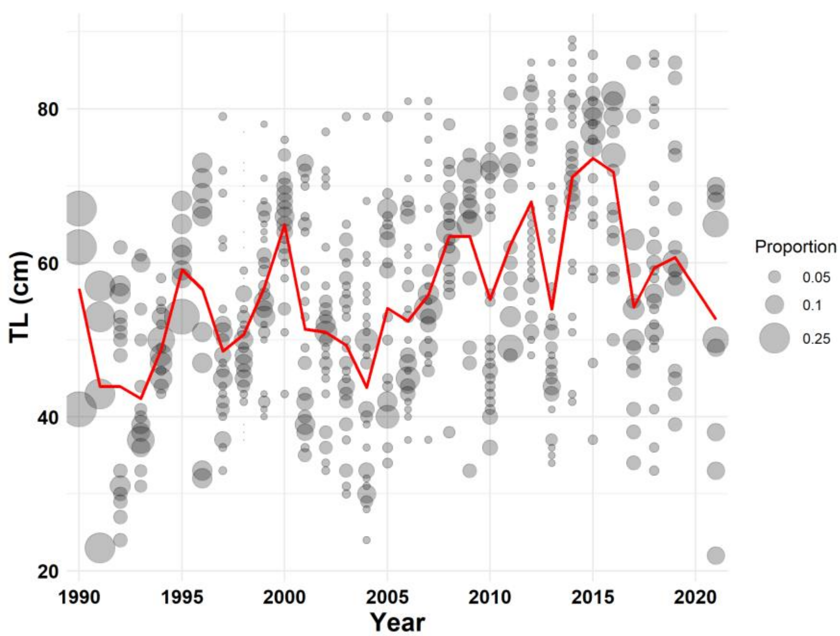


Figure 34. Chevron trap index of abundance and length composition characterization for Red Grouper A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

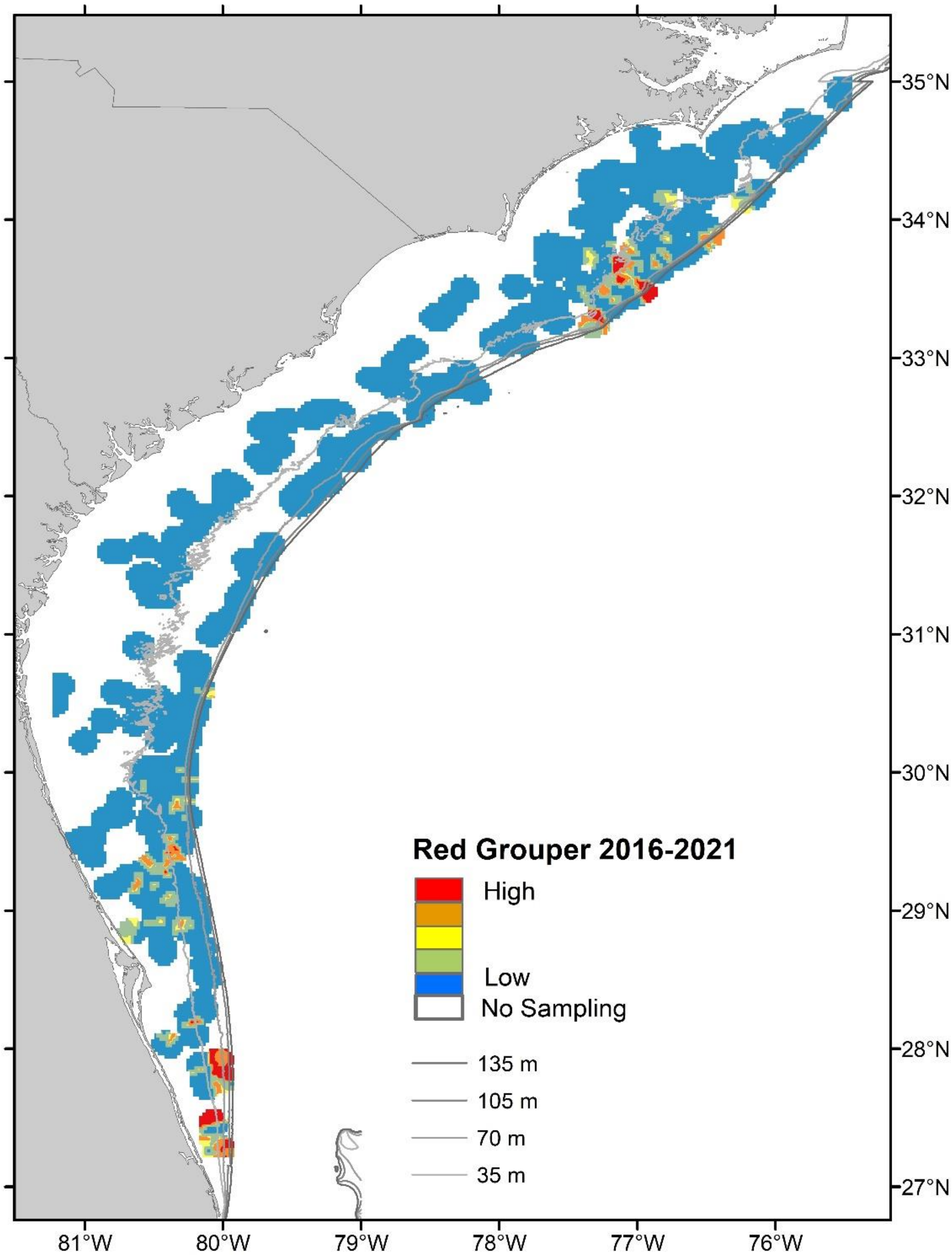


Figure 35. Distribution map of Red Grouper catch by SERFS from CVT in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Short bottom longline

Red Grouper were not caught with SBLL in large enough numbers or consistently enough for development of an index of relative abundance (**Table 28**). Red Grouper mean lengths were greatest in 2013 and lowest in 1999 (**Figure 36**). The mean length had increased throughout the time series as with those caught in CHVs, but no individuals have been caught on SBLL since 2013.

Table 28. Short bottom longline catch of Red Grouper and information associated with SBLL sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1996	12	0	0.00	0
1997	33	0	0.00	0
1998	31	0	0.00	0
1999	36	4	0.11	7
2000	34	3	0.09	5
2001	29	0	0.00	0
2002	19	0	0.00	0
2003	51	0	0.00	0
2004	21	0	0.00	0
2005	42	4	0.10	6
2006	50	1	0.02	2
2007	52	12	0.23	23
2008	29	0	0.00	0
2009	43	4	0.09	4
2010	77	0	0.00	0
2011	61	3	0.05	3
2012	21	0	0.00	0
2013	41	4	0.10	4
2014	57	0	0.00	0
2015	75	0	0.00	0
2016	62	0	0.00	0
2017	48	0	0.00	0
2018	66	0	0.00	0
2019	30	0	0.00	0
2020	20	0	0.00	0
2021	108	0	0.00	0

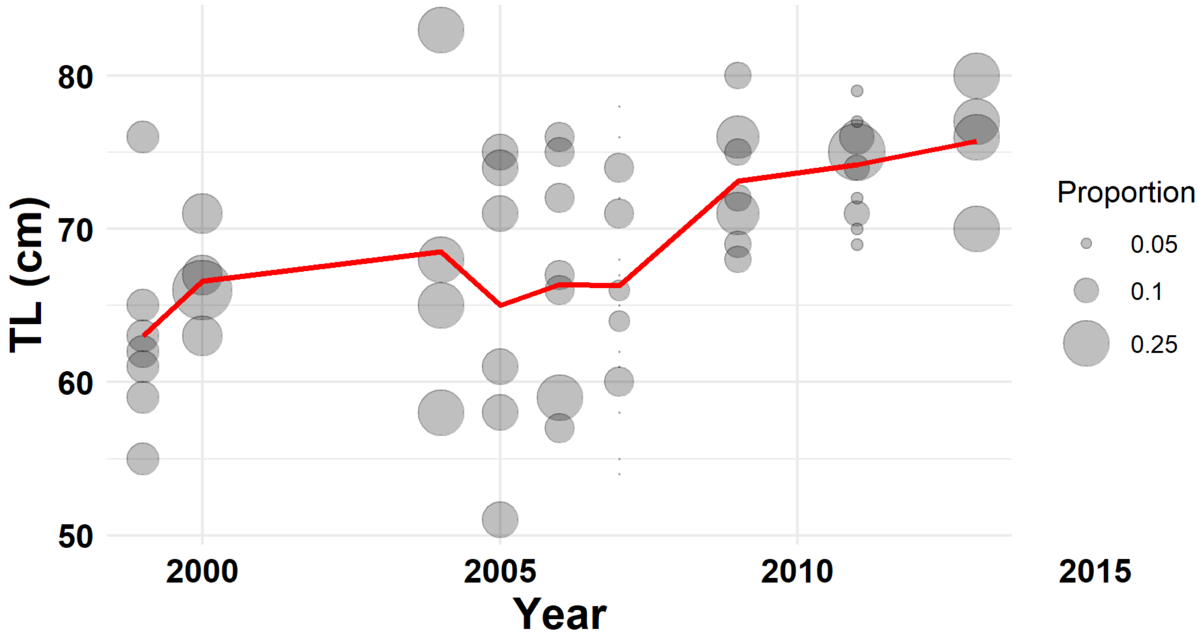


Figure 36. Red Grouper total lengths (cm) caught with short bottom longline by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

Sand Perch (*Diplectrum formosum*)

Chevron Trap
Nominal and standardized abundance of Sand Perch caught with CHVs in 2021 decreased from 2019 and both were below the time series mean (**Table 29** and **Figure 37A**). Sand Perch mean lengths caught in CHVs decreased in 2021 relative to 2019 (**Figure 37B**). The spatial distribution of Sand Perch is patchy in the shallow waters throughout the range in recent years (**Figure 38**).

Table 29. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Sand Perch and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	61	0.2	138	0.69	0.42	0.12
1991	259	78	0.3	301	1.8	1.01	0.11
1992	286	108	0.38	536	2.91	1.31	0.09
1993	380	93	0.24	279	1.14	0.85	0.11
1994	340	93	0.27	366	1.67	1.17	0.09
1995	336	74	0.22	195	0.9	0.82	0.09
1996	323	105	0.33	362	1.74	0.96	0.1
1997	345	74	0.21	231	1.04	1.14	0.13
1998	373	72	0.19	220	0.92	1.05	0.14
1999	213	55	0.26	251	1.83	1.68	0.13
2000	272	63	0.23	232	1.32	1.31	0.14
2001	231	42	0.18	185	1.24	1.35	0.15
2002	225	31	0.14	92	0.64	0.75	0.23
2003	206	39	0.19	176	1.33	1.96	0.16
2004	259	45	0.17	180	1.08	1.4	0.18
2005	278	66	0.24	307	1.72	1.55	0.11
2006	281	53	0.19	134	0.74	0.76	0.13
2007	317	47	0.15	162	0.79	0.87	0.17
2008	277	55	0.2	178	1	0.95	0.14
2009	404	79	0.2	289	1.11	1.27	0.12
2010	732	111	0.15	341	0.72	0.88	0.11
2011	731	68	0.09	265	0.56	0.98	0.15
2012	1174	110	0.09	382	0.51	0.84	0.1
2013	1358	120	0.09	331	0.38	0.6	0.11
2014	1473	132	0.09	337	0.36	0.59	0.13
2015	1464	138	0.09	339	0.36	0.53	0.1
2016	1485	156	0.11	427	0.45	0.74	0.1
2017	1541	133	0.09	455	0.46	0.77	0.12
2018	1736	171	0.1	561	0.5	0.84	0.11
2019	1665	205	0.12	710	0.66	0.88	0.08
2020	-	-	-	-	-	-	-
2021	1832	176	0.1	507	0.43	0.74	0.11

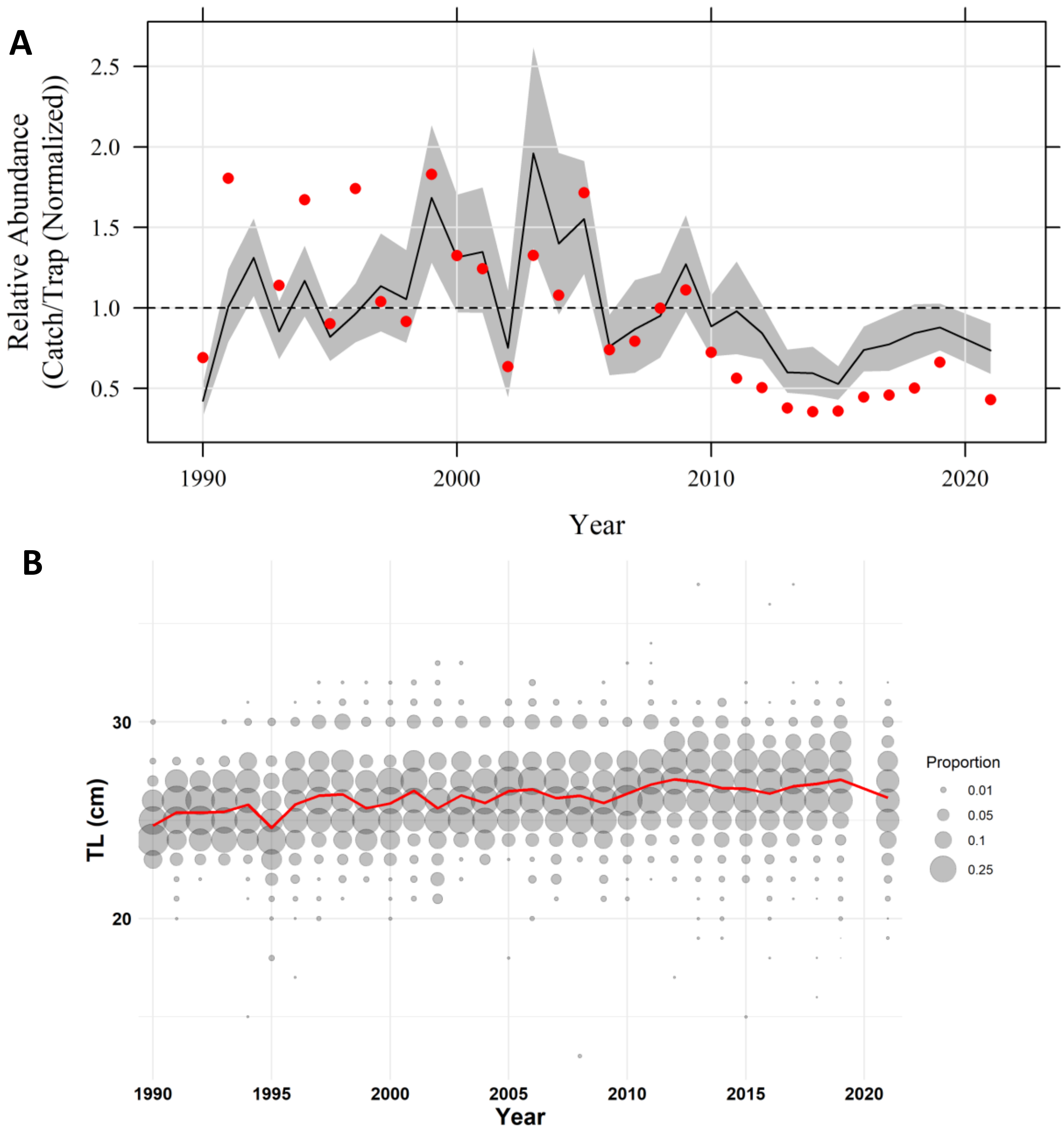


Figure 37. Chevron trap index of abundance and length composition characterization for Sand Perch A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

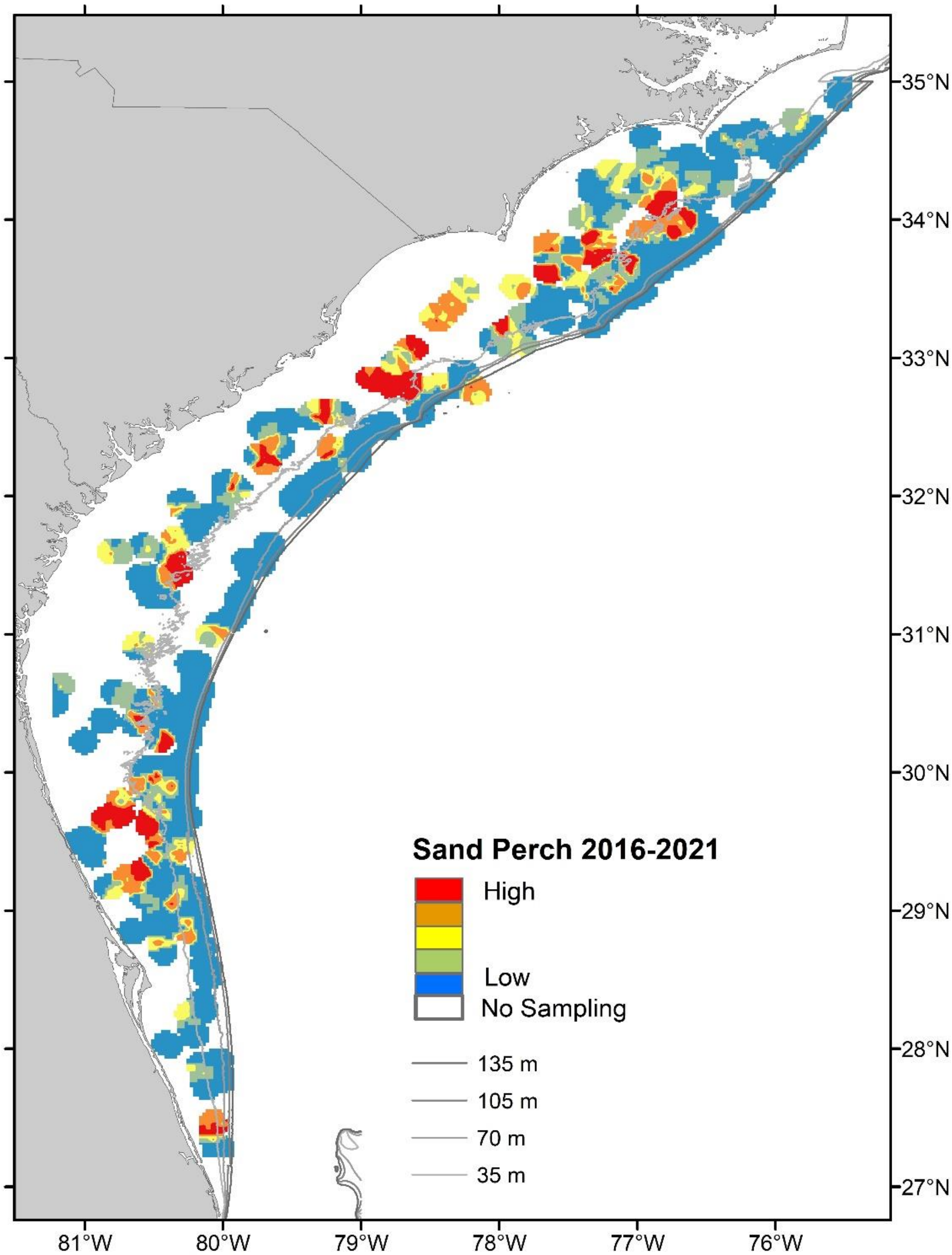


Figure 38. Distribution map of Sand Perch catch by SERFS from CVT in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Scamp (*Mycteroperca phenax*)

Chevron Trap

Nominal abundance of Scamp caught with CHVs in 2021 was level relative to 2019, while the standardized abundance increased from 2019 although both values are well below the time series mean (**Table 30** and **Figure 39A**). Scamp mean lengths caught in CHVs decreased slightly from 2019 (**Figure 39B**).

Table 30. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Scamp and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*$trap^{-1}$*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	32	0.1	63	1.41	1.46	0.17
1991	259	30	0.12	48	1.29	1.24	0.18
1992	286	29	0.1	49	1.19	1.48	0.2
1993	380	37	0.1	67	1.23	1.56	0.18
1994	340	66	0.19	121	2.48	1.66	0.11
1995	336	47	0.14	108	2.24	2.26	0.15
1996	323	35	0.11	59	1.27	1.37	0.19
1997	345	64	0.19	157	3.17	2.44	0.13
1998	373	47	0.13	104	1.94	2.17	0.16
1999	213	24	0.11	46	1.5	1.4	0.23
2000	272	40	0.15	57	1.46	1.35	0.16
2001	231	31	0.13	51	1.54	1.14	0.2
2002	225	24	0.11	36	1.11	0.97	0.22
2003	206	23	0.11	36	1.22	1.66	0.24
2004	259	35	0.14	50	1.34	1.5	0.18
2005	278	31	0.11	56	1.4	1.3	0.18
2006	281	10	0.04	15	0.37	0.38	0.34
2007	317	39	0.12	60	1.32	1.07	0.16
2008	277	10	0.04	13	0.33	0.32	0.33
2009	404	12	0.03	17	0.29	0.37	0.32
2010	732	31	0.04	47	0.45	0.74	0.2
2011	731	27	0.04	30	0.29	0.39	0.19
2012	1174	42	0.04	58	0.34	0.55	0.18
2013	1358	49	0.04	55	0.28	0.43	0.15
2014	1473	53	0.04	72	0.34	0.38	0.17
2015	1464	55	0.04	70	0.33	0.42	0.16
2016	1485	41	0.03	51	0.24	0.23	0.16
2017	1541	58	0.04	72	0.33	0.38	0.14
2018	1736	29	0.02	39	0.16	0.19	0.2
2019	1665	16	0.01	19	0.08	0.08	0.27
2020	-	-	-	-	-	-	-
2021	1832	18	0.01	20	0.08	0.1	0.26

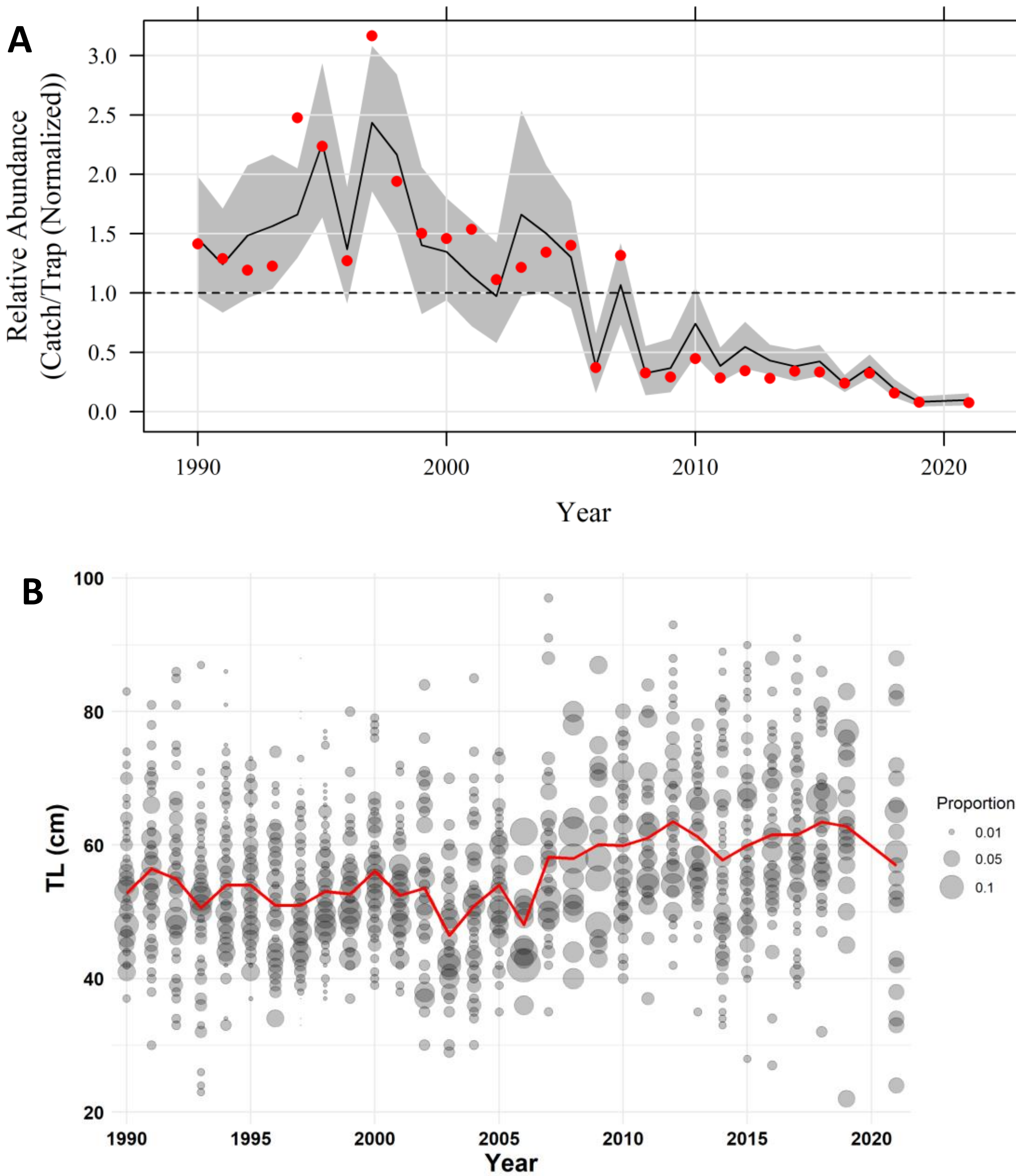


Figure 39. Chevron trap index of abundance and length composition characterization for Scamp A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

Short bottom longline

Scamp were not caught with SBLL in large enough numbers or consistently enough for development of an index of relative abundance (**Table 31**). Scamp mean length caught with SBLL increased in 2021 relative to 2019 (**Figure 40**). The spatial distribution of Scamp catches in all gears is highest in the central to northern portion of the region and in deeper waters while catches are more limited off the southern portion in recent years (**Figure 41**).

Table 31. Short bottom longline catch of Scamp and information associated with SBLL sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1996	12	1	0.08	1
1997	33	0	0	0
1998	31	0	0	0
1999	36	10	0.28	19
2000	34	1	0.03	2
2001	29	9	0.31	32
2002	19	4	0.21	9
2003	51	5	0.1	8
2004	21	3	0.14	3
2005	42	9	0.21	10
2006	50	10	0.2	18
2007	52	17	0.33	24
2008	29	3	0.1	3
2009	43	9	0.21	11
2010	77	7	0.09	8
2011	61	13	0.21	23
2012	21	0	0	0
2013	41	7	0.17	14
2014	57	6	0.11	9
2015	75	4	0.05	5
2016	62	3	0.05	4
2017	48	9	0.19	10
2018	66	4	0.06	4
2019	30	0	0	0
2020	20	1	0.05	1
2021	108	9	0.08	16

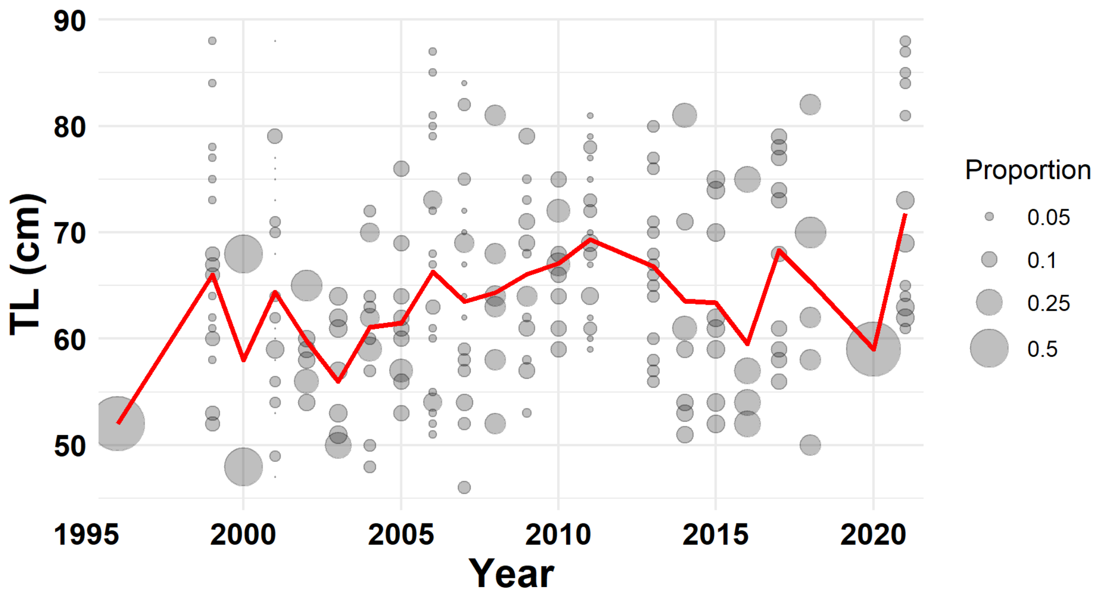


Figure 40. Scamp total lengths (cm) caught with short bottom longline by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

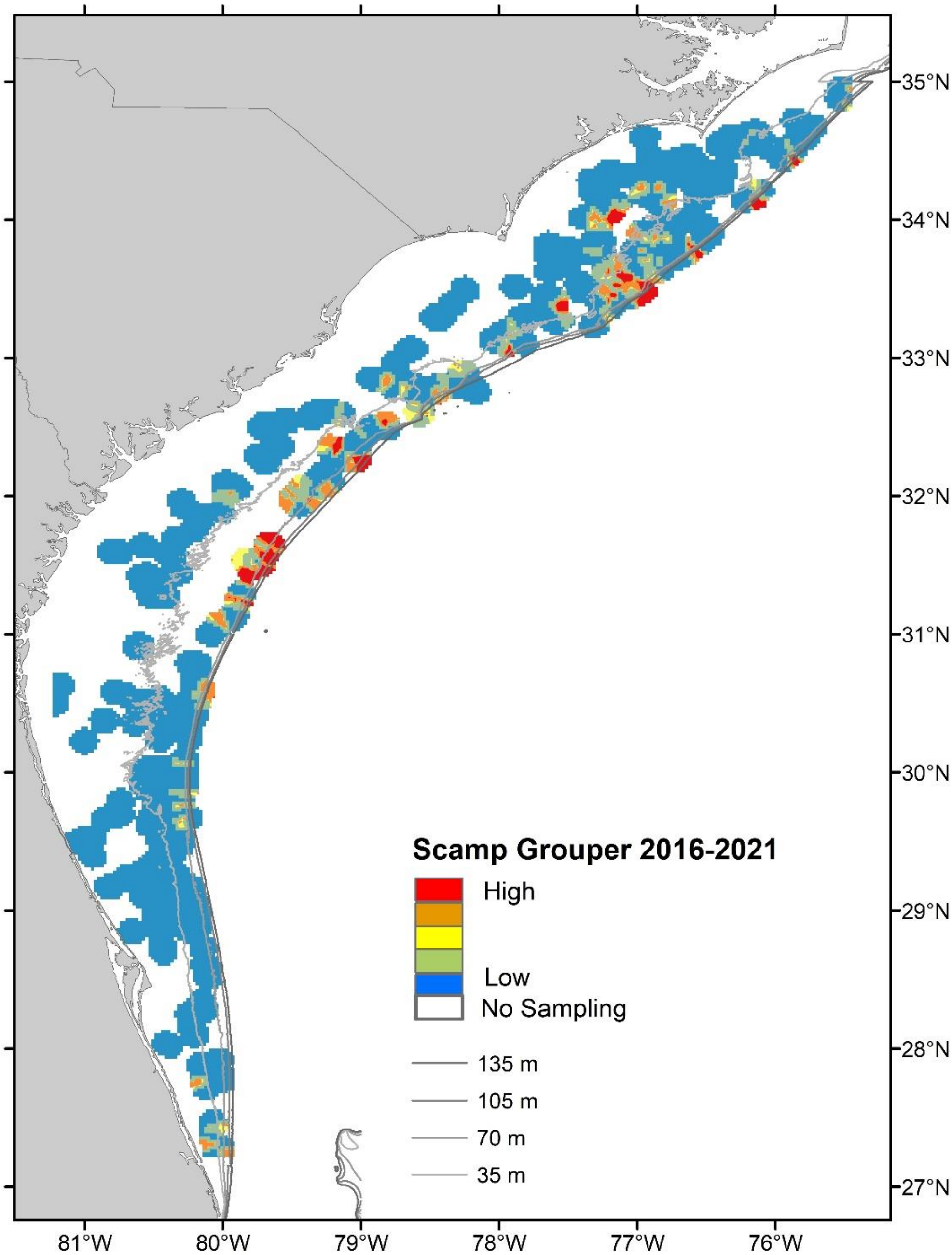


Figure 41. Distribution map of <u>Scamp</u> catch by SERFS from CVT in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Snowy Grouper (*Hyporthodus niveatus*)

Chevron Trap

Nominal and standardized abundance of Snowy Grouper caught with CHVs in 2021 decreased from 2019 and both were below the time series mean (**Table 32** and **Figure 42A**). Snowy Grouper mean lengths of fish caught in CHVs in 2021 decreased from 2019 (**Figure 42B**).

Table 32. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Snowy Grouper and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	5	0.02	9	0.7	2.73	0.71
1991	259	1	0	1	0.09	0.19	1.02
1992	286	0	0	0	0	0	>2.0
1993	380	3	0.01	19	1.2	1.95	0.41
1994	340	9	0.03	59	4.16	3.04	0.22
1995	336	0	0	0	0	0	>2.0
1996	323	11	0.03	37	2.75	1.33	0.28
1997	345	14	0.04	57	3.96	1.64	0.25
1998	373	8	0.02	22	1.41	1.21	0.28
1999	213	0	0	0	0	0	>2.0
2000	272	1	0	3	0.26	3.53	0.77
2001	231	12	0.05	35	3.63	2.03	0.27
2002	225	5	0.02	18	1.92	1.87	0.29
2003	206	7	0.03	18	2.1	0.98	0.25
2004	259	12	0.05	21	1.95	1.16	0.39
2005	278	3	0.01	4	0.35	0.98	0.56
2006	281	8	0.03	10	0.85	0.57	0.29
2007	317	5	0.02	10	0.76	0.73	1.27
2008	277	2	0.01	2	0.17	0.15	1.07
2009	404	5	0.01	6	0.36	0.35	0.49
2010	732	9	0.01	13	0.43	0.6	0.53
2011	731	10	0.01	18	0.59	0.6	0.26
2012	1174	21	0.02	38	0.78	1.09	0.2
2013	1358	6	0	13	0.23	0.39	0.44
2014	1473	12	0.01	17	0.28	0.55	0.22
2015	1464	11	0.01	16	0.26	0.55	0.29
2016	1485	14	0.01	27	0.44	0.68	0.26
2017	1541	23	0.01	46	0.72	0.83	0.26
2018	1736	11	0.01	23	0.32	0.63	0.43
2019	1665	9	0.01	13	0.19	0.34	0.35
2020	-	-	-	-	-	-	-
2021	1832	11	0.01	12	0.16	0.31	0.3

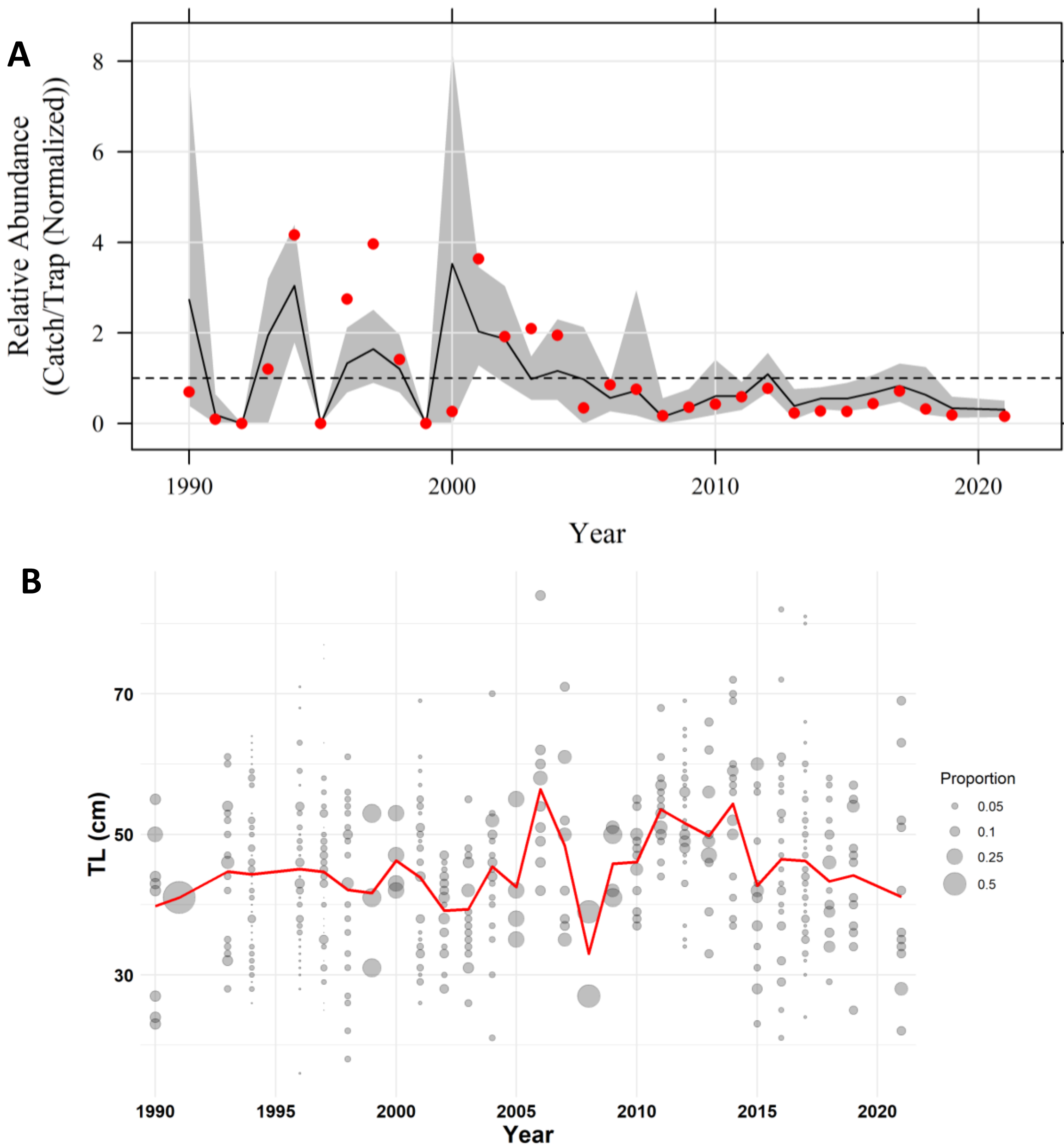


Figure 42. Chevron trap index of abundance and length composition characterization for Snowy Grouper A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

Short bottom longline

Nominal abundance of Snowy Grouper caught with SBLL in 2021 has increased from 2019, but the normalized abundance decreased, with both below the time series mean (**Table 33** and **Figure 43A**). Snowy Grouper mean lengths of fish caught in 2021 using SBLL decreased from 2019 (**Figure 43B**). The spatial distribution of Snowy Grouper catches using CHVs and SBLL is focused in deeper waters off the coast of South Carolina in recent years (**Figure 44**). This may be misleading in terms of latitudinal variation as the majority of SBLL stations sampled over this time period were located in this area and the majority of SBLL stations occur in this area as well.

Table 33. Short bottom longline nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Snowy Grouper and information associated with SBLL sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*20 hooks^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1996	12	4	0.33	5	0.4	0.71	0.43
1997	33	14	0.42	38	1.12	0.62	0.31
1998	31	13	0.42	27	0.85	0.64	0.41
1999	36	14	0.39	33	0.89	0.97	0.28
2000	34	17	0.5	34	0.97	0.63	0.26
2001	29	17	0.59	42	1.41	1.31	0.24
2002	19	10	0.53	27	1.38	2.36	0.35
2003	51	25	0.49	52	0.99	0.82	0.2
2004	21	4	0.19	8	0.37	0.75	0.58
2005	42	18	0.43	35	0.81	0.89	0.24
2006	50	13	0.26	30	0.58	0.63	0.34
2007	52	6	0.12	15	0.28	0.66	0.42
2008	29	20	0.69	61	2.04	1.4	0.2
2009	43	5	0.12	21	0.47	1.72	0.34
2010	77	39	0.51	72	0.91	0.9	0.17
2011	61	26	0.43	66	1.05	1.34	0.18
2012	21	17	0.81	76	3.52	1.83	0.19
2013	41	13	0.32	49	1.16	1.72	0.25
2014	57	28	0.49	66	1.12	0.89	0.2
2015	75	37	0.49	101	1.31	0.97	0.16
2016	62	28	0.45	71	1.11	1.23	0.24
2017	48	7	0.15	13	0.26	0.62	0.52
2018	66	20	0.3	44	0.65	0.51	0.28
2019	30	15	0.5	35	1.13	0.93	0.27
2020	20	4	0.2	6	0.29	0.55	0.48
2021	108	53	0.49	102	0.92	0.4	0.34

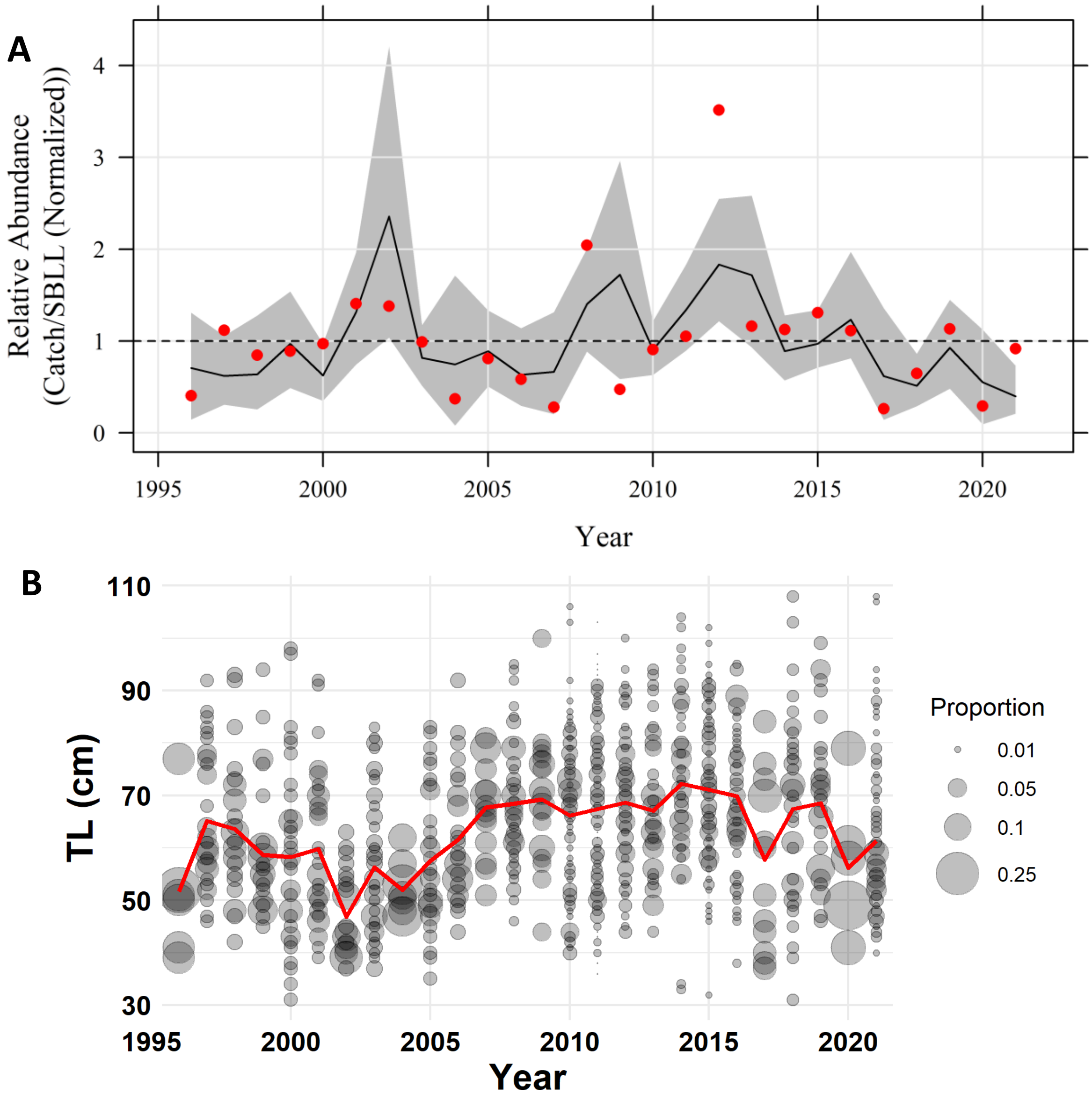


Figure 43. Short bottom longline index of abundance and length composition characterization for Snowy Grouper A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

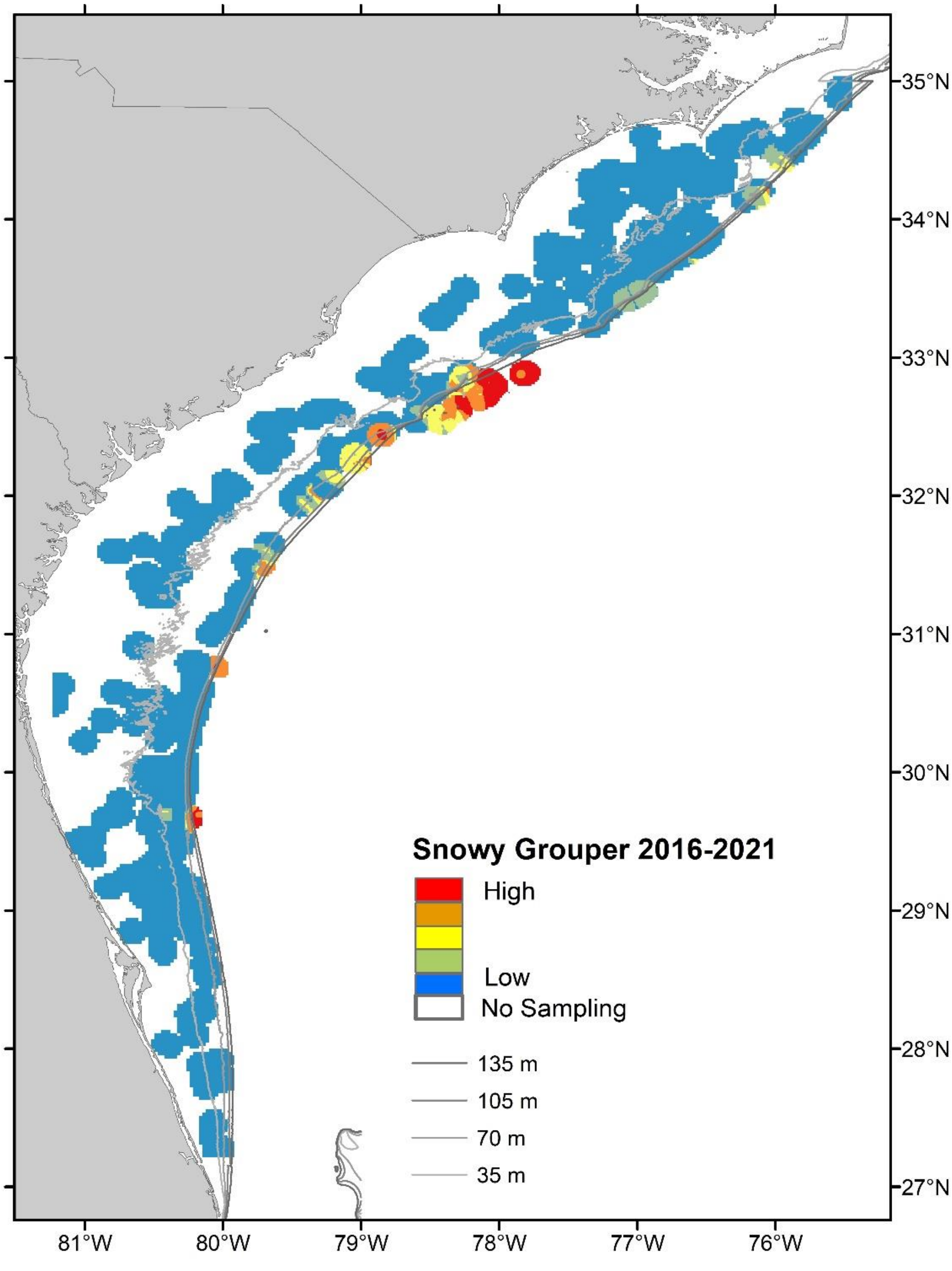


Figure 44. Distribution map of Snowy Grouper catch by SERFS from CVT and SBLL in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Speckled Hind (*Epinephelus drummondhayi*)

Chevron Trap

Speckled Hind were not caught with CHVs in large enough numbers or consistently enough for development of an index of relative abundance (**Table 34**). Mean length Speckled Hind caught in CHVs decreased in 2021 relative to the last year one was caught (2018), but these are individual fish, so caution should be taken in interpretation (**Figure 45**).

Table 34: Chevron Trap catch of Speckled Hind and information associated with chevron trap sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1990	310	5	0.02	5
1991	259	1	0.00	1
1992	286	3	0.01	4
1993	380	4	0.01	5
1994	340	2	0.01	4
1995	336	0	0.00	0
1996	323	4	0.01	5
1997	345	6	0.02	9
1998	373	5	0.01	5
1999	213	6	0.03	6
2000	272	11	0.04	18
2001	231	5	0.02	7
2002	225	14	0.06	18
2003	206	4	0.02	6
2004	259	3	0.01	5
2005	278	1	0.00	2
2006	281	0	0.00	0
2007	317	3	0.01	8
2008	277	1	0.00	1
2009	404	0	0.00	0
2010	732	2	0.00	2
2011	731	2	0.00	2
2012	1174	2	0.00	2
2013	1358	5	0.00	5
2014	1473	6	0.00	7
2015	1464	4	0.00	4
2016	1485	0	0.00	0
2017	1541	2	0.00	2
2018	1736	1	0.00	1
2019	1665	0	0.00	0
2020	-	-	-	-
2021	1832	1	0.00	1

Short bottom longline

Speckled Hind were not caught with SBLL in large enough numbers or consistently enough for development of an index of relative abundance (**Table 35**). No Speckled Hind was caught by SBLL in 2021 and none have been caught since 2018, so no additional length information is available (**Figure 46**).

Table 35: Short bottom longline catch of Speckled Hind and information associated with SBLL sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1996	12	0	0.00	0
1997	33	0	0.00	0
1998	31	0	0.00	0
1999	36	4	0.11	4
2000	34	2	0.06	3
2001	29	2	0.07	2
2002	19	0	0.00	0
2003	51	0	0.00	0
2004	21	5	0.24	6
2005	42	7	0.17	11
2006	50	2	0.04	3
2007	52	6	0.12	8
2008	29	0	0.00	0
2009	43	3	0.07	3
2010	77	4	0.05	4
2011	61	6	0.10	7
2012	21	0	0.00	0
2013	41	3	0.07	4
2014	57	0	0.00	0
2015	75	1	0.01	1
2016	62	0	0.00	0
2017	48	1	0.02	1
2018	66	3	0.05	3
2019	30	0	0.00	0
2020	20	0	0.00	0
2021	108	0	0.00	0

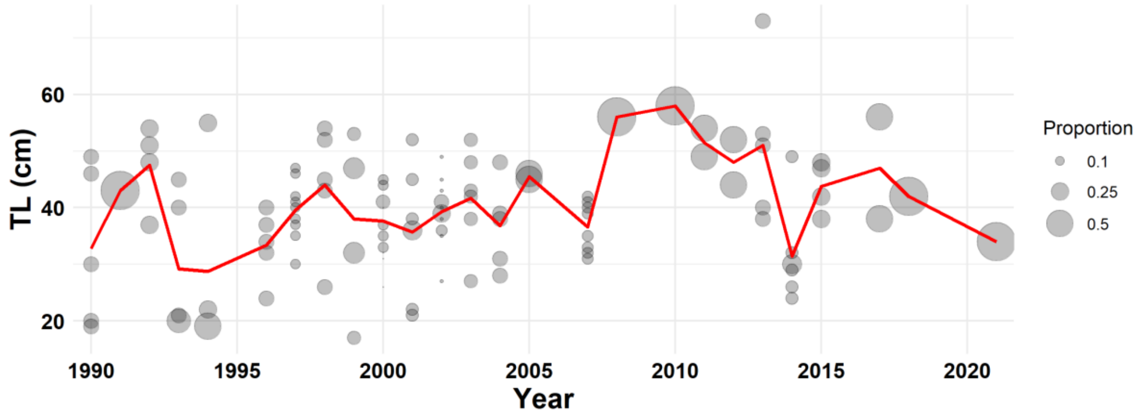


Figure 45. Speckled Hind total lengths (cm) caught in chevron traps by year. Red dots represent mean length. Vertical axis represents the length of samples from a given year, while the width represents the numbers caught of that length by year.

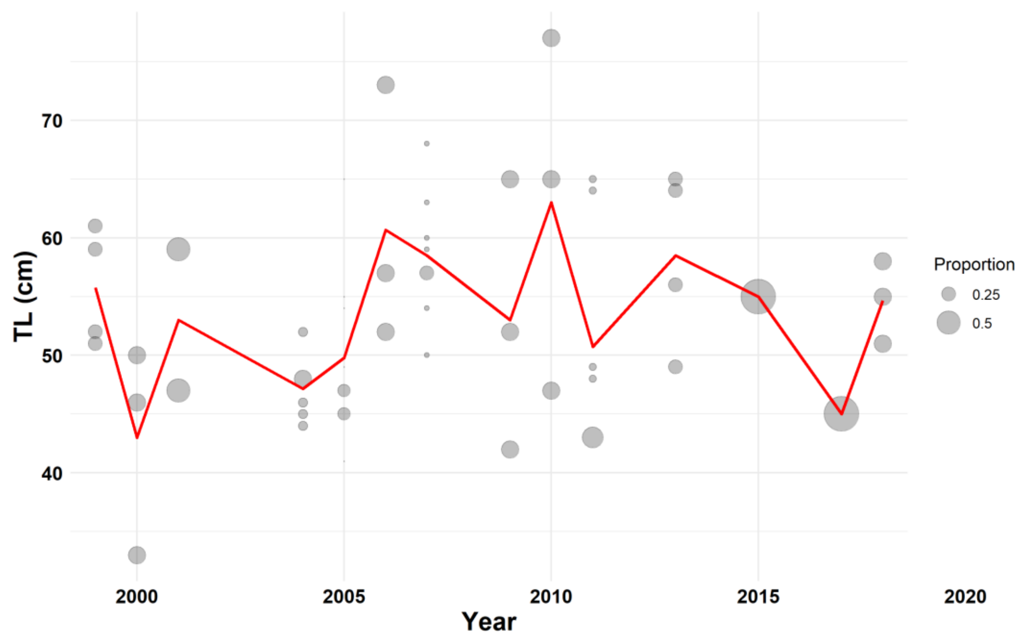


Figure 46. Speckled Hind total lengths (cm) caught with short bottom longline by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

Sparidae

Knobbed Porgy (*Calamus nodosus*)

Chevron Trap

Nominal and standardized abundance of Knobbed Porgy caught with CHVs in 2021 decreased relative to 2019. The nominal and standardized abundance were below the time series mean (**Table 36** and **Figure 47A**). Knobbed Porgy mean lengths caught in CHVs in 2021 decreased relative to 2019 (**Figure 47B**). The spatial distribution of Knobbed Porgy catches from CHVs is focused on the northern portion of the region and in deeper waters and is relatively limited off the southern portion in recent years (**Figure 48**).

Table 36: Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Knobbed Porgy and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	27	0.09	42	0.64	0.86	0.26
1991	259	57	0.22	153	2.8	2.3	0.14
1992	286	61	0.21	145	2.4	2.22	0.15
1993	380	72	0.19	154	1.92	2.18	0.16
1994	340	63	0.19	122	1.7	1.4	0.14
1995	336	55	0.16	108	1.52	2.42	0.18
1996	323	38	0.12	69	1.01	1.05	0.19
1997	345	47	0.14	167	2.29	1.84	0.16
1998	373	58	0.16	117	1.49	1.99	0.14
1999	213	34	0.16	81	1.8	1.16	0.16
2000	272	32	0.12	66	1.15	1.31	0.2
2001	231	49	0.21	132	2.71	1.59	0.16
2002	225	12	0.05	27	0.57	0.69	0.26
2003	206	30	0.15	63	1.45	0.74	0.19
2004	259	22	0.08	40	0.73	0.98	0.23
2005	278	34	0.12	54	0.92	0.81	0.18
2006	281	18	0.06	29	0.49	0.36	0.26
2007	317	35	0.11	64	0.96	0.82	0.15
2008	277	21	0.08	43	0.74	0.56	0.24
2009	404	21	0.05	34	0.4	0.44	0.24
2010	732	20	0.03	35	0.23	0.41	0.32
2011	731	16	0.02	30	0.19	0.33	0.25
2012	1174	36	0.03	61	0.25	0.51	0.16
2013	1358	28	0.02	36	0.13	0.26	0.19
2014	1473	58	0.04	92	0.3	0.34	0.15
2015	1464	73	0.05	118	0.38	0.61	0.14
2016	1485	86	0.06	129	0.41	0.51	0.14
2017	1541	60	0.04	71	0.22	0.43	0.14
2018	1736	65	0.04	92	0.25	0.48	0.15
2019	1665	109	0.07	204	0.58	0.88	0.12
2020	-	-	-	-	-	-	-
2021	1832	90	0.05	140	0.36	0.54	0.12

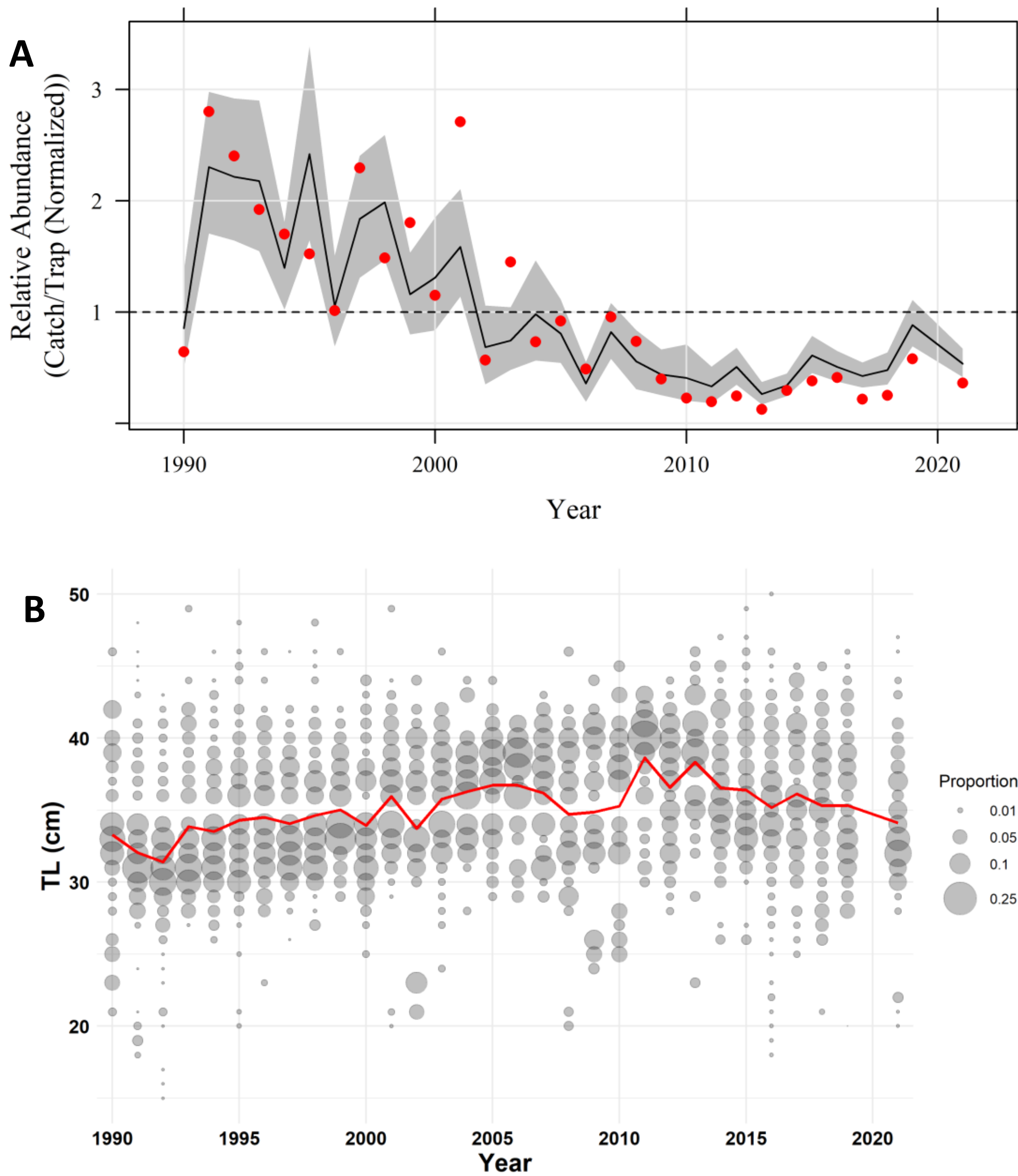


Figure 47. Chevron trap index of abundance and length composition characterization for Knobbed Porgy A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

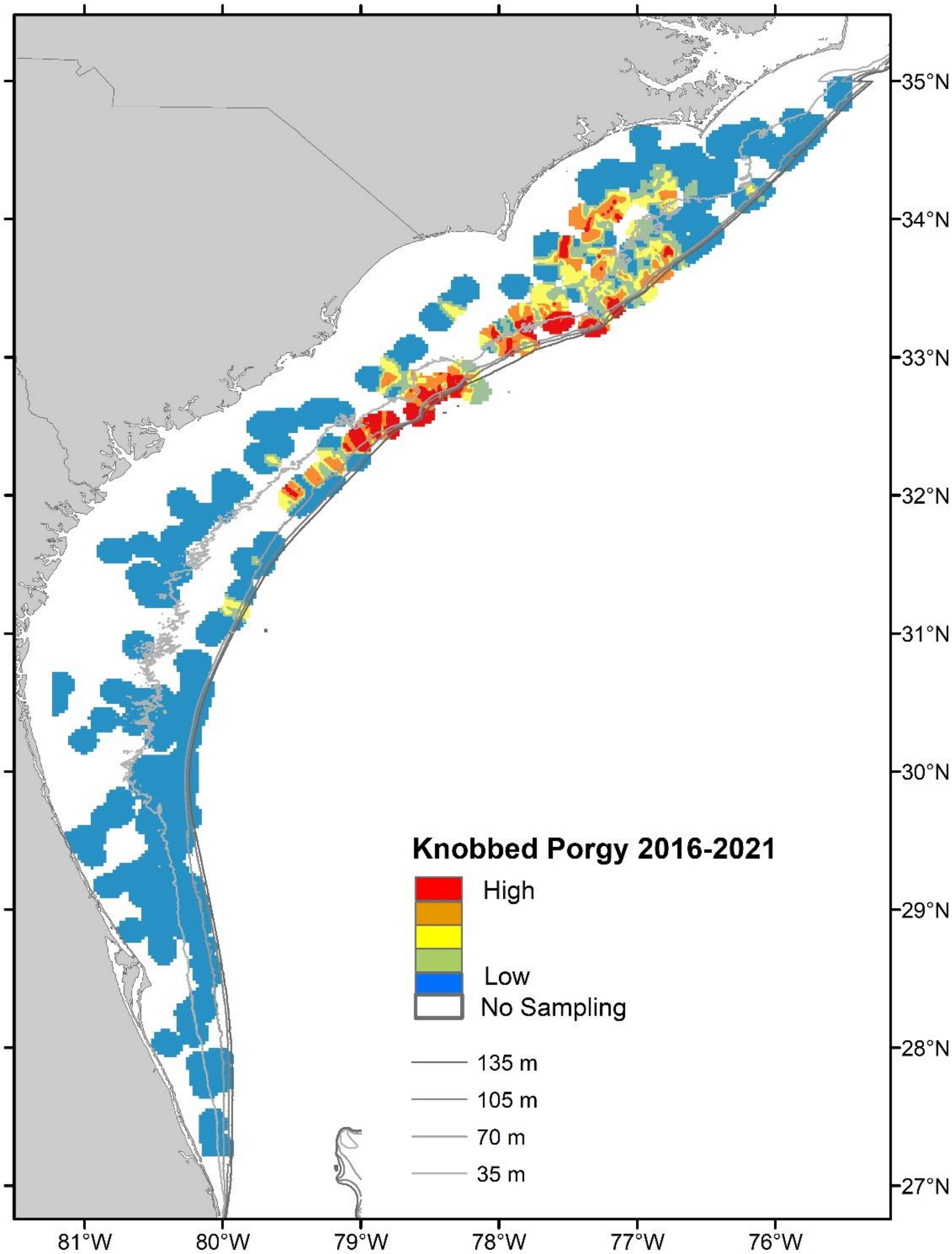


Figure 48. Distribution map of Knobbed Porgy catch by SERFS from CVT in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Pinfish (*Lagodon rhomboides*)

Chevron Trap

Nominal abundance of Pinfish caught with CHVs in 2021 decreased relative to 2019, while the standardized abundance increased slightly, though they are both remained well below the long-term mean since 2013 (**Table 37** and **Figure 49A**). Pinfish mean lengths caught in CHVs decreased in 2021 relative to 2019 (**Figure 49B**). The spatial distribution of Pinfish catches from CHVs is focused on the southern portion of the region in shallow waters, with limited catches in the central and northern portion in recent years (**Figure 50**).

Table 37. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Pinfish and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	22	0.07	168	1.92	2.92	0.7
1991	259	18	0.07	36	0.49	0.6	0.58
1992	286	30	0.1	175	2.17	2.83	0.33
1993	380	13	0.03	23	0.21	0.16	0.44
1994	340	5	0.01	9	0.09	0.13	1.79
1995	336	29	0.09	56	0.59	0.4	0.31
1996	323	30	0.09	186	2.04	2.11	0.49
1997	345	36	0.1	509	5.23	2.27	0.32
1998	373	55	0.15	429	4.07	2.44	0.3
1999	213	22	0.1	62	1.03	1.45	0.54
2000	272	29	0.11	119	1.55	0.85	0.35
2001	231	27	0.12	170	2.61	2.63	0.34
2002	225	10	0.04	79	1.24	0.65	1.15
2003	206	9	0.04	15	0.26	3.18	0.89
2004	259	15	0.06	51	0.7	1.55	0.54
2005	278	14	0.05	103	1.31	1.54	0.68
2006	281	11	0.04	74	0.93	0.58	0.63
2007	317	2	0.01	2	0.02	0.03	>2.0
2008	277	8	0.03	21	0.27	0.4	0.83
2009	404	13	0.03	107	0.94	0.55	1.21
2010	732	33	0.05	81	0.39	0.31	0.49
2011	731	41	0.06	192	0.93	1.24	0.49
2012	1174	28	0.02	176	0.53	0.62	0.51
2013	1358	19	0.01	58	0.15	0.12	1.02
2014	1473	11	0.01	32	0.08	0.15	1.17
2015	1464	18	0.01	126	0.3	0.25	>2.0
2016	1485	12	0.01	30	0.07	0.11	1.14
2017	1541	25	0.02	116	0.27	0.38	0.81
2018	1736	33	0.02	100	0.2	0.24	0.39
2019	1665	16	0.01	98	0.21	0.14	>2.0
2020	-	-	-	-	-	-	-
2021	1832	20	0.01	97	0.19	0.17	>2.0

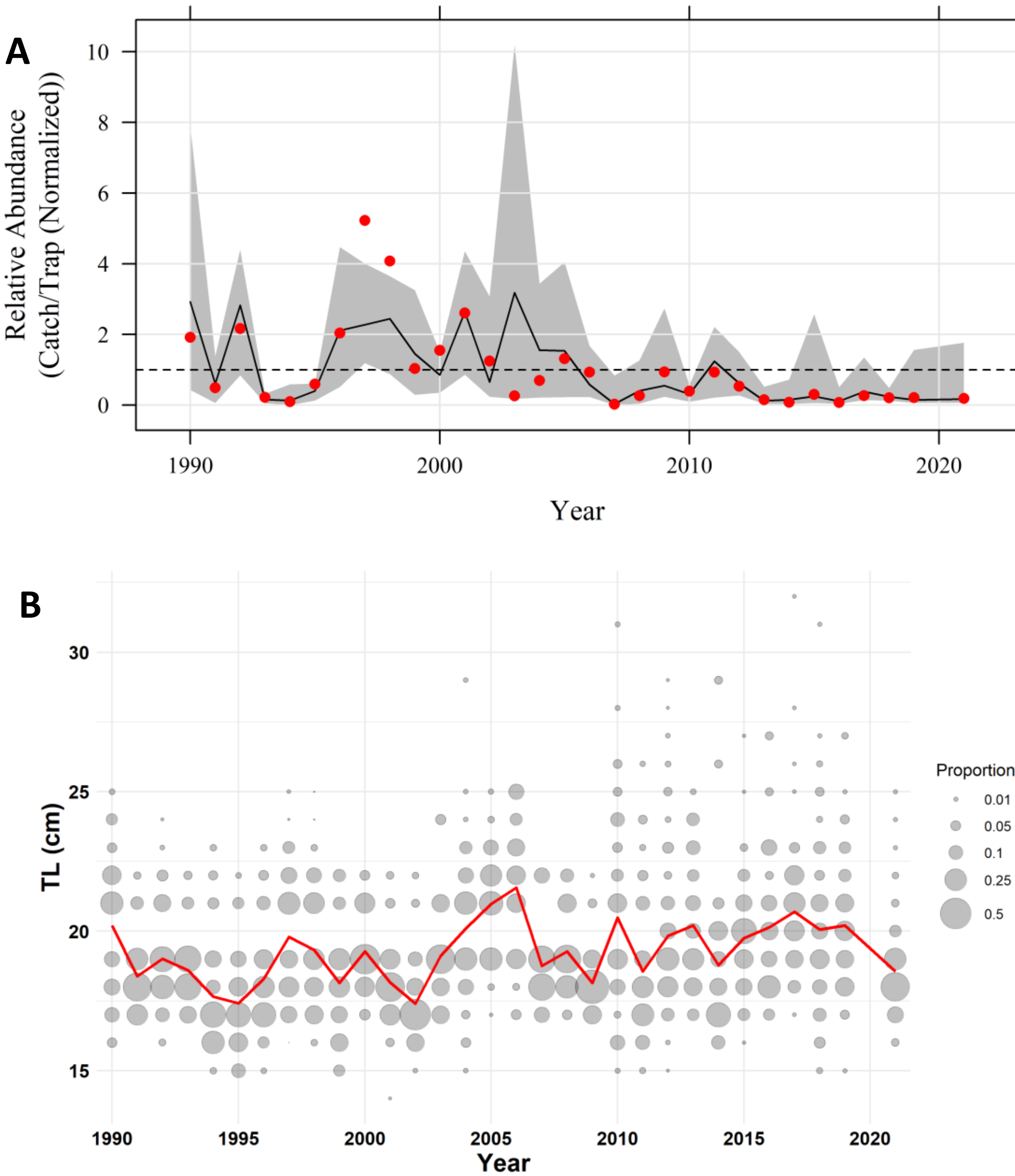


Figure 49. <u>Chevron trap</u> index of abundance and length composition characterization for <u>Pinfish</u> A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

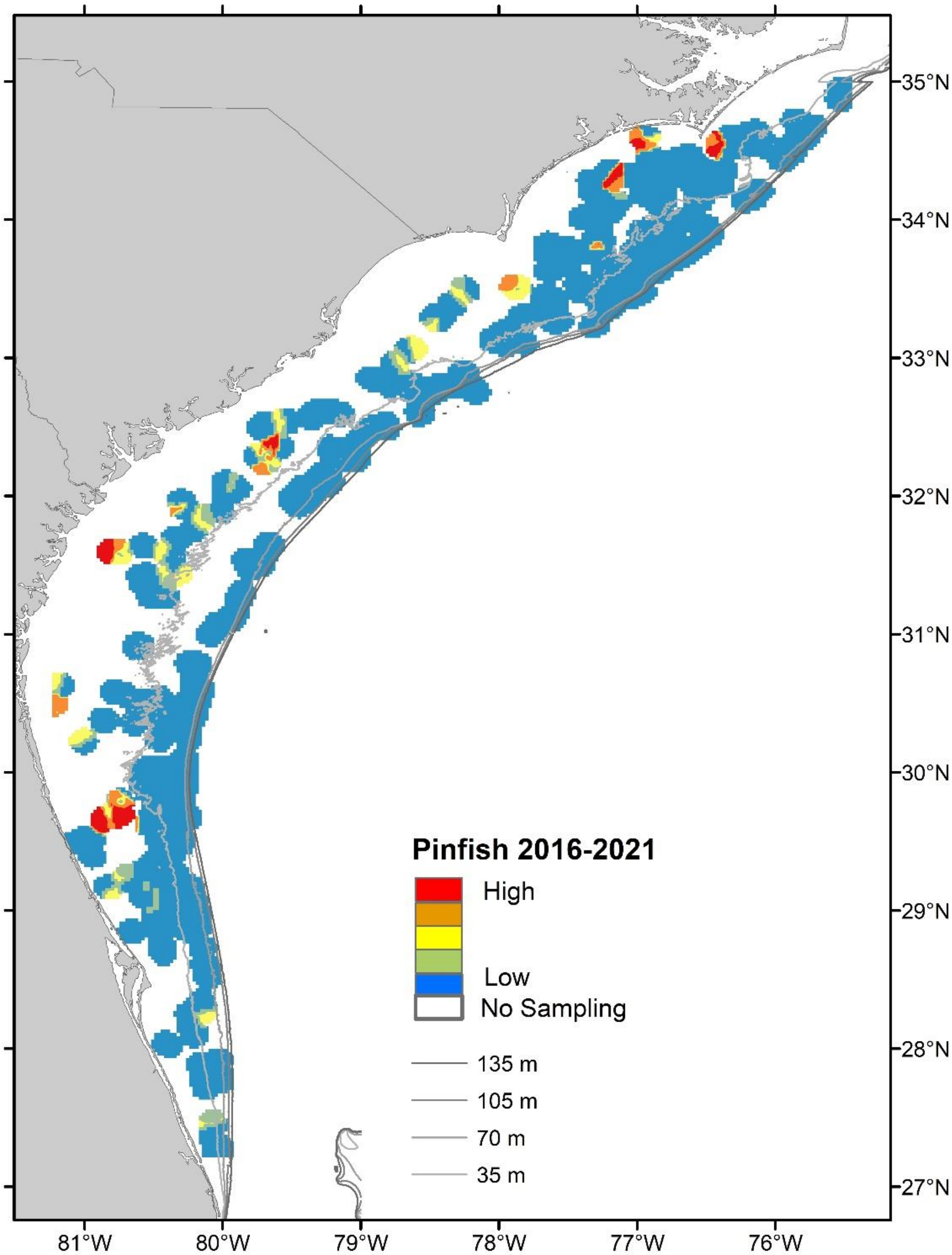


Figure 50. Distribution map of Pinfish catch by SERFS from CVT in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Red Porgy (*Pagrus pagrus*)

Chevron Trap

Nominal and standardized abundance of Red Porgy caught with CHVs in 2021 have decreased from 2019 to a new all-time low, which continued their abundance being below the time series mean since 2015 (**Table 38** and **Figure 51A**). Red Porgy mean lengths from CHVs in 2021 decreased slightly relative to 2019 (**Figure 51B**). The spatial distribution of Red Porgy catches from CHVs is focused in the mid to northern portion of the region in deeper waters, with limited catches in the southern portion in recent years (**Figure 52**).

Table 38. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Red Porgy and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	158	0.51	708	1.14	0.97	0.09
1991	259	132	0.51	781	1.5	1.53	0.11
1992	286	176	0.62	1068	1.86	1.5	0.1
1993	380	158	0.42	687	0.9	0.82	0.1
1994	340	143	0.42	959	1.4	0.87	0.1
1995	336	138	0.41	844	1.25	1.29	0.11
1996	323	149	0.46	782	1.21	0.92	0.09
1997	345	111	0.32	477	0.69	0.62	0.12
1998	373	136	0.36	599	0.8	0.78	0.11
1999	213	89	0.42	363	0.85	0.85	0.12
2000	272	104	0.38	445	0.81	0.82	0.14
2001	231	95	0.41	618	1.33	1.22	0.13
2002	225	91	0.4	461	1.02	1.03	0.14
2003	206	84	0.41	417	1.01	0.83	0.13
2004	259	125	0.48	959	1.84	1.5	0.1
2005	278	148	0.53	1035	1.85	1.64	0.1
2006	281	114	0.41	715	1.27	1.09	0.12
2007	317	145	0.46	1107	1.74	1.59	0.1
2008	277	96	0.35	510	0.92	0.83	0.13
2009	404	112	0.28	513	0.63	0.74	0.12
2010	732	212	0.29	1056	0.72	0.98	0.09
2011	731	204	0.28	1146	0.78	1.08	0.09
2012	1174	321	0.27	2146	0.91	1.33	0.07
2013	1358	330	0.24	1864	0.68	0.99	0.07
2014	1473	448	0.3	2680	0.91	1.16	0.07
2015	1464	395	0.27	1979	0.67	0.92	0.07
2016	1485	382	0.26	1786	0.6	0.81	0.07
2017	1541	337	0.22	1599	0.52	0.69	0.08
2018	1736	355	0.2	1828	0.52	0.69	0.08
2019	1665	341	0.2	1519	0.45	0.58	0.08
2020	-	-	-	-	-	-	-
2021	1832	198	0.11	816	0.22	0.32	0.1

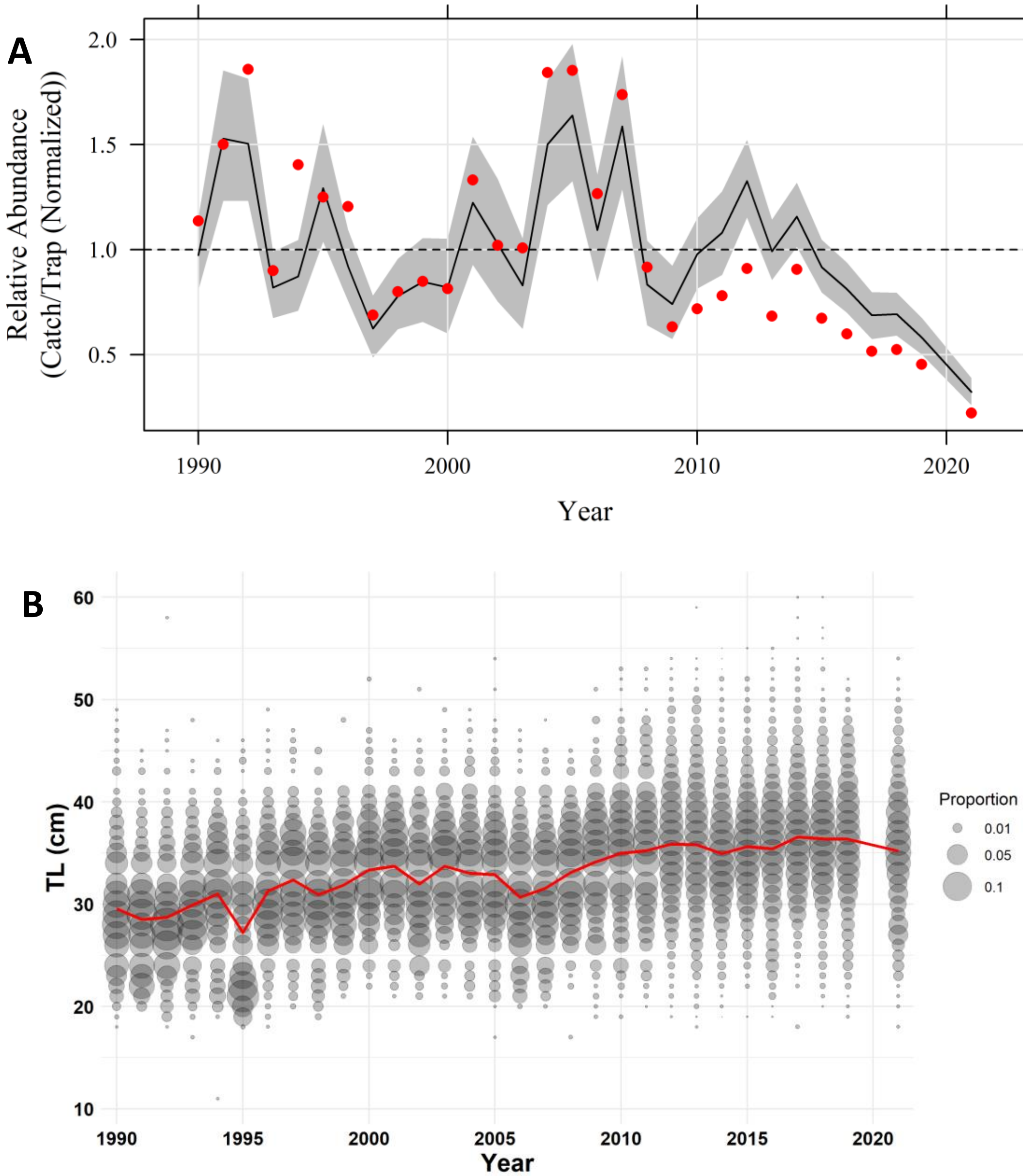


Figure 51. Chevron trap index of abundance and length composition characterization for Red Porgy A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

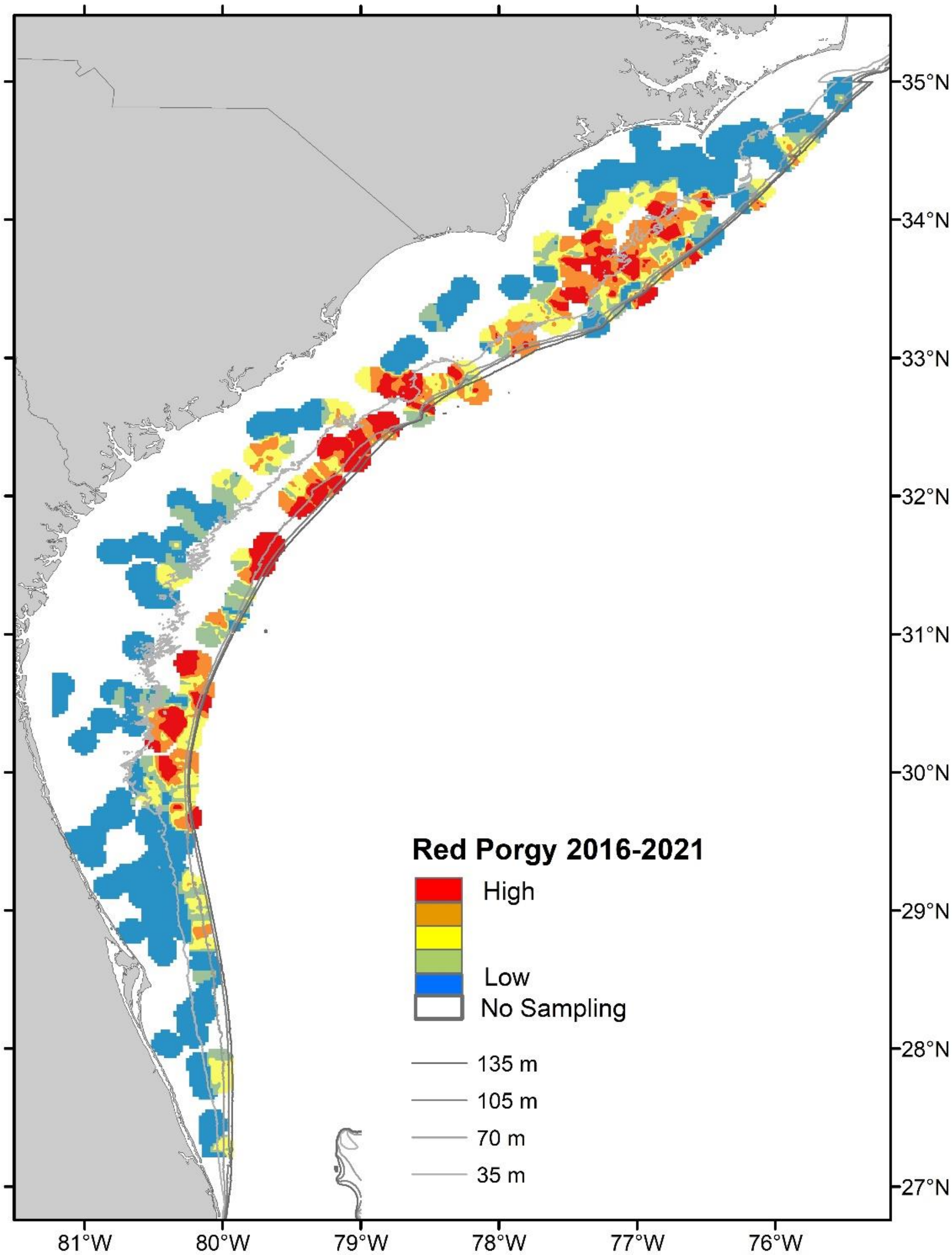


Figure 52. Distribution map of <u>Red Porgy</u> catch by SERFS from CVT in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Short bottom longline

Red Porgy were not caught with SBLL in large enough numbers or consistently enough for development of an index of relative abundance (**Table 39**). Red Porgy mean lengths in catches by SBLL decreased slightly relative to the last year there was catch, 2018 (**Figure 53**).

Table 39. Short bottom longline catch of Red Porgy and information associated with SBLL sets. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest.

Year	Included Collections	Positive	Proportion Positive	Total Fish
1996	12	0	0.00	0
1997	33	0	0.00	0
1998	31	0	0.00	0
1999	36	3	0.08	4
2000	34	3	0.09	3
2001	29	0	0.00	0
2002	19	3	0.16	4
2003	51	5	0.10	6
2004	21	2	0.10	2
2005	42	2	0.05	2
2006	50	2	0.04	2
2007	52	0	0.00	0
2008	29	1	0.03	1
2009	43	3	0.07	4
2010	77	1	0.01	1
2011	61	6	0.10	6
2012	21	1	0.05	1
2013	41	5	0.12	8
2014	57	1	0.02	1
2015	75	2	0.03	2
2016	62	6	0.10	6
2017	48	3	0.06	3
2018	66	1	0.02	1
2019	30	0	0.00	0
2020	20	0	0.00	0
2021	108	7	0.06	9

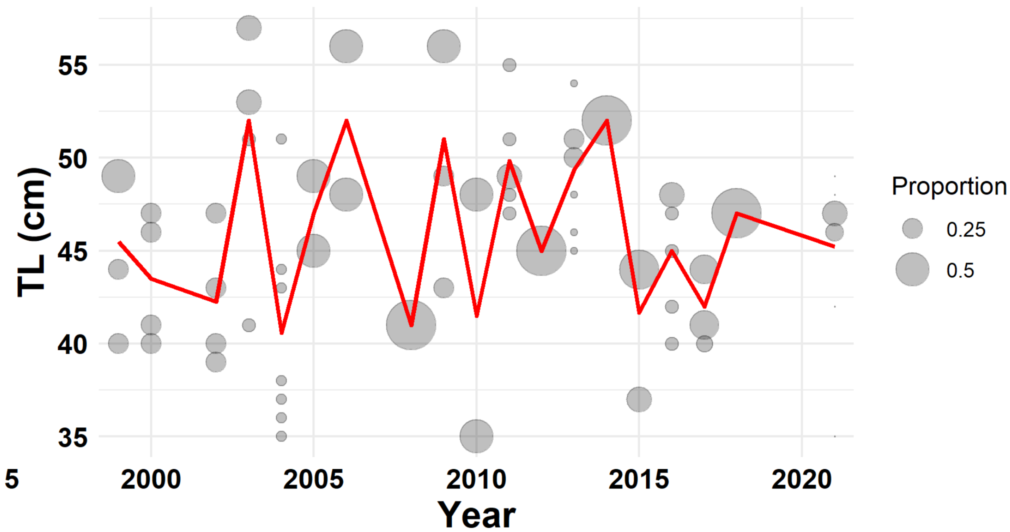


Figure 53. Red Porgy total lengths (cm) caught with short bottom longline by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

Spottail Pinfish (*Diplodus holbrookii*)

Chevron Trap

Nominal and standardized abundance of Spottail Pinfish caught with CHVs in 2021 decreased relative to 2019 and both were below the time series mean (**Table 40** and **Figure 54A**). Spottail Pinfish mean lengths from CHVs in 2021 increased relative to 2019 (**Figure 54B**). The spatial distribution of Spottail Pinfish catches from CHVs is focused in the northern portion of the region in shallower waters, with limited catches in the southern portion in recent years (**Figure 55**).

Table 40. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for Spottail Pinfish and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	20	0.06	374	3.8	1.96	0.55
1991	259	16	0.06	179	2.18	0.97	0.39
1992	286	17	0.06	128	1.41	0.65	0.34
1993	380	11	0.03	54	0.45	0.25	0.57
1994	340	5	0.01	147	1.36	1.95	1.02
1995	336	13	0.04	104	0.98	0.61	0.61
1996	323	22	0.07	127	1.24	0.73	0.32
1997	345	16	0.05	59	0.54	2.64	0.89
1998	373	25	0.07	188	1.59	2.29	0.54
1999	213	14	0.07	126	1.87	1.7	0.33
2000	272	13	0.05	87	1.01	1.11	0.47
2001	231	21	0.09	77	1.05	1.03	0.43
2002	225	11	0.05	92	1.29	0.9	0.48
2003	206	8	0.04	31	0.47	0.39	0.43
2004	259	9	0.03	36	0.44	0.39	0.48
2005	278	12	0.04	82	0.93	1.13	0.5
2006	281	3	0.01	11	0.12	0.07	0.9
2007	317	5	0.02	37	0.37	0.41	0.63
2008	277	10	0.04	47	0.53	0.59	0.41
2009	404	14	0.03	47	0.37	0.17	0.53
2010	732	17	0.02	55	0.24	0.27	0.37
2011	731	38	0.05	155	0.67	1.47	0.36
2012	1174	68	0.06	284	0.76	1.26	0.26
2013	1358	41	0.03	155	0.36	0.71	0.26
2014	1473	111	0.08	707	1.51	1.67	0.23
2015	1464	115	0.08	615	1.32	1.41	0.21
2016	1485	100	0.07	418	0.89	0.96	0.21
2017	1541	85	0.06	392	0.8	0.97	0.35
2018	1736	89	0.05	376	0.68	0.62	0.28
2019	1665	113	0.07	538	1.02	0.96	0.23
2020	-	-	-	-	-	-	-
2021	1832	85	0.05	433	0.75	0.75	0.29

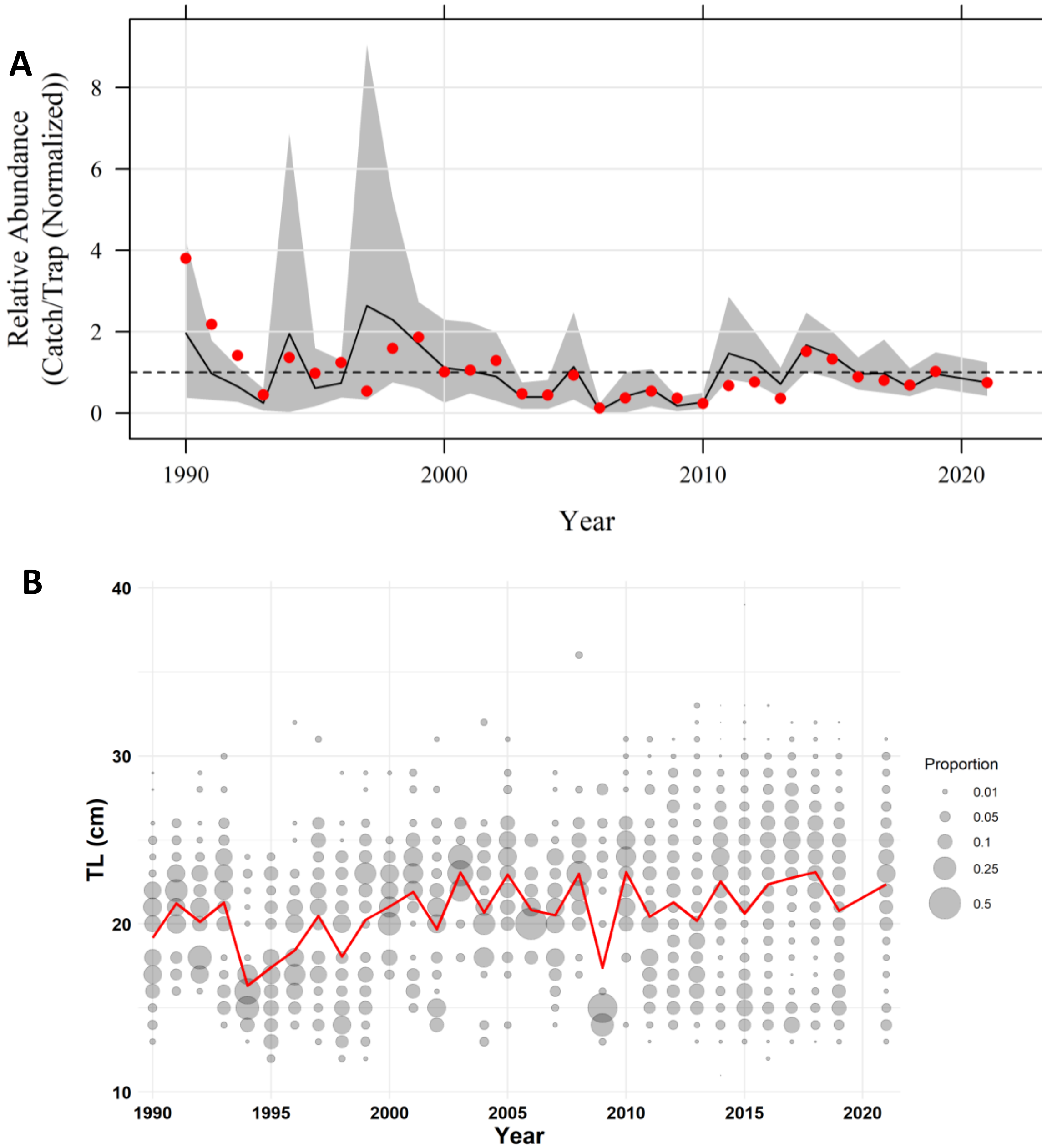


Figure 54. Chevron trap index of abundance and length composition characterization for Spottail Pinfish A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) Total lengths (cm) caught in chevron traps by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

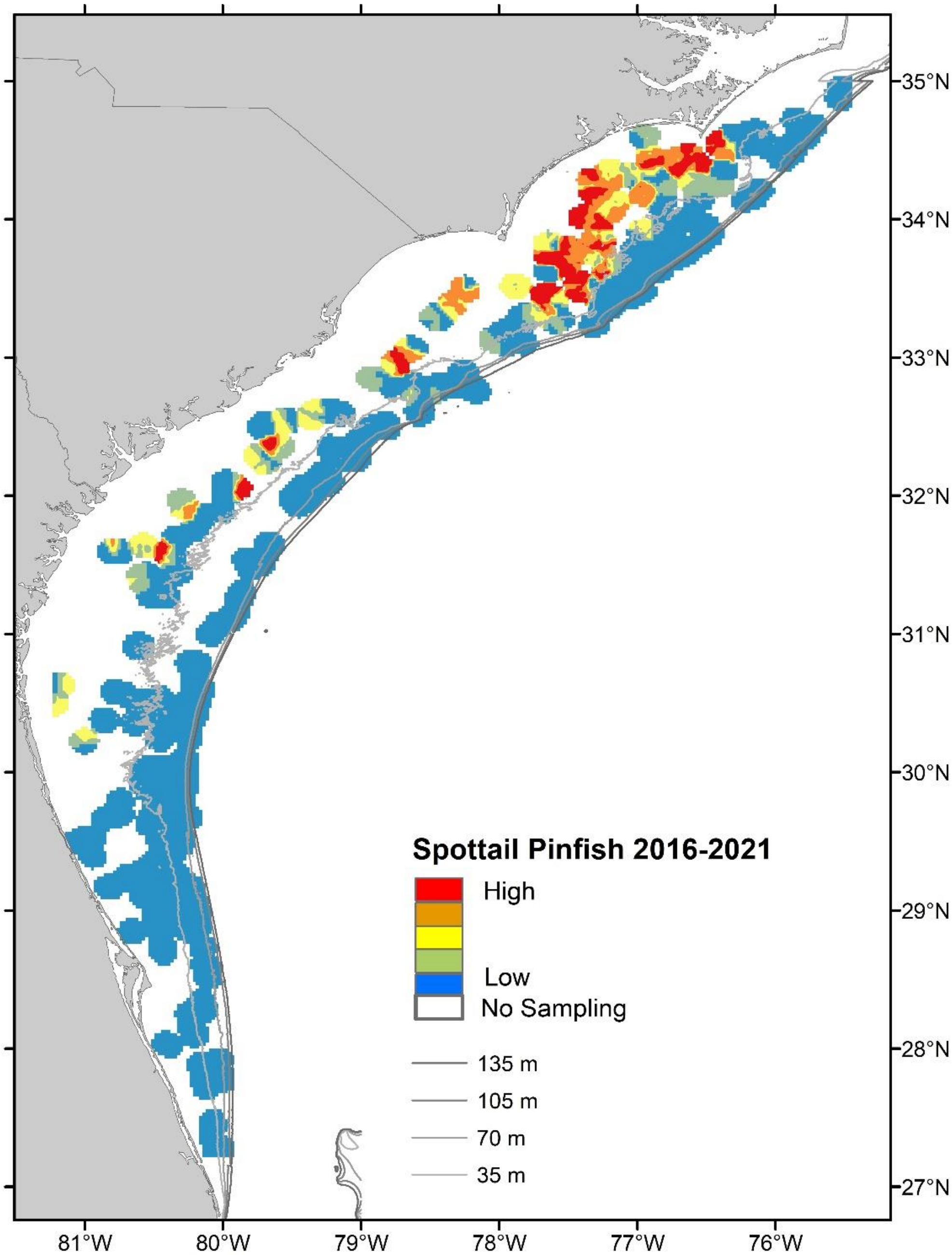


Figure 55. Distribution map of Spottail Pinfish catch by SERFS from CVT in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

Stenotomus spp.

Chevron Trap
Nominal and standardized abundance of *Stenotomus* spp. caught with CHVs in 2021 decreased relative to 2019, with both below the time series mean (**Table 41** and **Figure 56A**). *Stenotomus* spp. mean lengths from CHV catch in 2021 increased slightly relative to 2019 (**Figure 56B**). The spatial distribution of *Stenotomus* spp. catches from CHVs is relatively evenly distributed in shallower waters, with slightly limited catches in the southern portion in (**Figure 57**).

Table 41. Chevron trap nominal abundance and zero-inflated negative binomial (ZINB) standardized abundance for *Stenotomus* spp. and information associated with chevron trap sets included in standardized abundance calculation. Positive = number of included collections positive for the species of interest, Proportion Positive = proportion of included collections positive for the species of interest, Normalized = abundance (number of fish*trap^{-1}*hr^{-1}) normalized to its mean value over the time series, and CV = coefficient of variation.

					Nominal Abundance	ZINB Standardized Abundance	
Year	Included Collections	Positive	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	310	119	0.38	3540	1.41	0.71	0.11
1991	259	100	0.39	3716	1.77	1.25	0.12
1992	286	122	0.43	3791	1.63	0.75	0.12
1993	380	85	0.22	2097	0.68	0.51	0.14
1994	340	75	0.22	2552	0.92	0.78	0.16
1995	336	143	0.43	5522	2.02	1.23	0.09
1996	323	126	0.39	5555	2.12	1.38	0.12
1997	345	109	0.32	6094	2.18	2.03	0.1
1998	373	128	0.34	5244	1.73	1.74	0.1
1999	213	67	0.31	3211	1.86	1.93	0.12
2000	272	78	0.29	3940	1.78	1.81	0.13
2001	231	63	0.27	2580	1.38	1.65	0.12
2002	225	52	0.23	1276	0.7	1.59	0.46
2003	206	33	0.16	2795	1.67	1.77	0.16
2004	259	65	0.25	3661	1.74	1.62	0.12
2005	278	72	0.26	3636	1.61	1.55	0.13
2006	281	62	0.22	1835	0.8	1.02	0.16
2007	317	43	0.14	1747	0.68	0.97	0.21
2008	277	47	0.17	2239	1	1.1	0.16
2009	404	68	0.17	1503	0.46	0.53	0.17
2010	732	125	0.17	3431	0.58	0.69	0.2
2011	731	137	0.19	2959	0.5	0.85	0.17
2012	1174	206	0.18	3847	0.4	0.54	0.1
2013	1358	150	0.11	1760	0.16	0.28	0.16
2014	1473	122	0.08	1392	0.12	0.24	0.14
2015	1464	136	0.09	2128	0.18	0.34	0.15
2016	1485	131	0.09	2737	0.23	0.51	0.15
2017	1541	108	0.07	2526	0.2	0.53	0.15
2018	1736	144	0.08	2718	0.19	0.43	0.15
2019	1665	131	0.08	2653	0.2	0.4	0.16
2020	-	-	-	-	-	-	-
2021	1832	118	0.06	1759	0.12	0.27	0.19

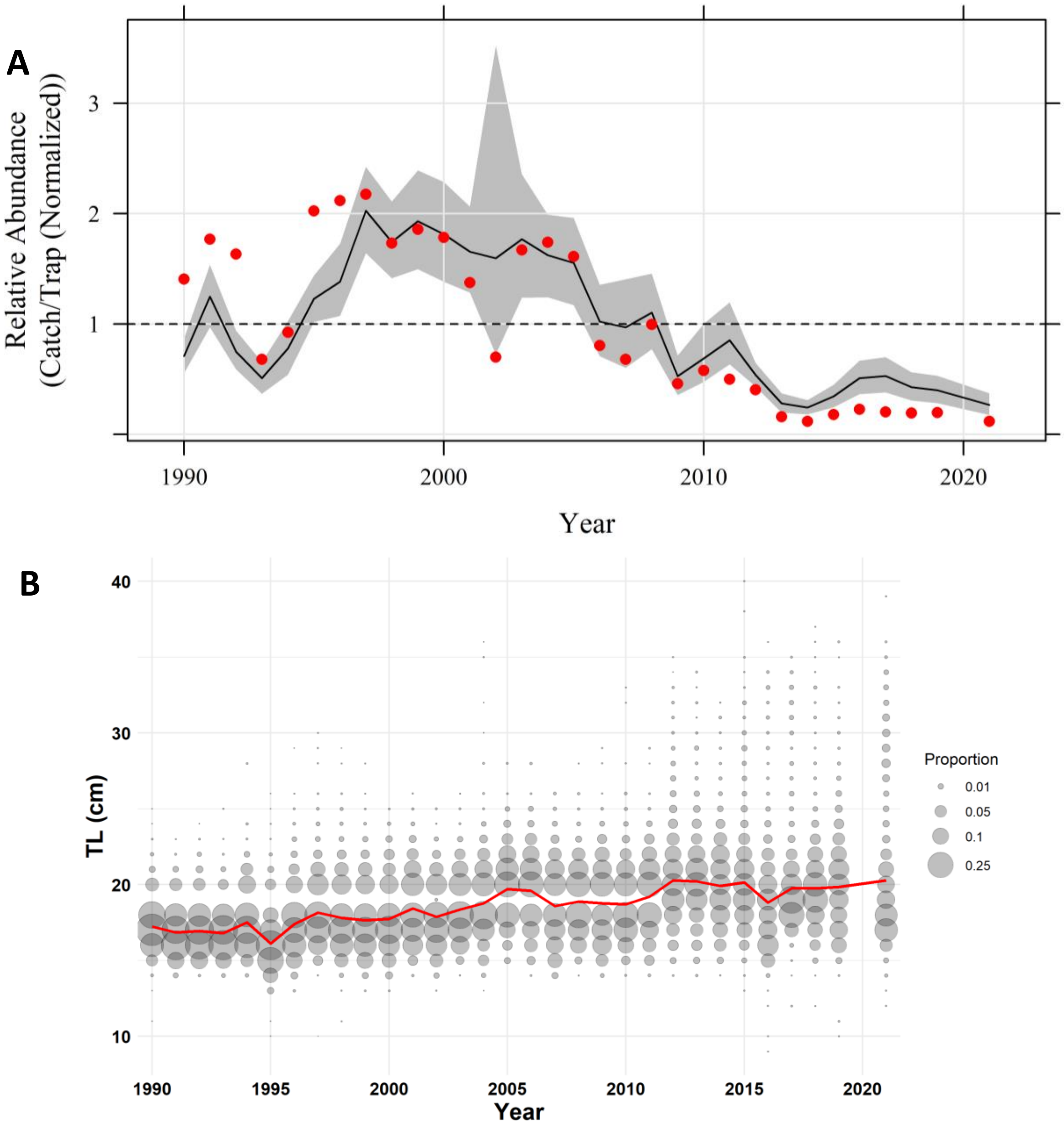


Figure 56. Chevron trap index of abundance and length composition characterization for *Stenotomus* spp. A) Normalized nominal (red dot) and zero-inflated negative binomial (black line) standardized abundance (gray area = 95% CI). B) *T*otal lengths (cm) by year. Red line represents annual mean length. Vertical axis represents the length of samples from a given year, while the bubble diameter represents the proportion caught of that length by year.

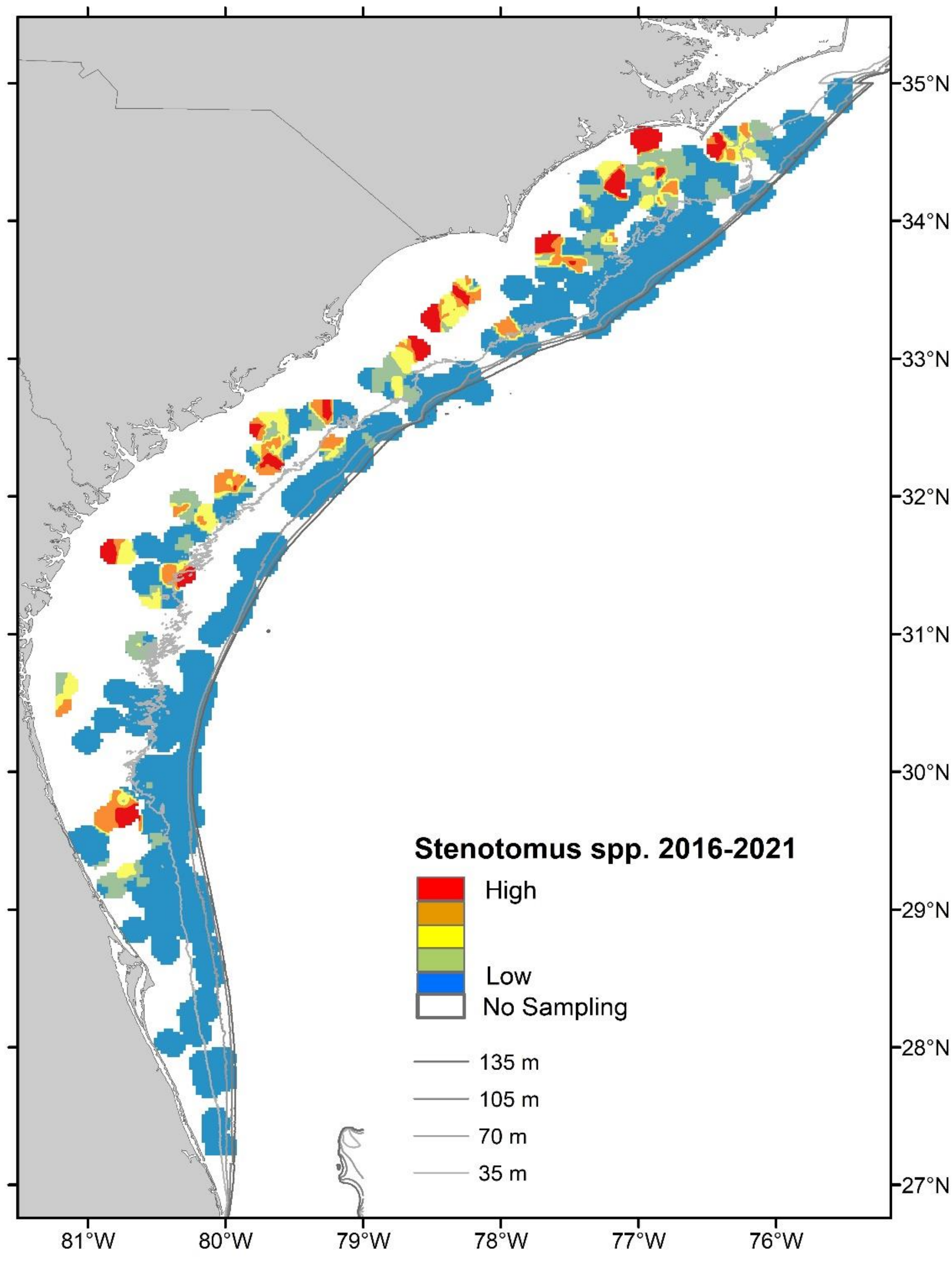


Figure 57. Distribution map of ***Stenotomus* spp.** catch by SERFS from CVT in 2016-2021. Colors indicate quartiles by catch per trap hour and white indicates areas not sampled by SERFS. The map smoothing was accomplished with inverse distance weighting.

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