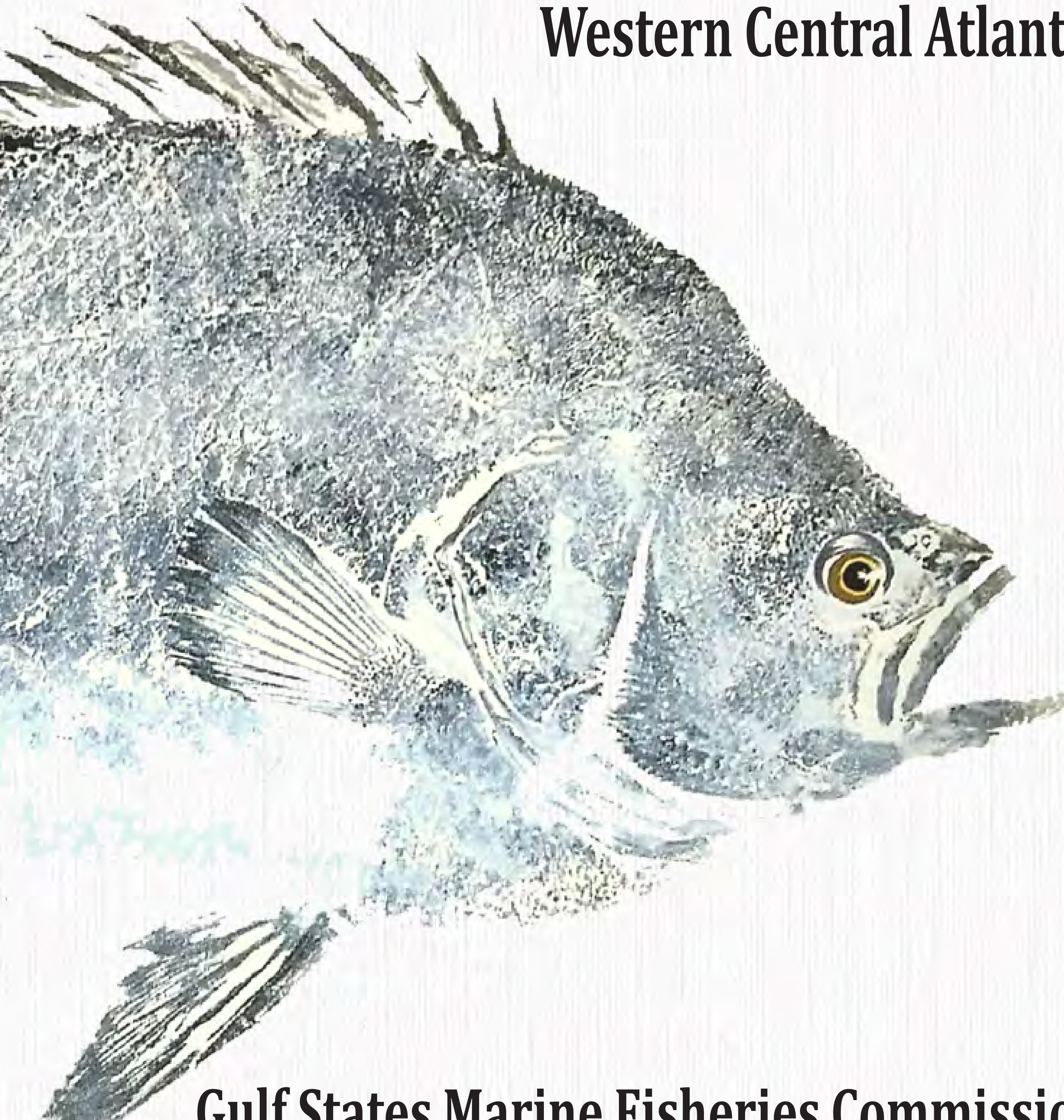
Biological Profile for Tripletail
in the Gulf of Mexico and the Western Central Atlantic



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Biological Profile for Tripletail in the Gulf of Mexico and the Western Central Atlantic

by the

Tripletail Technical Task Force

edited by

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Preface

The Gulf States Marine Fisheries Commission (GSMFC) was established by the Gulf States Marine Fisheries Compact under Public Law 81-66 approved May 19, 1949. Its charge is to promote better management and utilization of marine resources in the Gulf of Mexico.

The GSMFC is composed of three members from each of the five Gulf States. The head of the marine resource agency of each state is an ex officio member. The second is a member of the legislature. The third is a governor-appointed citizen with knowledge of or interest in marine fisheries. The offices of the chairman and vice chairmen are rotated annually from state to state.

The GSMFC is empowered to recommend to the governor and legislature of the respective states action on programs helpful to the management of marine fisheries. The states, however, do not relinquish any of their rights or responsibilities to regulate their own fisheries as a result of being members of the GSMFC.

One of the most important functions of the GSMFC is to serve as a forum for the discussion of various problems and needs of marine management authorities, the commercial and recreational industries, researchers, and others. The GSMFC also plays a key role in the implementation of the Interjurisdictional Fisheries (IJF) Act. Paramount to this role are the GSMFC's activities to develop and maintain regional profiles and plans for important Gulf species.

The Biological Profile for the Tripletail Fisheries in the Gulf of Mexico and Western Central Atlantic is a cooperative planning effort of the five Gulf states under the IJF Act. Members of the Technical Task Force (TTF) contributed by drafting individually-assigned sections. In addition, each member contributed his/her expertise to discussions that resulted in revisions and led to the final draft of the profile.

The GSMFC made all necessary arrangements for task force workshops. Under contract with NOAA Fisheries' National Marine Fisheries Service (NMFS), the GSMFC funded travel for state agency representatives and consultants other than federal employees.

Throughout this document, metric equivalents are used wherever possible with the exceptions of reported landings data and size limits which, by convention, are reported in English units. Recreational landings in this document are Type-A and Type-B1 and actually represent total harvest, as designated by the NMFS. Type-A catch is fish that are brought back to the dock in a form that can be identified by trained interviewers and Type-B1 catch is fish that are used for bait, released dead, or filleted – i.e., they are killed, but identification is by individual anglers. Type-B2 catch is fish that are released alive – again, identification is by individual anglers and is excluded from the values in this profile.

Abbreviations and Symbols

ADCNR/MRD	Alabama Department of Conservation Natural Resources/Marine Resources Division
B	Billions
BRD	Bycatch Reduction Device
˚C	degrees Celsius
DO	Dissolved Oxygen
DMS	Data Management Subcommittee
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
FWC/FMRI/FWRI	Florida Fish and Wildlife Conservation Commission/Florida Marine Research Institute/Florida Fish and Wildlife Research Institute
FMP	Fishery Management Plan
ft	feet
g	gram
GADNR	Georgia Department of Natural Resources
GSI	Gonadal Somatic Index
GSMFC	Gulf States Marine Fisheries Commission
hr(s)	hour(s)
ha	hectare
IJF	interjurisdictional fisheries
kg	kilogram
km	kilometer
lbs	pounds
LDWF	Louisiana Department of Wildlife and Fisheries
m	meter
M	Millions
mm	millimeters
min(s)	minute(s)
MDMR	Mississippi Department of Marine Resources
MRFSS/MRIP	Marine Recreational Fisheries Statistical Survey/Marine Recreational Information Program
mt	metric ton
n	number
NL	Notocord Length
NMFS	National Marine Fisheries Service
ppm	parts per million
‰	parts per thousand
PPI	producer price index
SAT	Stock Assessment Team
SD	Standard Deviation
SE	Standard Error
sec(s)	second(s)
SL	Standard Length
S-FFMC	State-Federal Fisheries Management Committee
SPR	Spawning Potential Ratio
TCC	Technical Coordinating Committee
TED	Turtle Exclusion Device
TL	Total Length
TPWD	Texas Parks and Wildlife Department
TTF	Technical Task Force
TTS	Texas Territorial Sea
TW	Total Weight
YOY	Young-of-the-Year
yr(s)	year(s)

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Chapter 1
SUMMARY

Tripletail (*Lobotes surinamensis*), a pelagic fish species found throughout tropical and subtropical regions of the world's oceans, supports commercial and recreational fisheries throughout much of its geographic range. In the Atlantic Ocean, tripletail are found throughout the Western Central Atlantic Ocean, including the Gulf of Mexico, Caribbean Sea, Bermuda, and southward to Argentina. Very little is known about the biology and life history of tripletail, including age and growth, reproductive biology, seasonal movements, and migratory patterns.

Tripletail occur in a wide variety of color patterns, both as juveniles and adults. Juveniles are predominately yellow in color and frequently have a mottled pattern, mimicking floating leaves in nearshore areas and *Sargassum* in offshore waters, while adults are darker in color, from olive to dark brown. Tripletails are recognizable to most anglers because they turn on their side and suspend close to the water surface in marine and brackish areas. In addition, these fish are often found in close proximity to structures that can be used for shade, protection, and potential forage. They are often referred to as buoy fish or blackfish by recreational anglers due to their coloration and unusual behavior.

Along the northern Gulf of Mexico and southern Atlantic, tripletail appear to move based on prevailing water temperatures and seasonal movement has been confirmed through tagging studies. The reproductive cycle is less understood, and the spawning locations are yet unknown for tripletail anywhere in the western central Atlantic and Gulf of Mexico. Tripletail have been successfully spawned in captivity under laboratory conditions but there is no documentation of spawning in the wild. Early juvenile fish occur everywhere from the open ocean to estuaries, but no eggs or newly hatched larvae have even been found. The fish grows at a rapid rate, achieving sexual maturity by the end of their first year at sizes approaching 500 mm TL. Gonadal development reaches a peak in June-August in females and occurs from May-September in males. The maximum age of tripletail appears to be 7-10 years based on growth and current state and world records.

Tripletail are rarely found in high densities in the Gulf of Mexico and are rather ephemeral in their occurrence, which is not conducive to supporting a large dedicated recreational or commercial fishery. In other regions of the world, they do occur with more frequency, but are still a relatively minor component of most fishing activities. In the U.S., the majority of landings are derived from rod-and-reel by commercial fishermen opportunistically harvesting tripletail as they are encountered. Since the year 2000, landings from the east Florida coast have comprised 62% of the total U.S. commercial landings and average 7,000 lbs annually. Compared to other fish species in the U.S., few recreational anglers 'target' tripletail due to their infrequent, although not rare occurrence, and the largest concentrations of these anglers are found along the Atlantic coast from Port Canaveral, Florida, to Jekyll Island, Georgia.

All five of the Gulf States and Georgia have commercial and recreational harvest regulations for tripletail; however, most of those regulations apply to state waters and there are no federal restrictions on tripletail in the EEZ. As a result, states are beginning to note increases in the landings of tripletail from commercial gears who harvest from the EEZ. These gears include hook-and-line, trawls, and some landings from spear in recent years.

Outside the eastern Atlantic basin, there are a few countries that report some commercial landings of tripletail, including Australia, Malaysia, and Mozambique. However, the majority of the world production of tripletail is derived from the region referred to as the North Brazil Shelf Large Marine Ecosystem along the South American coast. This region includes the countries of Venezuela, Guyana, Suriname, French

Guiana, and Brazil which lave landed around 3.0M lbs of tripletail on average since 2000. The majority (70%) of those originated from Guyana alone.

Tripletail do not support a large portion of the fresh fish market in the U.S., with total dockside values in the Gulf of Mexico rarely generating more than $5,000 annually. Dockside revenue from commercial landings along the Atlantic coast of the U.S. is dominated almost exclusively by Florida, which has an annual average of around $25,000. In the past decade, there has been a notable increase in tripletail dockside revenues for Florida with an annual average of $34,000 since 2007 and a peak of approximately $83,500 in 2014. In comparison to other finfish species, these recent values are almost negligible. During the development of this profile, a small market survey was conducted by state agency and GSMFC staff. The results suggest that a number of dealers utilize imported tripletail to supplement the domestic supply derived from southeastern U.S. sources. Most of the dealers who replied to the survey indicated a substantial demand for tripletail by restauranteurs throughout the Gulf and southern Atlantic states; however, to meet demand, a large portion of the tripletail being sold domestically are being imported from the eastern Pacific (Panama and Costa Rica) and from the central and South American waters along the Atlantic and Caribbean. This information could not be confirmed by comparing to import records because tripletail are shipped in small quantities and often combined with other high volume seafood products. Indications are that a larger domestic market could be developed if tripletail were available.

Chapter 2
INTRODUCTION

In October 2014, the S-FFMC directed GSMFC staff to begin development of a Biological Profile for tripletail (*Lobotes surinamensis*) in the Gulf of Mexico. Because of the popularity of this species, the lack of consolidated information regarding these fish and the fisheries, and the level of concern for the well-being of stocks, the S-FFMC concluded that a Gulf-wide species profile was needed.

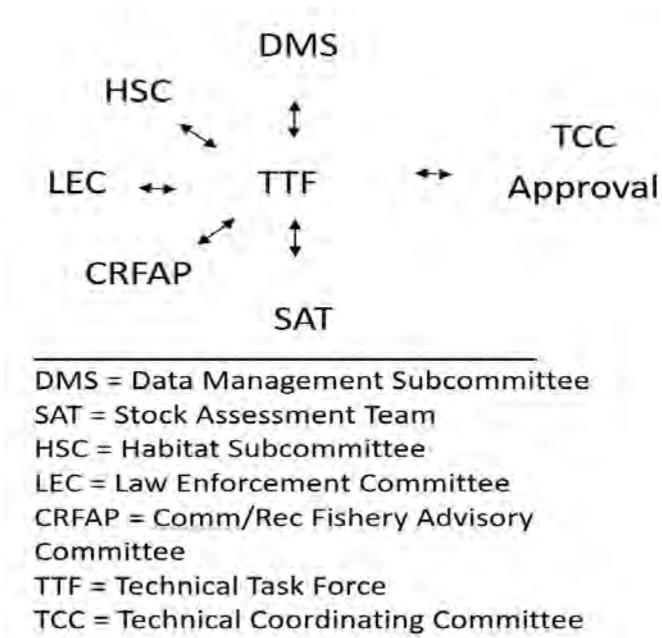
The Tripletail Technical Task Force (TTF) was subsequently formed, and an organizational meeting was held in February 2015 in New Orleans, Louisiana.

IJF Program and Management Profile and Plan Development

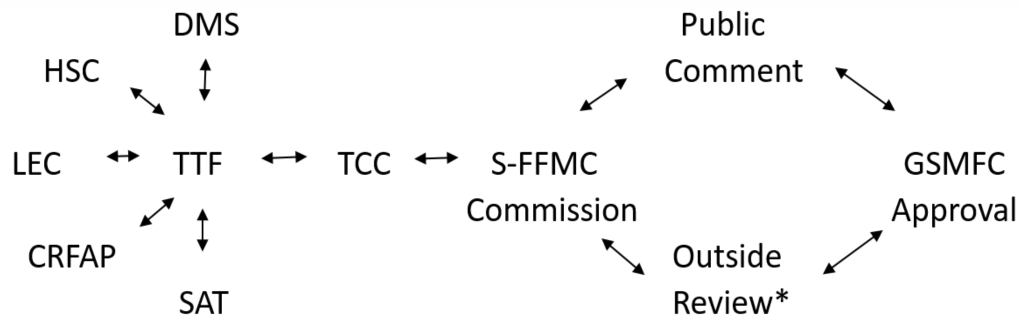
The Interjurisdictional Fisheries Act (IFA) of 1986 (Title III, Public Law 99-659) was approved by Congress to: (1) promote and encourage state activities in support of the management of interjurisdictional fishery resources and (2) promote and encourage management of interjurisdictional fishery resources throughout their range. Congress also authorized federal funding to support state research and management projects that were consistent with these purposes. Additional funds were authorized to support the development of interstate management plans by the marine fishery commissions.

After passage of the IFA, the Commission initiated the development of a planning and approval process for the management profiles and plans. The process has evolved to its current form outlined below:

Biological and Management Profiles



Fishery Management Plans



DMS = Data Management Subcommittee
SAT = Stock Assessment Team
HSC = Habitat Subcommittee
LEC = Law Enforcement Committee
CRFAP = Comm/Rec Fishery Advisory Committee
TTF = Technical Task Force

TCC = Technical Coordinating Committee
S-FFMC = State-Federal Fisheries Management Committee
GSMFC = Gulf States Marine Fisheries Commission
*Outside Review = standing committees, trade associations, general public

A **Biological Profile** contains the elements related to the species itself (biology and habitat) and a brief overview of the fisheries that exist in each state (landings, effort, economics, and a description of participation). This option is provided when biological or fisheries data is limited or unavailable to provide any type of evaluation of the fishery or population. Research and data needs will be highlighted and presented for state agency consideration.

A **Management Profile** contains the same elements as the Biological Profile plus the addition of any state information related to the stock status, but not a regional stock assessment. The Management Profile will identify research and data needs as well as management considerations which are optional for the states should a need arise to change existing management scenarios or to conduct a stock assessment for the resource in the future.

A **Fishery Management Plan** is the final option should a state or particular sector within the fishing community request a formal stock assessment be facilitated by the GSMFC. Along with a regional assessment will be recommendations on management goals and objectives as well as a suite of potential biological reference points for management which are available to the states as options.

The profiles and plans are developed by a Technical Task Force (TTF) for that species or fishery. The TTF is composed of a core group of scientists from each Gulf state and is appointed by the respective state directors who serve on the Commission. Also, a TTF member from each of the Commission's standing committees (Law Enforcement, Habitat Advisory, Commercial Fisheries Advisory, and Recreational Fisheries Advisory) is appointed by the respective committee. In addition, the TTF may include other experts in economics, socio-anthropology, population dynamics, and other specialty areas when needed. The TTF is responsible for development of the management plan/profile and receives input in the form of data and other information from the Data Management Subcommittee and the Stock Assessment Team.

Once the TTF completes the plan/profile, it may be approved or modified by the Technical Coordinating Committee (TCC) in the case of a biological or management profile. If a management plan is developed or revised, the TCC must approve the draft before being sent to the Commission for review. The Commission may also approve or modify the management plan before releasing it for a voluntary public review and comment. After public review, the document and all comments are considered by the Commission and it is accepted, accepted with modification, or rejected and returned to the TCC or the TTF for further revision. Once approved, the profiles or plans are submitted to the Gulf states marine resource agencies for their consideration as potential measures for research or management in their respective states.

Biological Profile Objectives

The objectives of the Biological Profile for the Tripletail Fisheries in the Gulf of Mexico and Western Central Atlantic are:

1. To consolidate information regarding tripletail in the Gulf and Western Central Atlantic (including relevant scientific studies, fisheries and monitoring data, and anecdotal reports) for use by fisheries managers in the southeastern U.S.

2. To summarize the state and federal jurisdictions and management authorities and review the laws, regulations, and policies that affect tripletail.

3. To identify gaps in the knowledge of tripletail and fishery-dependent and independent data to direct research with the purpose of informing future management.

Chapter 3
DESCRIPTION OF STOCK(S) COMPRISING THE MANAGEMENT UNIT

Introduction

Tripletail (*Lobotes surinamensis*), a pelagic fish species found throughout tropical and subtropical regions of the world's oceans, support commercial and recreational fisheries throughout much of its geographic range. Very little is known about the biology and life history of tripletail, including age and growth, reproduction, seasonal movements, and migratory patterns. This profile will focus on that segment of the tripletail population which occurs in the Gulf of Mexico, the Atlantic Ocean, and the Caribbean Sea, with most of the information centered on the U.S. from Texas to Georgia, Puerto Rico, and the South American countries bordering the Caribbean.

Geographic Distribution

Tripletail occur in tropical and temperate waters worldwide (Gudger 1931; Figure 3.1). In the Atlantic Ocean, tripletail are found throughout the western Central Atlantic Ocean, including the Gulf of Mexico (Gunter 1935, Gunter 1941, Woods 1942, Yerger 1961), Caribbean Sea (Breder 1949, Gunter 1957, Prince and Gonzalez 1985), Bermuda (Bean 1906), and southward to Argentina (Berg 1895, Artigas et al. 2003, Reis-Filho and Cruz 2009, Isaac et al. 2010). They have been reported to occur along the eastern coast of North America as far north as Nova Scotia, Canada (Gilhen and McAllister 1985). Tripletail are occasionally documented from Atlantic oceanic islands such as Madeira (Wirtz et al. 2008) and Fernando de Noronha (Sazima et al. 2009). Tripletail are reported from the Mediterranean Sea, including the Balearic Islands (Riera et al. 1999), Adriatic Sea (Dulcic and Dragicevic 2011), Malta (Deidun et al. 2010),

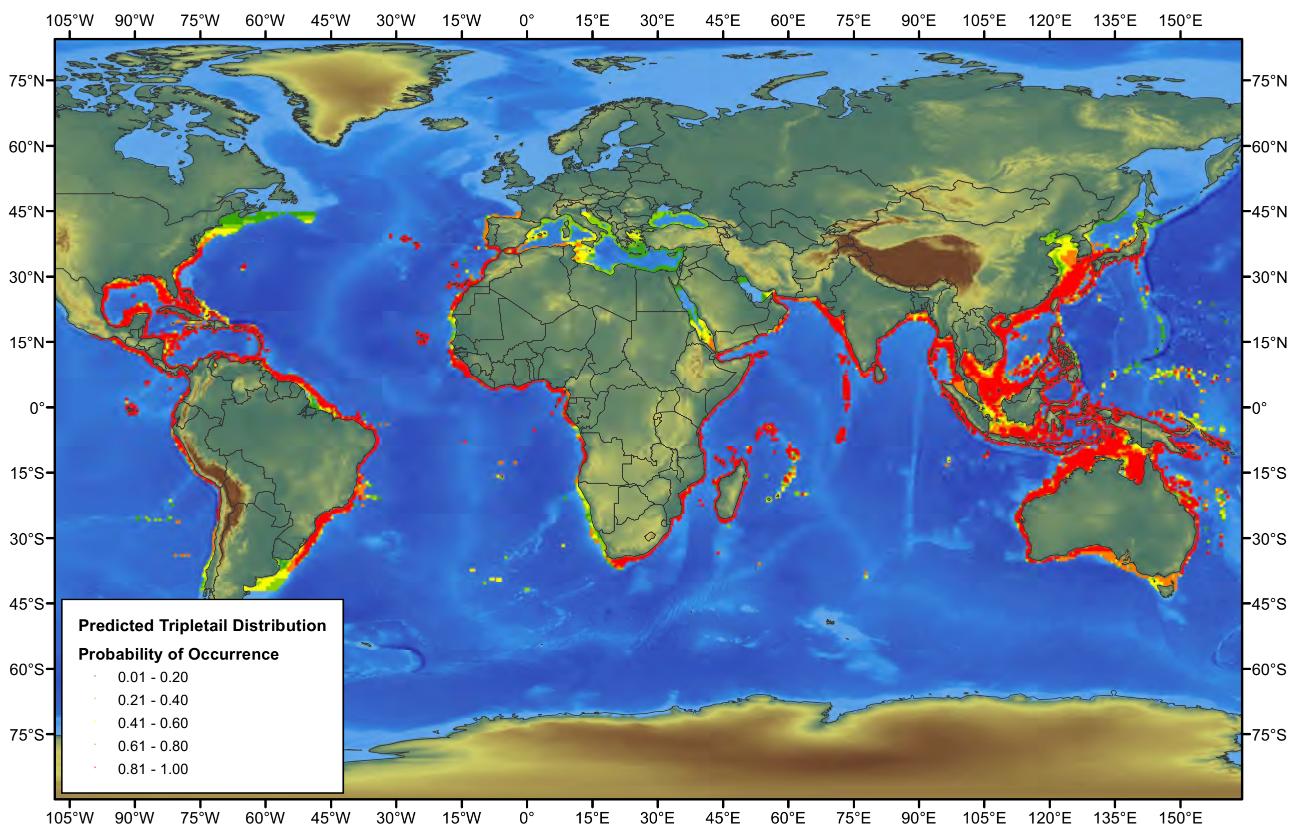


Figure 3.1 Predicted coastal distribution of tripletail (both *Lobotes surinamensis* and *L. pacificus*) worldwide based on summarized landings data on FishBase (*from* Froese and Pauly 2016).

Greece (Corsini-Foka and Economidis 2007, Katsanevakis et al. 2014), and Syria (Saad 2005). These fish also occur off equatorial west Africa and in the Gulf of Guinea (Poizat and Baran 1997) with commercial landings reported coming from Mozambique (FAO-FISHSTAT).

In the western Indian Ocean, tripletail occur off the western coast of India (Silas et al. 1984), in the Seychelles, at Reunion Island (Taquet et al. 2007, Letourner et al. 2004), and as far south as South Africa (Pradervand et al. 2007). In the eastern Indian Ocean along Southeast Asia, tripletail occur offshore of Indonesia in the Java Sea (Chanrachkij and Loog-On 2004) and throughout the South China Sea, along Malaysia (Lee et al. 2013), Vietnam (Munprasit and Prajakjitt 2000), and China. They also occur in the East China Sea and in the Sea of Japan, as far north as Peter the Great Bay along the coast of Russia's Primorski Krai (Kharin et al. 2009).

Tripletail are reported throughout the western Pacific Ocean from Japan to southern Australia, including the Marianas Islands (Tenorio 2013) the Solomon Islands, New Guinea, and French Polynesia (Dufour 1996), and as far south as New South Wales, Australia (Gray et al. 2003). In the eastern Pacific, tripletail are generally considered to be *L. pacificus*, though the Atlantic tripletail (*L. surinamensis*) has been documented off the coasts of California (Rounds and Feeney 1993) and western Mexico (Vera and Sánchez 1997, Lucano-Ramirez et al. 2001).

While the western Central Atlantic Ocean, Gulf of Mexico, and Caribbean populations of tripletail are considered to be a single stock, evidence of potential sub-populations throughout the region may impact how the species is managed throughout its range in the future. Additional genetics work will need to be conducted to examine local populations around the region.

Biological Description

The family Lobotidae contains one genus, *Lobotes*, and was originally described with nine species and variations (Fowler 1931). According to McEachern and Fechhelm (2005), members of Family Lobotidae are

> "oval to oblong in lateral profile, deep bodied, and compressed, with symmetrically shaped posterior dorsal and anal fin lobes and a rounded caudal fin giving the fish the triple-tailed appearance."

The maximum size for tripletail varies slightly by source, but the consensus seems to be about a meter in length and most angling records are around 18 kg (40 lbs; Table 3.1). Coloration ranges from olive to reddish brown to dark brown with darker spots or blotches, and some slightly silvery ventrally. Juveniles tend to be more of a yellow color, mottled with brown and black. The coloration serves as a protective mechanism, helping the fish to blend in with or appear as drifting flotsam or leaves (Randall 2005). Though most often observed or collected in nearshore waters (Gudger 1931), they also frequent flotsam and drifting algae mats far offshore (Caldwell 1955). Though never an abundant species, there are rare reports of schools or aggregations (Baughman 1941).

Classification

The following classification is a complete outline of the species according to FishBase (Froese and Pauly 2016)

- Kingdom Animalia
  - Subkingdom Bilateria
    - Infrakingdom Deuterostomia
      - Phylum Chordata

Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Percoidei
Family Lobotidae
Genus Lobotes (Cuvier and Valenciennes 1830)
Species *Lobotes surinamensis* (Bloch 1790)

The valid scientific name for Atlantic tripletail is *Lobotes surinamensis* (Bloch 1790). Bloch assigned the genus *Lobotes* to tripletail from the Latin "lobus" meaning lobed based on the appearance of three lobes or tails. The species name *surinamesis* was given because it was discovered in the Caribbean off Suriname, in northern South America. The following synonymy for Atlantic tripletail is provided by FishBase (Froese and Pauly 2016):

Lobotes surinamensis Bloch 1790
Holocentrus surinamensis Bloch 1790
Lobotus surinamensis Bloch 1790
Bodianus triourus Mitchill 1815
Lobotes somnolentus Cuvier 1830
Lobotes erate Cuvier 1830
Lobotes farkharii Cuvier 1830
Lobotes incurvus Richardson 1846
Lobotes citrinus Richardson 1846
Lobotes auctorus Günther 1859
Lobotes pacificus non Gilbert 1898
Labotes pacificus non Gilbert 1898

With the exception of *Lobotes pacificus* (Pacific tripletail), the synonyms have all been accepted as *Lobotes surinamensis*. An additional freshwater species (*Lobotes hexazona* Bleeker 1851) was originally included with *Lobotes* but was later moved to the family Datnioididae, the freshwater tripletail, with the single genus *Datnioides*.

Table 3.1 Current tripletail state recreational saltwater records for the Gulf of Mexico, Georgia, and the current IGFA World Record (IGFA 2016).

State	Year	Record Holder	Weight
Florida	1998	Mr. Thomas D. Lewis	40.8 lbs
Alabama	1976	Mr. Bob Barnes	37.3 lbs
Mississippi	1972	B. Gibson	37.75 lbs
Louisiana	1959	Mrs. Jimmy Toups	39.5 lbs
Texas	1984	Mrs. Eddie Porter	33.6 lbs
Georgia	2005	Mr. Kyle Thigpen	38.9 lbs
IGFA World Record South Africa	1989	Mr. Steve Hand	42.3 lbs

Many common names exist for *L. surinamensis*, although only Atlantic tripletail is recognized by the American Fisheries Society (Page et al. 2013). Common and market names in the United States reported besides tripletail include biajaca de la mar (Spanish), blackfish, black grunt, black perch, bouy bass, bouyfish, chobie (French), dormeur (French), flasher, lumpfish, rockfish, sea perch, snag-drifter, steamboat, strawberry bass, and sunfish (Froese and Pauly 2016). Elsewhere in the Caribbean and Mexico, tripletail are commonly referred to as chopa (Spanish), piraca (Portuguese), macuri (Spanish), pargo sargo (Spanish), prejereba (Portuguese), dormilona (Spanish), and plateado (Spanish).

Morphology

Most descriptions of tripletail are primarily of juveniles and adults and extend in their distribution as far as Japan (Uchida et al. 1958, Konishi 1988) and as close as Louisiana (Ditty and Shaw 1994). Very few eggs and larvae have been collected in the wild and kept alive; most of the descriptions are based on museum samples (Hardy 1978, Ditty and Shaw 1994). An extensive species description was provided by Fowler (1931) and included fish from locations worldwide. What is presented here is based on the limited published work available on tripletail, specifically in the western Central Atlantic and with limited data from live specimens (Franks et al. 2001, Saillant et al. 2014). While most of the published descriptions of tripletail eggs and larvae are derived from museum specimens, Saillant et al. (2014) described eggs and larvae in laboratory/culture.

Eggs

Hardy (1978) reports description of tripletail eggs collected from the wild; however, it is unclear as to the source of those eggs. Based upon observations during captive spawning trials, Saillant et al. (unpublished data) noted that unfertilized, hydrated eggs were spherical when released during spawning, typically measured >500 µm in diameter, and contained an oil globule (Figure 3.2). Hatching occurred at roughly 24 hours post-fertilization at 26°C (Saillant et al. 2014).

Larvae

Saillant et al. (unpublished data) successfully spawned tripletail in captivity and achieved larval survival to nine days post-hatch. Post-hatch, tripletail larvae did not have well-defined yolk-sacs (Figure 3.3A). After 20hrs, pigmentation became more pronounced (Figure 3.3B) and exogenous feeding began on day three at ~ 3.0 mm SL. Saillant et al. (2014) noted the supra-occipital crest could form as early as three days post-hatch and a pigmentation line developed along the dorsal part of the digestive tract (Figure 3.3C).

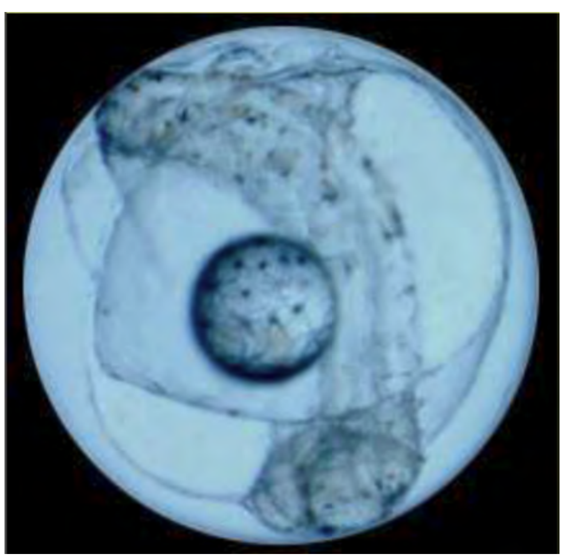


Figure 3.2 Twenty-hour old fertilized tripletail embryo with oil globule (photo by Franks and Saillant).

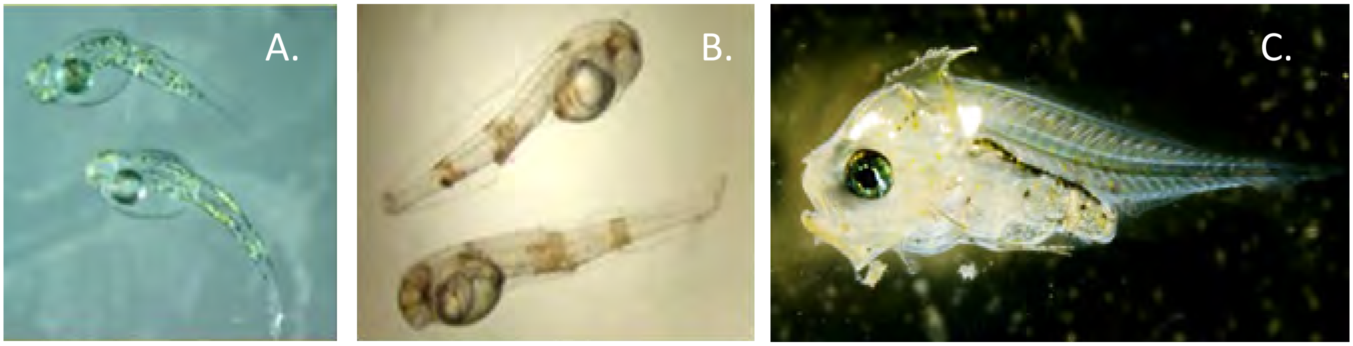


Figure 3.3 A. Tripletail two hours post-hatch with oil globule. B. Yolk-sac larval tripletail 20-hour post-hatch 2.7 mm notochord length (NL) (photos by Franks and Saillant). C. Tripletail larva with supraorbital crest from September 2010 GCRL captive spawning trial; nine days post-hatch (~ 4.0 mm SL) (photo by D. Graham).

Hardy (1978) provides one of the earliest compilations of tripletail larvae descriptions (museum specimens) from the mid-Atlantic Bight for specimens from 6.0-7.4 mm TL and includes material from Uchida et al. (1958). In addition, Konishi (1988) provides limited information and illustrations of tripletail larvae captured off Japan. The most detailed descriptions of the larval stages of tripletail (2.2-23.0 mm SL) were included in Table 3.2 and Figure 3.4 and were provided by Ditty and Shaw (1994) from specimens collected in the northern Gulf of Mexico. Ditty and Shaw (1994) indicate that reabsorption of the supra-occipital crest is complete by 15.0-16.0mm (age unknown; Figure 3.4B).

Juveniles

Tripletail grow rapidly during their first year of life. The transition from larval tripletail to juvenile stage occurs around 9.0-9.5 mm SL (Ditty and Shaw 1994). Hardy (1978) provides one of the few complete descriptions of tripletail juveniles from 10.6-208.0 mm TL:

"Gill rakers 5-1-13; scales 55; maxillary extended to vertical from posterior margin of pupil.

At 10.6 mm TL (SL 8.3 mm) HL 43% SL, depth 57% SL. Proportions as percent SL (based on two specimens of 120 and 263 mm SL): Head 33.3-34.1, depth 47.5-52.2, eye 4.1-6.2.

Table 3.2 Morphometrics of larval tripletail *(Lobotes surinamensis)* from the northern Gulf of Mexico. Measurements are expressed as % standard length (SL) (Table 1. *from* Ditty and Shaw 1994).

SL	n	Preanal length	Head length	Snout length	Orbit diameter	Greatest Body depth	Upper Jaw length	Prepelvic Distance
2.2-2.4	2	60.5-66.0	29.0-29.5	6.5-7.0	12.5-13.5	25.0-27.5	11.5-14.5	---
4.0-5.9	3	60.0-70.0	37.5-40.0	7.5-10.0	14.0-14.5	40.0-53.5	20.0-20.0	37.5-55.0
6.0-7.9	4	69.5-79.5	38.0-43.0	6.5-9.5	14.0-16.0	51.0-59.5	15.5-17.5	38.0-57.0
8.0-9.9	4	68.0-77.5	34.5-38.5	5.5-6.5	14.0-15.5	58.0-59.0	14.0-15.5	39.0-48.0
10.0-11.9	2	68.5-74.0	38.0-39.0	6.0-6.5	14.5-15.0	54.0-56.5	14.0-14.5	39.0-40.0
13.0-14.9	2	71.5-72.5	35.5-37.0	6.5-7.0	13.0-14.0	55.0-57.5	13.5-14.0	40.0-44.5
15.0-16.9	2	72.5-77.5	34.5-35.5	6.0-6.5	12.5-13.0	56.5-58.0	12.5-13.0	42.0-47.5
21.0-23.0	2	74.0-76.5	39.5-41.5	7.0-8.0	12.0-13.0	54.5-58.0	13.0-14.0	46.5-52.0

Pigmentation: Body darker above than below; body grayish, brownish, greenish, yellow, yellow and tan, yellow and black, or bronze and blackish silver; sometimes resembles yellowed leaves and with yellowish and grayish blotches [Figure 3.5]; fins same color as body except pectorals which are whitish and translucent; caudal fin with broad light marginal band; dorsal and anal fins narrowly marked with lighter; 2 narrow streaks on top of head extending to nape, another from posterior margin of eye to nape, and one from posterior margin of eye to lower angle of Preopercle."

from Hardy 1978

"In very small specimens brownish pigment tends to be concentrated in scale centers forming ill-defined crossbars and narrow longitudinal streaks; anal sometimes distinctly ocellated.

At 10.6 mm melanophores developed on caudal peduncle; pigment on head, opercle, and body increased; upper posterior part of eye with dark band. At 15.0 mm pectoral and caudal fins entirely white. At 18 mm soft dorsal fin tipped with pinkish, remainder of fin gray with pinkish tint toward base; caudal fin with wide translucent terminal band; snout pale. At 33 mm dull grayish green; all fins except pectorals black, their bases same color as rest of body; caudal, dorsal, and anal fins tipped with grayish white; 5 black spots at base of soft dorsal fin; a black spot at base of posterior anal fin rays; a narrow grayish line along anal fin base. At 40 mm color highly changeable, nearly

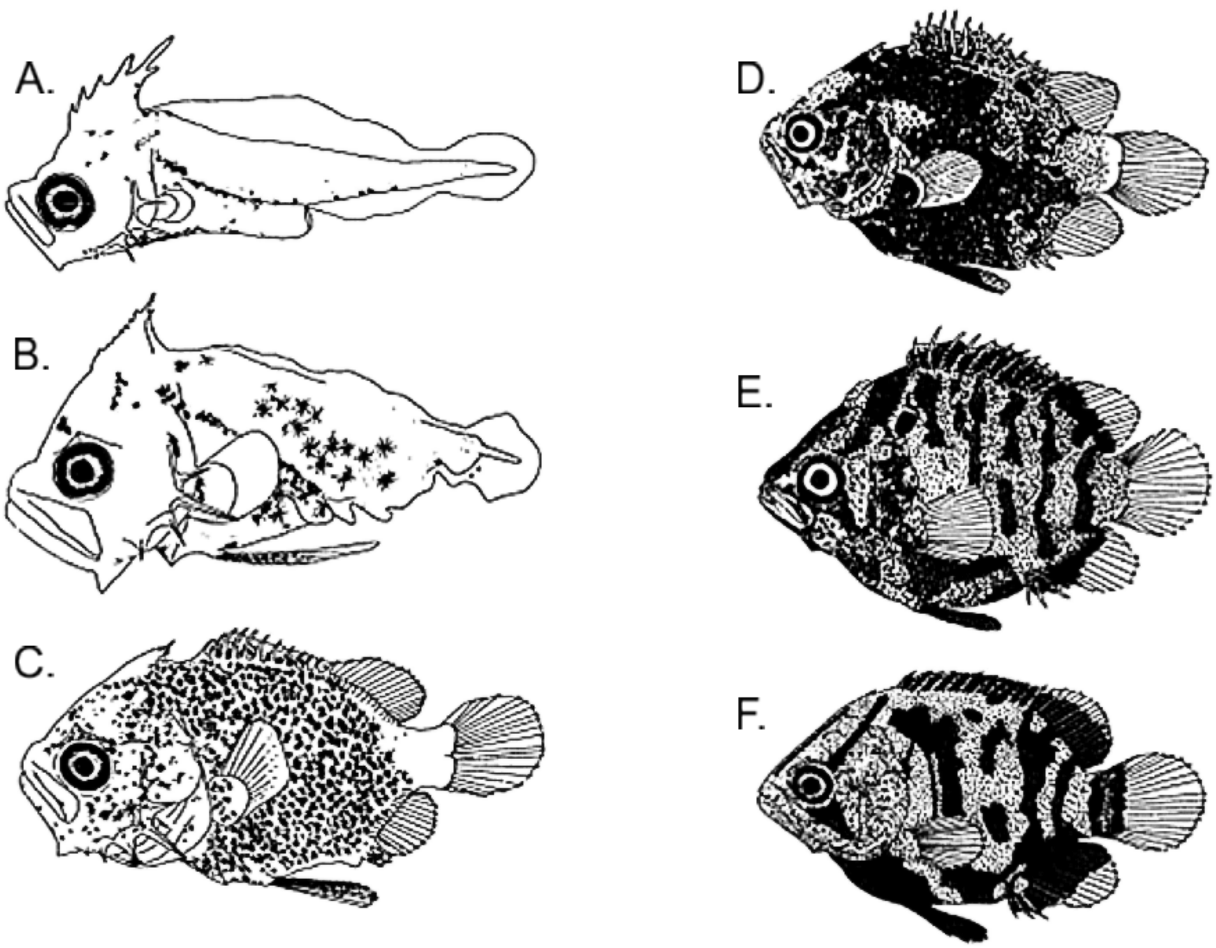


Figure 3.4 Larval development of tripletail (Lobotes surinamensis) from the northern Gulf of Mexico. (A) 2.2 mm, (B) 4.0 mm, (C) 6.3 mm, (D) 8.5 mm, (E) 10.8 mm, (F) 13.7 mm. All measurements are standard length (SL) (Figure 1 from Ditty and Shaw 1994).

black in aquarium, much lighter in porcelain dish; preserved specimens of this size with prominent dark spots at base of soft dorsal fin. At 90 mm body yellowish tan with roundish black spots; ca. 15 spots of various sizes and shapes in central area of sides, three on dorsal base posteriorly, one on anal base, four on frontal area of head; lobate portion of dorsal and anal narrowly edged with black; pelvic fins black-edged along first spine; pectorals completely hyaline. At 185 mm caudal still with white edge; dark spots at base of soft dorsal more conspicuous. A 208 mm TL specimen was observed to change color from completely yellow, to yellow mottled with black, and to completely black."

from Hardy 1978

Figure 3.5 Examples of color patterns in three juvenile tripletail collected from the Gulf of Mexico (photo by Drinnen).

Adults

For the purposes of this document, the transition of tripletail from juvenile to adult is at 50% maturity, which has been calculated at around 448 mm TL for tripletail from Mississippi (Brown-Peterson and Franks 2001) and in Alabama is 450 mm TL (Strelcheck et al. 2004). The description of adult *Lobotes surinamensis* is as follows: Gill rakers on first arch number 5-7 on upper limb and 13-15 on lower limb, head length 33%-39%, snout length about 8%, eye diameter 4%-7%, upper jaw length about 14%, and body depth 48%-54% (measurements expressed as percent of standard length). Dorsal fin has 11-12 spines and 15-16 rays; anal fin has three spines and 11-12 rays; and pectoral fin has 16 rays. Lateral line scales are 43-48. The third anal spine is relatively large. The opercle is serrated on the back edge (Shipp 1999). The body is deep brown to olive in color, often with darker-colored blotches on the body and soft portions of the fins (Figure 3.6). Teeth in jaws are small, pointed, and arranged in narrow villiform bands. No teeth are present on the vomer or palatines. Scales are weakly ctenoid and extend onto the bases of all soft fins (Hardy 1978).

"Dorsal profile behind head is strongly elevated and straight to slightly concave. Snout is short and moderately acute. Mouth is slightly oblique, with thick lips, lower jaw projecting beyond upper jaw, and upper jaw extending to center of eye. Nostril is paired, with nares round and close together. Eye is small and laterally located. Upper jaw is protrusible, and supramaxilla is absent. Jaws have an outer row of enlarged, conical, posteriorly directed teeth and an inner narrow band of villiform teeth. Teeth are absent in vomer and palatine. Preoperculum is angular and has strong serrae on posterior and ventral margins, with those at corner strongest and those on posterior margin curved dorsally. Operculum has two spines. Branchiostegal rays number 6. Pectoral fin is located on lower flank and is of moderate size. Dorsal fin is notched and consists of 11 to 13 stout spines and 13-16 rays. Pelvic fin is thoracic and well developed and consists of one spine and 5 rays. Anal fin has three spines and 8 to 11 rays. Moderate-sized cycloid scales with spines on posterior margin cover body and head except for preorbital region and jaws. Bases

Figure 3.6 Typical coloration of adult tripletail from the northern Gulf of Mexico (photo by Franks and Reid).

of dorsal and anal fins are covered with scales. Lateral line is complete and consists of 42 to 70 scales. Vertebrae number 24: 12 precaudal and 12 caudal. Gas bladder is present and lacks posterior extension."

From McEachern and Fechhelm 2005

Lobotes Differences

The Pacific tripletail (*L. pacificus*) is found almost exclusively from southern California to Peru (Rounds and Feeney 1993, Vera and Sanchez 1997, Ramirez 2001). *L. pacificus* was described based on specimens collected from southern Central America near Panama (Gilbert *in* Jordan and Evermann 1898). Historically, several authors have examined the morphological features of the two species and separated them based on meristics (Jordan and Thompson 1911, Meeks and Hildebrand 1925, Fowler 1931). The most notable difference for *L. pacificus* was the occurrence of a more strongly serrated operculum and the absence of one soft dorsal ray. However, the genetic resolution of the two species in the genus *Lobotes* is debated today. Recent authors who have questioned the differentiation include Hilton and Bemis (2005) who acknowledge only one single species in the genus, inclusive of the eastern Pacific. In addition, Zemnukhov and Turanov (2011) found no significant differences between spined and "less spined" museum specimens when describing a new record of a *Lobotes* collected from waters off eastern Russia, concluding that as a diagnostic character, the more heavily spined operculum had little taxonomic value.

There are also reports that an additional meristic difference between *Lobotes surinamensis* and *L. pacificus* is the existence of 15 gill rakers on lower limb of arch 1 in *L. pacificus* (Jiménez-Prado and Béarez 2004) and 13-15 gill rakers in *L. surinamensis* (Kharin et al. 2009). It is widely agreed that the *Lobotes* taxonomy requires further genetic investigation (Heemstra 1995, Zemnukhov and Turanov 2011, Franks personal communication).

Anomalies and Abnormalities

Physical abnormalities and anomalies such as dwarfism, spinal deformities, and pugheadedness in fish can be considered part of the natural selection process, and even though many were reported for hundreds of years, little progress was made in understanding their complex derivation. As Hickey (1972) succinctly states:

“the causes and effects of abnormalities in fishes, nevertheless, will largely remain matters of conjecture until more carefully selected data are obtained through controlled research.”

Dahlberg (1970) noted that abnormalities can result from anomalies, either genetic or epigenetic, or injuries. Genetic anomalies result from errors at the gamete development and recombination level while epigenetic anomalies occur post-fertilization as the embryo develops.

One abnormality that has interested ichthyologists and fishermen all over the world is pugheadedness. Reports of this condition have come from North America, Europe, and the British Isles (Gudger 1930) as well as Africa (Junor 1967) and Asia in a variety of species. This malady, also known as pug nose (Sutton 1913), bulldog head, lion head, tête du chien, lowenkopf, mopskoph (Schwartz 1965), and mopsgesicht (Gudger 1929) is one of the earliest reported abnormalities in fishes. The negative effects of pugheadedness on fish depend upon the severity of the condition and the existing environmental conditions. A pugheaded fish may have difficulty passing water over the gills as well as catching, holding, and subsequently swallowing prey (Rose and Harris 1968, Gudger 1929).

Franks (personal observation) encountered one pugheaded tripletail from Mississippi waters, which is the only documented case anywhere in the world at this time. The specimen appeared to have a severely reduced maxilla and premaxilla, giving it a strong under-bite, although it seemed to have no ill effects as a result of the impairment (Franks personal communication; Figure 3.7).

It is uncertain whether pugheadedness affects feeding, body weight, or breathing ability of tripletail. The causes of pugheadedness have not been clearly defined, though potential links to heavy metal exposure and oxygen depletion were explored by Schmitt and Orth (2015).

Spinal curvatures in fish can include a humpback condition caused by kyphosis, a lateral curve from scoliosis, and saddle or sway back from lordosis (Branson and Turnball 2008). Dahlberg (1970) documented several species of fish displaying vertebral curvature and indicated that this condition is more likely to result from anomaly rather than injury. Franks (personal observation) provides the only record of a humpback tripletail (Figure 3.8) which was captured by a recreational angler with hook-and-line in Mississippi waters. The tripletail had no indication of a reduced physical condition due to the dorsal hump.

Figure 3.7 Tripletail with pughead condition (photo by Franks).

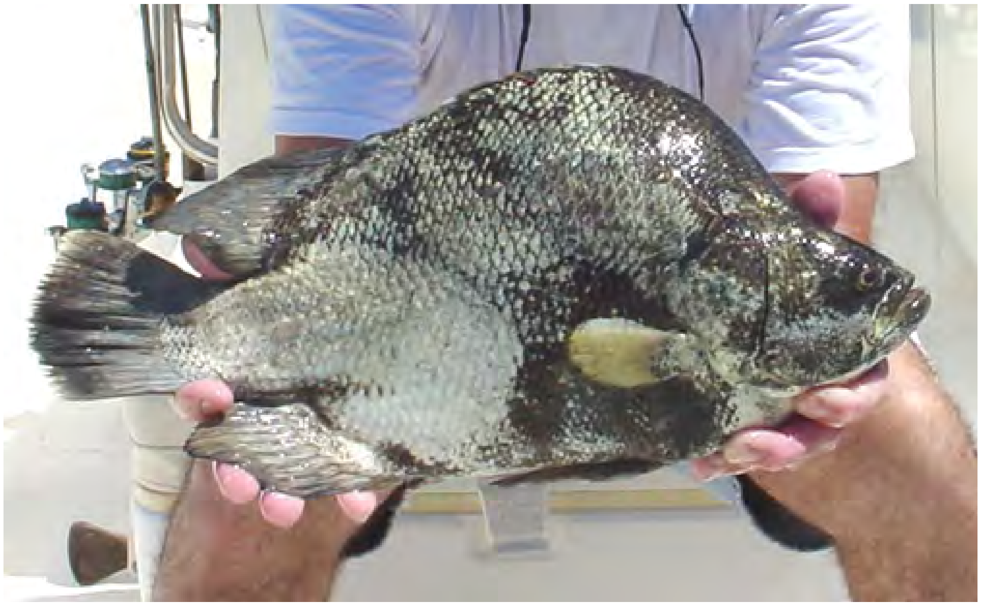


Figure 3.8 A humpback tripletail captured by hook-and-line from Mississippi waters (photo by Franks).

General Behavior

Tripletail have a tendency to float on their sides close to the surface, and they have been described as assuming a stance at a 45° angle with the head downward and tail upward (USFWS 1978). It has been assumed that this stance affords the fish a view of the surface. In adults, the proximity to structure may originate from a desire more for shade and less for protection (Gudger 1931, Baughman 1941). It may also provide the fish access to prey items as smaller fish seek shelter near structure (Sazima et al. 2009).

Cryptic Behavior, Coloration, and Camouflage

The ability to change coloration is tied to pigment cells in fish. Sugimoto (2002) describes this general phenomenon in fishes from a variety of locations worldwide. Sugimoto (2002) indicates that there are two processes by which coloration and patterns can be changed: physiologic (direct responses of the chromatophores) and morphologic (physical adjustments to the body to reshape the location of the chromatophores). Tripletail can be seen in a wide variety of color patterns as both juveniles (Figure 3.5) and adults. While collecting live juvenile specimens for a growth study, Franks (personal communication) reported tripletail collected in the northern Gulf of Mexico could change their coloration from bright to dark within minutes of capture. Kalinowsky (personal observation) reports that an adult tripletail harvested recreationally changed color almost instantaneously as it was handled, shimmering from dark to light.

The floating leaves of both red and black mangroves provide inshore habitat for tripletail less than 120 mm (Breder 1949). Tripletail have been observed to mimic mangrove leaves in color, pattern, position in the water, and movement (Alcalá and P. Sánchez-Duarte 2011). This behavior seems limited to the fall, when decaying mangrove leaves most closely resemble tripletail color schemes (Breder 1949). This type of mimicry, where coloration is utilized for disguise is termed chromatic mimesis (Fujii 1993).

When mangrove leaves were introduced in a controlled setting, young tripletail deliberately schooled with them, but not with other forms of flotsam (Breder 1949). Breder suggested tripletail may also adjust fin shape to closer mimic species-specific leaf length-width ratios. This combination of free-floating behavior, coupled with their general morphology/shape, results in complete mimicry.

Physiologic Requirements

Temperature

Studies by GADNR indicate that Atlantic tripletail prefer water temperatures above 20-21°C and migrate accordingly (see MIGRATION). Franks (personal communication) found similar conditions when tripletail return to nearshore waters of the northern Gulf of Mexico. Tripletail captured off Georgia were found in temperatures ranging from 20.8-31.1°C with an average of 26.1°C (GADNR unpublished data, Parr 2011, Streich et al. 2013). Hunnewell (2013) maintained captive tripletail in Georgia and had 100% mortality when water temperatures fell below 15°C. Hunnewell (2013) indicated optimal temperatures for tripletail range from 15° to 29°C. He noted that most tripletail have migrated out of the region by the early winter, which is a time that Georgia has been known to experience rapid temperature changes.

Tripletail are not regularly encountered by Florida's FIM (Fishery-Independent Monitoring) program; only 2.5% of the occurrences were in waters cooler than 20°C. The warmest water in which tripletail were encountered during FIM sampling was 32.4°C, while the coldest water was 15°C during December off of Jacksonville (FWC unpublished data). In a study by De Angelo et al. (2014), tripletail were found at temperatures of 28.0°C in Charlotte Harbor, Florida and 27.8°C in Tampa Bay, Florida.

Alabama's FID sampling data includes nine tripletail that were captured in gillnets between 2006 and 2011 in temperatures ranging from 22.4-29.2°C with an average of 26.5°C (AMRD unpublished data). Half of those fish were captured in May with the remainder caught in July and August. The MDMR fishery-independent sampling program has only captured one tripletail since the start of the long-term program in 1973. The single tripletail was encountered in an otter trawl in June 2009 at a temperature of 29.9°C. No other records for tripletail occur in the database.

In Louisiana, tripletail have been encountered in the LDWF's fishery-independent finfish sampling program as early as February and as late as November in temperatures ranging from 12.1°C to 33.5°C with an average temperature of 26.5°C (LDWF unpublished data). The long-term monitoring program has only collected 49 tripletail in gillnets and seines since the program's inception. Additionally, LDWF otter trawl sampling has captured 43 tripletail since 1967 between the months of June and September, in temperatures ranging from 22.9-31.9°C with an average of 29.2°C (LDWF unpublished data).

TPWD fishery-independent data suggest that tripletail in Texas begin to occur in their gillnet samples as waters approach 20°C with an average of 27.7°C. The majority of their fish occur in Matagorda Bay in the summer, however, the TPWD gill net sampling only occurs in April-June and September-November, so the temperatures do not reflect the waters in July and August when tripletail are most abundant (Harper personal communication). Though tripletail have been gill netted at temperatures up to 34.1°C, it is possible that the maximum and average waters temperatures in Texas could be much higher.

Salinity

Tripletail spend much of their lives offshore in oceanic conditions. However, based on their occurrence inshore, they are euryhaline, tolerating a wide range of salinities from hypersaline (53.4 ppt; TPWD unpublished data) to near freshwater in estuaries and rivers (1.3 ppt; FWC unpublished data). Table 3.3 summarizes the salinity ranges for collection of tripletail from fishery-independent monitoring by state.

Reproduction

Spawning and Season

Few studies have specifically focused on reproduction of tripletail, and the majority of that information

Table 3.3 Salinity ranges for tripletail captured in each states' fishery-independent sampling (GADNR, FWC, AMRD, MDMR, LDWF, and TPWD unpublished data).

State Agency	Salinity min	Ave	Salinity max	Years
GADNR[1]	5.2	28.8	36.3	2002-2015
FWC (East Coast)	1.3	25.9	36.4	1998-2015
FWC (West Coast)	2.4	23.7	34.7	1998-2015
AMRD	3.4	15.6	24.4	2006-2015
MDMR	21.0[2]	-	21.0[2]	1973-2013
LDWF	1.1	15.5	30.5	1967-2013
TPWD[3]	2.8	24.1	53.4	1980-2014

[1] GADNR data includes fishery-independent samples and from fish sampled by Parr 2011.
[2] Mississippi only encountered one tripletail so min and max salinity is the actual salinity at time of capture
[3] TPWD gillnet data only

is regional in nature. Tripletail spawning in the northern Gulf of Mexico occurs between June and August, with the peak spawning period in July (Brown-Peterson and Franks 2001, Cooper 2002, Strelcheck et al. 2004). Similar findings were recorded off Georgia in the Atlantic Ocean (Parr 2011), indicating parallel reproduction strategies within the northern range of this species.

In the northern Gulf of Mexico, tripletail were captured during spring and summer between July 1994 and September 1999 to determine size at sexual maturity and reproductive patterns (Brown-Peterson and Franks 2001). No sexually immature male tripletail were captured during the course of this study. Size at 50% maturity for female tripletail was 485 mm TL, corresponding to an estimated age of one year (Brown-Peterson and Franks 2001). Mean monthly female gonadosomatic index (GSI) values were elevated throughout the summer, highest in July, and near resting levels by September. Male GSI values were elevated from May through September. Histological analysis of gonadal tissue from 93 male tripletail showed the majority of males captured from May through September were running ripe. However, active spermatogenesis declined in the testis during the course of the reproductive season. Female tripletail are capable of releasing multiple batches of eggs during the estimated three month spawning season (Brown-Peterson and Franks 2001). Ovarian recrudescence appears to begin in May, and some females were found in the spawning capable and actively spawning reproductive phases from June through August in the northern Gulf of Mexico (Figure 3.9). By September all females were in the regressing or regenerating reproductive phases (Brown-Peterson and Franks 2001).

A high percentage of females captured during April, May, and June were in the immature and early developing ovarian maturation stages. Females with oocytes undergoing final oocyte maturation (FOM) were found June through August, with the highest percentage in July (Brown-Peterson and Franks 2001). Franks (personal communication) reported that fishermen, off Mississippi, have harvested tripletail females that were fully mature as early as March.

Franks (unpublished data) observed large fat deposits (bodies) in tripletail, particularly females, during the summer (Figure 3.10). Those fat bodies most likely serve as a source of energy during gonadal development. Size of those fat bodies tended to diminish as the summer progressed and ovaries matured (Figure 3.11). Fat bodies have also been found in males, in association with testes, during spawning season (Franks unpublished data). It is also speculated that fat bodies might aid tripletail in maintaining buoyancy as they float at or near the surface of the water.

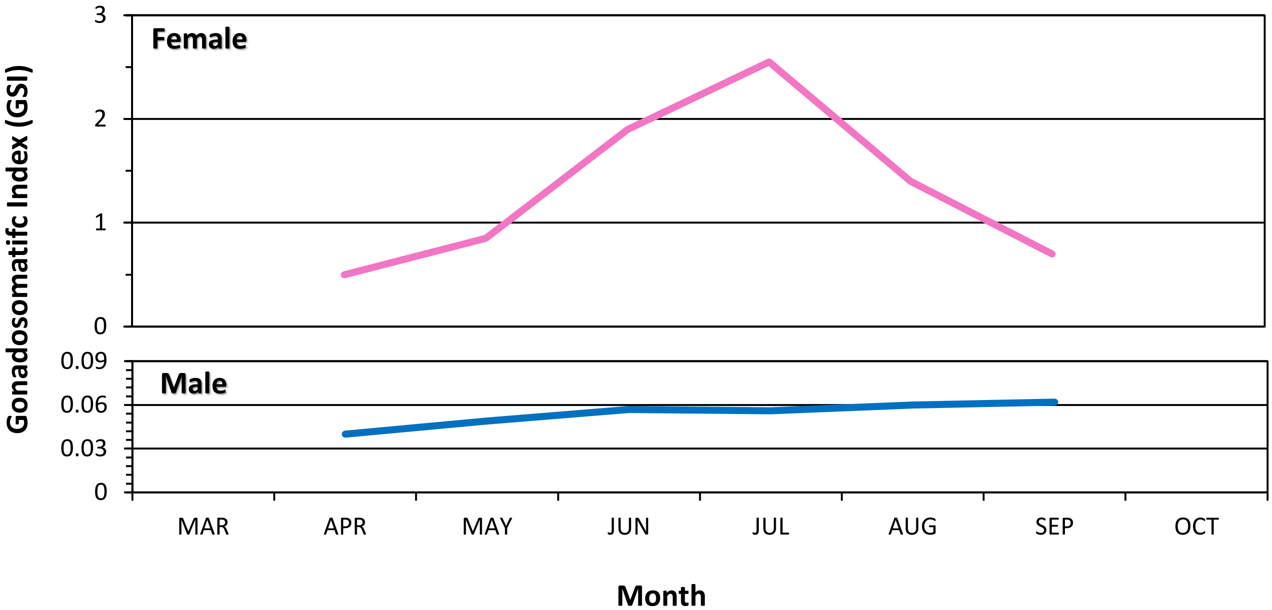


Figure 3.9 Gonadosomatic index (GSI) for tripletail examined by Brown-Peterson and Franks (2001) from the northern Gulf of Mexico.

Fecundity

Estimates of spawning frequency indicate that female tripletail are multiple spawners (i.e., batch spawners), possibly spawning every three to five days (Brown-Peterson and Franks 2001, Cooper 2002), or 18 to 31 times per spawning season (Brown-Peterson and Franks 2001). For example, a large female tripletail (24 inches TL) is capable of producing 4.5-8.0 M eggs in a single spawning season. Egg production increases with increased size of mature females (Brown-Peterson and Franks 2001).

Gonadal Development

Age at maturity is not well understood for male and female tripletail; however, in the northern Gulf of Mexico, it was estimated that 50% of males matured at approximately 300 mm TL and females reached

Figure 3.10 A late stage maturing female tripletail captured in June off Mississippi. Note: Fat body (indicated by arrow) attached to the ovary (photo by Franks).

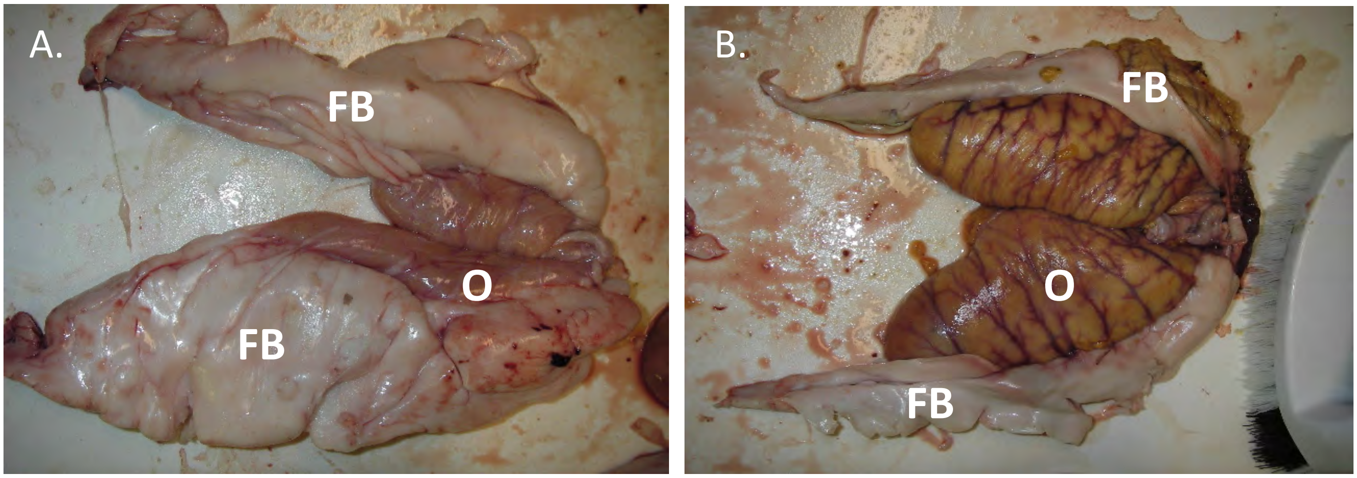


Figure 3.11 Tripletail ovaries (**O**) and associated fat bodies (**FB**) from A) developing ovaries and B) spawning capable ovaries both collected off Georgia (GADNR unpublished data).

50% maturation between 350-500 mm TL (Brown-Peterson and Franks 2001, Strelcheck et al. 2004). More specifically, Brown-Peterson and Franks (2001) proposed 485 mm TL as the size at 50% maturity for northern Gulf of Mexico females which corresponds to one year of age. Franks (personal communication) indicates that additional observations since Brown-Peterson and Franks (2001) suggest that the size at 50% maturation in females may actually be higher than originally reported.

Strelcheck et al. (2004) warned that including fish in the early developing phase of maturity may lead to an underestimate of the size at 50% maturity and suggested using vitellogenic oocytes as the minimum qualification for maturity status. This more conservative approach resulted in a slightly larger size at maturity estimate of 594 mm TL rather than 494 mm TL for females off Alabama (Strelcheck et al. 2004). Parr (2011) found that by using this more conservative approach for estimating size at maturity in Georgia fish increased the minimum size at 50% maturity from 449 mm TL to 491 mm TL. Differences in estimated size at maturity between the two regions may be a result of sample size, gear bias, or size of available fish.

Courtship and Spawning Behavior

There are no published reports or observations of courtship and spawning by tripletail.

Location

In the northern Gulf of Mexico, tripletail are presumed to spawn in offshore waters, likely in association with floating debris or ocean current features (fronts, color change, etc.) (Ditty and Shaw 1994, Brown-Peterson and Franks 2001). The collection of tripletail larvae from offshore waters (and none inshore) and the lack of females in imminent spawning condition from inshore collections support this presumption. Tripletail are summer spawners; therefore, warm waters, moderate to high salinities, and perhaps high dissolved oxygen content, are likely preferred during spawning activities.

In Georgia, there are no documented occurrences of spawning events and no larvae have ever been collected in long-term monitoring programs (Kalinowsky personal communication). Spawning-capable fish have been observed inshore, however no evidence of eggs or larvae has been documented inshore. As batch spawners, it seems unlikely that mature females would move from inshore waters to offshore every few days to spawn. Parr (2011) found two spawning-capable female tripletail in the nearshore waters of Jekyll Island, Georgia that contained hydrated oocytes, and one of the fish (collected in April) also had post-ovulatory follicles suggesting it had spawned within the last 48 hours.

Effects of Temperature, Salinity, Dissolved Oxygen, and Photoperiod on Spawning

Nothing is published regarding a relationship between photoperiod and tripletail spawning.

Incubation

There are no published accounts of active spawning by tripletail in the wild. Limited aquaculture studies involving tripletail spawning have been conducted in a laboratory setting (Saillant et al. 2014). In these laboratory studies, eggs hatched about 24 hours after fertilization and newly hatched larvae absorbed their yolk sacs in approximately 48 hours.

Larval Transport

This aspect of tripletail early life history is poorly understood and the sparsity of recent larval tripletail collections does not provide any assistance. No newly hatched larvae have been reported by any of the fishery-independent monitoring programs in the Gulf of Mexico. Early juveniles have been collected from *Sargassum* and petroleum structures offshore (Franks unpublished data) and as far upstream as 12 river miles in the Ogeechee River, Georgia (Kalinowsky unpublished data); however, it is unknown if the presence of juveniles in these locations is the result of passive transport, active swimming, or nearby spawning activity.

Genetics

As noted earlier, Atlantic tripletail are found throughout tropical and temperate waters of the world; however, there are only a few specimens of *Lobotes* that have been sequenced. These sequences were developed from collections around the world and housed by the National Bureau of Fish Genetic Resources (NBFGR), and are available electronically on the Fish Barcode Information System (FBIS) under the Indian Agricultural Statistics Research Institute in New Delhi, India (Nagpure et al. 2012; Table 3.4). Anderson (TPWD) provided the following observations based on the NBFGTR and FBIS databases.

A cursory analysis of haplotype distributions from these samples yielded two general findings with respect to phylogeography of *Lobotes surinamensis* (Figure 3.12; Anderson personal communication). First, there is fairly clear divergence between samples taken in the Atlantic and Indo/Pacific basins with each of the specimens taken in these areas falling into haplotype clusters that were exclusive to their respective basin. Secondly, samples taken from the Mediterranean (Turkey) seem to be more diverse and reside on branches of the network adjacent to haplotypes observed in the Atlantic and Pacific, suggesting that the Mediterranean may have been a historical migratory route between Atlantic and Indo-Pacific populations (Anderson personal communication).

Table 3.4 Sampling distribution of *Lobotes surinamensis* sequences obtained online from the Fish Barcode Information System (FBIS - http://mail.nbfgr.res.in/cgi-bin/fbis/divergence.pl?185).

Location	Basin	Sample size
Alabama, USA	Atlantic	1
Sao Paulo, Brazil	Atlantic	7
Turkey	Mediterranean	20
Kwazulu-Natal, South Africa	Indo-Pacific	2
Indonesia	Indo-Pacific	3
South China Sea	Indo-Pacific	8

Among individuals from all basins, there was an overall sequence divergence of $\pi = 0.013$, which translates to 1.3% divergence across the sampled range of the species, and is consistent with the finding of a single taxonomic species (Anderson personal communication). However, there was significantly high genetic partitioning when haplotypes were pooled into their sampled basin. The θ_{st} statistic was used to estimate the overall proportion of genetic variance that can be accounted for by haplotype differences among samples. A finding of $\theta_{st} = 0.789$ indicates that ~79% of the observed sequence divergence could be reliably attributed to difference in haplotype distribution among basins (Anderson personal communication).

Although this work was based on a very small sample size and should be viewed as highly tentative, there are a number of findings that may be used as baseline hypotheses for future work (Anderson personal communication). First, it is likely that Atlantic and Indo-Pacific samples of *Lobotes surinamensis* represent independent populations with very little gene flow between them. The estimated number of effective migrants-per-generation among these basins is $Nm = 0.009$, which is far fewer than the number thought to be required to homogenize wild populations ($Nm = 1$). Second, specimens from the Mediterranean are also significantly diverged from both of the other observed populations, but exchange migrants at a higher rate with both the Atlantic and Indo-Pacific groups (*Nm* range 0.133 – 0.555 migrants/generation), suggesting that the Mediterranean may have historically been a migratory route for the species from east to west, or vice-versa (Anderson personal communication). Finally, although only a single specimen from the Gulf of Mexico was observed (Alabama), the haplotype for this specimen was identical to haplotypes observed in 6/7 specimens from Brazil. While this finding tentatively suggests genetic linkage between these areas, it should be noted that the COI gene is a highly conserved genetic locus, and is generally inappropriate for diagnosing weak or even moderate levels of population structure (Anderson personal communication). The genetic signal observed here more probably reflects historical

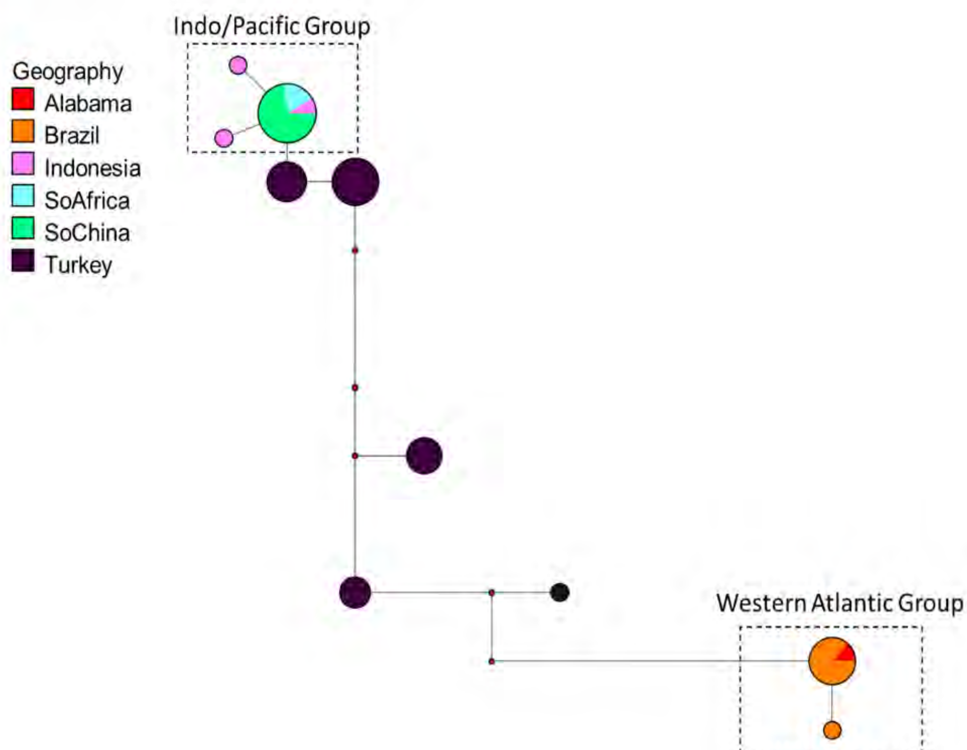


Figure 3.12 Haplotype network of all *Lobotes surinamensis* sequences obtained online from the Fish Barcode Information System. Each colored circle represents a single autonomous mtDNA sequence (haplotype). The size of the circle indicates the number of individuals carrying that haplotype. Color distributions represent the proportion of each haplotype that was found at the specified sampling location (Anderson personal communication).

taxonomic association, rather than contemporary genetic exchange or "stock" structure. Beyond this, data pertaining to population genetics of *Lobotes surinamensis* is lacking and represents a critical data gap in our understanding of the species (Anderson personal communication).

Age and Growth

The study of tripletail age and growth remains in its infancy and, although a variety of structures have been examined, each has unique challenges. Identifying the best method to age tripletail and validating annuli have yet to be achieved. This section provides the information available on age and growth but details related to the techniques used for ageing tripletail can be found in VanderKooy (2009).

Despite an early account by Gudger (1931) of estimating a 15 mm tripletail to be approximately one year old (due to "show[ing] no larval structures,"), there is widespread agreement among biologists that tripletail grow rapidly in their first few years of life (Armstrong et al. 1996, Franks et al. 1998, Franks et al. 2001, Strelcheck et al. 2004, Parr 2011). Studies using otoliths and/or spines (Armstrong et al. 1996, Franks et al. 1998, Strelcheck et al. 2004, Parr 2011) found that tripletail can experience a wide range of growth during their first year, the widest of which is ≈300-600 mm TL (Strelcheck et al. 2004). In addition to rapid growth in length, tripletail can reach weights greater than 4 kg in their first year (Parr 2011) or year and a half (Merriner and Foster 1974). Rapid growth in early life stages is likely an asset to survival for fish that spend their early life stages in the epipelagic zone (Ditty and Shaw 1994) where risk of predation is high.

Although a large variation in size can be found at each age, Franks et al. (1998), Strelcheck et al. (2004), and Parr (2011) found lengths of tripletail aged at one and two years to be significantly different from each other as well as significantly different from all other age classes in the study (ages 3-5). Parr (2011) also found substantial overlap in the lengths of tripletail aged at 3, 4, and 5 (the oldest fish in the sample).

It has been observed in multiple studies that female tripletail are generally slightly larger than their male counterparts (Armstrong et al. 1996, Strelcheck et al. 2004, Parr 2011; Table 3.5). Although Parr (2011) found a significant difference between males and females in terms of both length and weight, he believed the significance was likely due to an absence of large males in the sample. Similarly, the longest male tripletail in Strelcheck et al. (2004) was 80 mm less that the longest female in the study. Despite this apparent difference in length between the sexes, studies generally agreed that while female tripletail typically reach greater lengths than males, the overall difference in length-at-age between male and female tripletail is not significant (Armstrong et al. 1996, Strelcheck et al. 2004).

Based on perceived weight differences between the sexes, many studies began with an assumption of sexual dimorphism. Armstrong et al. (1996) found females to be significantly heavier than males of the same length. Parr (2011) also detected significant differences between sexes in mean TL and TW (Figure 3.13); however, these differences are likely a result of the lack of males captured in the upper size range (> 700 mm). Franks et al. (1998) found total length-total weight relationships for males and females to be significantly correlated and determined that male and female tripletail could be pooled into one sample for that ageing study. In contrast, Cooper (2002) reported females sampled from Cape Canaveral, Florida were slightly heavier than males. However, there is general agreement that the differences were not biologically relevant for management but were likely caused by sampling biases. Therefore, Franks et al. (2001) and Parr (2011) both suggested that the males and females did not need to be treated separately.

To date, the majority of studies published on the growth of tripletail have used tripletail of varying sizes caught and aged for the study; however, Franks et al. (2001) examined the growth of captive early-juvenile tripletail (n=27, 45-115 mm TL, 3.2-34.7 g TW) reared in a sheltered tank, exposed to a natural

Table 3.5 Mean size (mm) at age of tripletail reported in various studies.

			Size at Age Estimates (mm)					
Author(s)	Region	Ageing structure	0	1	2	3	4	5
Armstrong et al. (1996)[1]	Florida	Otolith (females/ males)	400/390	450/425	525/525	600/575	725/600	750/625
Franks et al. (1998)	Northern GOM	First dorsal spine	301 ± 63.69	476 ± 8.91	546 ± 8.23	578 ± 18.45	675 ± 14.61	
Strelcheck et al. (2004)[2]	Northern GOM	First dorsal spine		304-603	407-673	490-719	521-707	
Parr (2011)	Jekyll Island, GA	Otolith		413	556	664	707	781
Parr (2011)	Jekyll Island, GA	First dorsal spine		418	567	640	736	781

[1] Armstrong et al. (1996) only provided graphical representation of their data from which these sizes were estimated
[2] Strelcheck et al. (2004) have wide ranges because they provided partial ages to their fish.

light/dark cycle, and fed to satiation three times per day over a 210 day period (Table 3.6). All specimens were measured and weighed at 1, 60, 135, and 210 days, and growth rates were calculated between these dates. Average TL growth rates decreased from 2.2 mm/day to 1.0 mm/day during the study while average TW growth rates increased from 2.9 g/day to 7.1 g/day. The mean growth rates over the course of the study were 1.4 mm/day and 4.9 g/day for TL and TW, respectively. Both TL and TW were found to be significantly correlated to measurement date. It is unknown if observed changes in the TL and TW growth rates were due to slowing TL growth with age or a seasonal effect associated with the natural light/dark cycle and seasonal changes in water temperature (Franks et al. 2001). During this study, it was noticed that, despite consuming large amounts of food, the captive tripletails seemed to defecate very little, possibly indicating highly efficient digestion and gut-to-energy transfer (Franks personal observation).

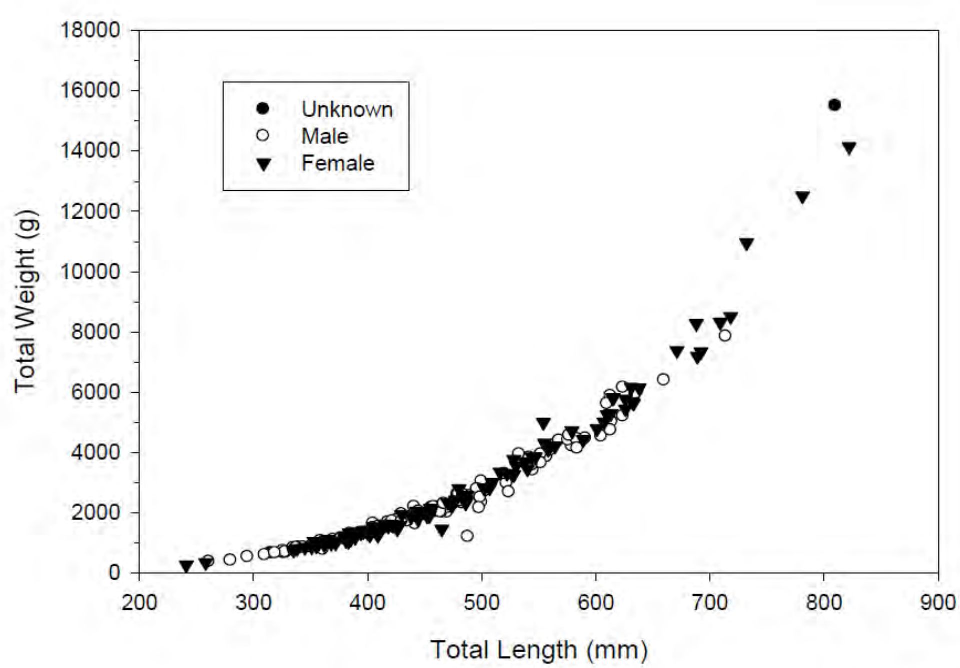


Figure 3.13 Total length (TL) and total weight (TW) regression for tripletail captured (n = 229) from the aggregation near Jekyll Island, Georgia from March to August 2009 and 2010 (*Figure 2-4 from* Parr 2011).

Table 3.6 Total length (TL; mm/day) and total weight (TW; g/day) growth rates reported for captive early-juvenile tripletail (Franks et al. 2001).

Duration	TL Growth Rate (mm/day)	TW Growth Rate (g/day)
1-60 days	2.2	2.9
61-135 days	1.2	4.3
136-210 days	1.0	7.1
1-210 days	1.4	4.9

Life Span

Merriner and Foster (1974) estimated that tripletail could grow to between age-7 and age-10 if one assumed a maximum weight of 45 lbs (20.4 kg), which is only slightly larger than the current IGFA world record (42.3 lbs) and many of the states' records (Table 3.1). Based on tripletail size-age relationships reported by studies, it is likely that the majority of tripletail caught on hook-and-line gear from U.S. waters are between one and three years old (Parr 2011).

Migration

There is a paucity of information regarding migration of tripletail anywhere in the literature. All information is based on ongoing tag-recapture studies in the Gulf of Mexico and the western Central Atlantic. The existing programs and results to-date will be summarized.

Tagging Studies

Tag-recapture studies provide valuable insights into the residence, migration, and overwintering behavior of fishes. In the Gulf of Mexico and southern Atlantic, very little was known about movement of tripletail prior to 2000 when GCRL began tagging fish off Mississippi and Alabama. Since that time, a number of tags have been released throughout the Gulf of Mexico and eastern Florida. In 2001, Georgia added tripletail to their conventional tagging program, and in 2009 began an acoustic telemetry study which extended the tracking of tripletail movements all along the southern Atlantic coast. Understanding the movement of tripletail is critical to the effective management of the species.

GCRL Conventional Tagging

Seasonal movements of tripletail in the Gulf of Mexico and some regions of the southern Atlantic are being investigated through the Tripletail Tag and Release Program (program), managed by GCRL in Ocean Springs, Mississippi. The program began in 1996 and is funded by the USFWS – Sport Fish Restoration Program and the Mississippi Department of Marine Resources (MDMR). The program is an angler-based collaborative effort between GCRL scientists and a corps of volunteer tripletail taggers located in each Gulf state, as well as Georgia, South Carolina, and North Carolina. Each participating angler is provided a tagging kit (at no cost) that contains five dart tags/tag data cards, as well as a tag applicator and instructions on use of the proper tag-release technique. Data card fields are: date of tag-release, length of fish, location of tag-release, condition of fish at tag-release, and angler contact information. Once all tags are deployed by an angler, the data cards are returned to the program manager for entry into a database. If requested, anglers are provided additional tags/tag cards. Anglers are notified of any recaptures of their tagged-released tripletail and anglers who recaptured tagged fish are provided the specific tag-release information associated with their recaptures. As of December 2015, 529 anglers had participated in the program (Tables 3.7 and 3.8).

Table 3.7 Tripletail conventional dart tag-release summary information as of December 2015 from the GCRL tagging program (Franks and Gibson unpublished data). Sizes range from 4.3-40 inches TL; 15.1 inches mean TL.

Tag and Release by State	**Number of Fish**
TX, LA, MS, AL, WFL including FL Keys	3,239
EFL, GA, SC, NC	539
Total	**3,778**
Tag and Release by Area	
Northern Gulf of Mexico	1,812
Southwest Florida	1,351
Florida Keys	76
U.S. Atlantic coast	539
Total	**3,778**

GADNR Conventional Tagging

The Cooperative Angler Tagging project in Georgia began in 1987 for red drum as an in-house research project on the species using conventional dart tags (McDowell 2015). Tripletail was added to the species list in 2001 and, as of May 2016, 1,822 tripletail had been tagged by anglers in Georgia waters (Table 3.9). Tagged tripletail ranged in size from 9.4-36.0 inches TL with an average of 19.4 inches TL. Since 2001, 194 tagged tripletail were recaptured, yielding a recapture rate of 10.6% (Table 3.10). Six fish were double-recaptured in Georgia waters and two fish were double-recaptured in Florida after an initial recapture in Georgia.

The GADNR program experimented with multiple tag types (dart, t-bar, and anchor) and decided that dart tags were the most cost-effective and easy for anglers to administer while minimizing injury to the fish. Tag kits consisting of five dart tags, associated postage paid tag cards, an applicator, and instructions are mailed to the angler. Information on handling the fish is also provided. Anglers who use all of their tags are re-supplied with additional tags (in packs of 5-25) as requested. A unique alphanumeric identifier is assigned to every participant in order to monitor tagging activity and track tag issuance. This information, along with initial tag and recapture data is maintained in a Microsoft© Access database (McDowell 2015).

Table 3.8 Tripletail conventional dart recapture summary information as of December 2015 from the GCRL tagging program (Franks and Gibson unpublished data). Sizes range from 4.3-40 inches TL; 15.1 inches mean TL.

Recaptures by State	**Number of Fish**
TX, LA, MS, AL, WFL including FL Keys	308
EFL, GA, SC, NC	59
Total	**367**
Recaptures by Area	
Northern Gulf of Mexico	175
Southwest Florida	127
Florida Keys	9
U.S. Atlantic coast	56
Total	**367**

Table 3.9 Total number of tripletail dart tagged in Georgia from 2001-2016 (GADNR unpublished data).

Year	Number of Fish Tagged in Georgia
2001	15
2002	41
2003	3
2004	14
2005	23
2006	22
2007	44
2008	186
2009	272
2010	231
2011	175
2012	282
2013	252
2014	174
2015	58
2016	30
Total	**1,822**

Dart tags are applied with an applicator made of a hollow stainless steel tube with a tip cut at a sharp angle, which is mounted inside a wooden dowel. The tag is inserted between the third and fourth ray in the first dorsal fin at a 45 degree angle to allow the barb to anchor between the pterygiophores. Once a fish has been properly tagged and released, anglers are asked to record the date, location, species, length, and name and address on the tag card.

GADNR Acoustic Tagging

Internal acoustic tagging of tripletail in Georgia began in 2009 in an effort to better understand the habitat utilization and seasonal movements of the species. From 2009-2012, a total of 57 fish (390 mm TL to 765 mm TL) were surgically implanted with a coded, acoustic transmitter (Vemco™ V16-4H). The acoustic transmitters had an expected battery life of approximately 858 days and were programmed with a ping rate interval of 30-90 seconds. Transmitters also had printed information including a fish identification number and contact information.

Table 3.10 Total recaptures of Georgia dart tagged fish from 2001-2016 (GADNR unpublished data). **Note**: A total of 194 individual fish were recaptured but eight were double-recaptured, making the total reported recaptures 202.

Recaptures by State	Number of Fish
GA	175
East Coast FL	26
NC	1
Total	**202**

Acoustic monitoring for tagged fish was done using a stationary array of Vemco™ VR2W receivers. Four acoustic monitoring stations were created in the lower portion of the North Channel (Green Island Sound) by directly attaching receivers to day markers distributed within the estuary. From 2009-2012, the receivers were serviced monthly to download data and remove fouling. Since 2012, they have been maintained on a quarterly basis.

From 2009 to 2012 a total of 57 tripletail were tagged in Georgia using Vemco® acoustic transmitters to study habitat utilization and seasonal movements. These acoustic transmitters produce an acoustic pulse with a unique ID for each fish which can be detected by Vemco® VR2W acoustic hydrophones stationed in coastal waters. Because the Vemco® equipment is universal, fish that swim into regions where other researchers are using Vemco® VR2 receivers can be detected and recorded on those receivers. This creates the potential for a vast network of "arrays" which can be used to explain the migratory nature of some fish. As a result, regional consortiums of researchers have formed to collaborate and share detection information on fish and receiver arrays. One such group is the Florida Atlantic Coast Telemetry network (FACT), a collaborative partnership among researchers representing 24 different organizations conducting acoustic telemetry research. Members of FACT collaborate on projects, share data, and exchange design concepts on a variety of projects including site fidelity studies, habitat preference, and investigations into seasonal migrations of fishes. Collaborators all agree to use similar equipment, locate receivers in

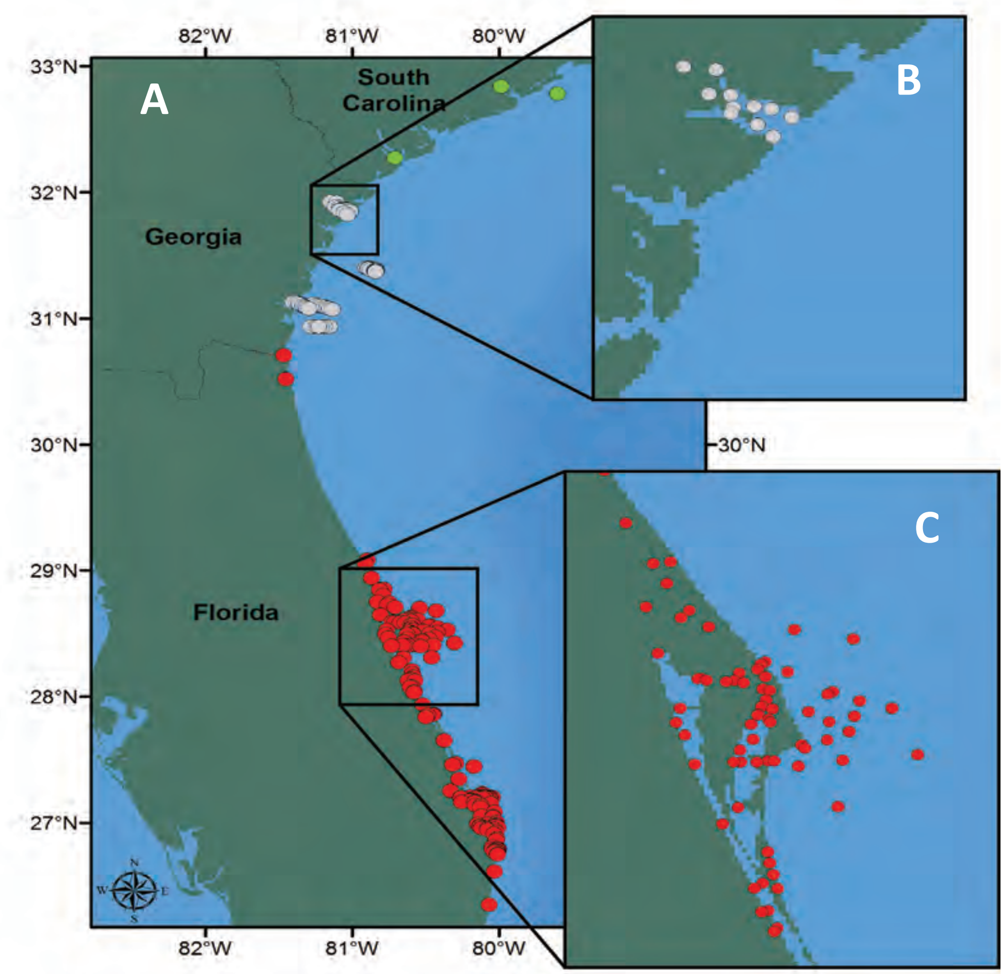


Figure 3.14 Map of the primary locations (A.) of the Florida Atlantic Coast Telemetry network (FACT) receivers in Florida (red dots), Georgia (grey dots), and South Carolina (green dots). Panel B. provides detail of individual receivers in the primary tagging site of Ossabaw Sound, Georgia. Panel C. indicates the large receiver array off the Cape Canaveral region of Florida.

Table 3.11 Days at liberty, release/recapture locations, and growth at liberty for eight tagged tripletail that were recaptured greater than one year following release based on angler data from the GCRL tagging program. **Note:** There were no reported double-recaptures of tagged tripletail (Franks and Gibson unpublished data).

Days at Liberty	Location	Distance (miles)	Length at Release[1] (inches TL)	Length at Recapture [1] (inches TL)	Total Change (inches)
1,004	Ship Island, MS to West Cameron, LA	364	25.0	42.3	+17.3
742	Ft. Myers, FL (Estero Bay) to Ft. Myers, FL (Estero Bay)	0	15.0	25.0	+10.0
732	Panama City, FL to Apalachicola, FL (St. George Sound)	65	16.5	25.5	+9.0
561	Ft. Myers, FL (Estero Bay) to Ft. Myers, FL (Estero Bay)	0	10.5	20.8	+10.3
554	Sarasota, FL (Long Boat Key) to Marco Island, FL	112	10.0	25.5	+15.5
528	Cape Canaveral, FL to Cape Canaveral, FL	0	15.5	25.5	+10.0
414	Mobile Bay, AL to Mobile Bay, AL	0	17.5		
409	Cape Canaveral, FL to Cape Canaveral, FL	0	20.0	20.0	0.0
394	Cape Canaveral, FL to Islamorada, FL	260	37.0	37.5	+0.5
391	Port St. Joe, FL to Panama City, FL	35	14.8	20.5	+5.7
383	Cape Canaveral, FL to Ft. Myers, FL	413	28.0	44.0	+16.0

[1]All lengths are as reported by anglers and could not be independently verified for accuracy.

priority areas, and share data with the proper owners (recognized as the person who deployed the tag). By participating in the consortium, researchers have access to a network of 480 receivers distributed throughout freshwater and marine habitats (both inshore and offshore) ranging from the Dry Tortugas to South Carolina (Figure 3.14A).

Seasonal Movement

Gulf of Mexico – Southern Atlantic Corridor

The seasonal occurrence of tripletail in the northern Gulf of Mexico and Southern Atlantic reflects the migratory nature of the species, and much remains unknown of the migratory behavior and pathways of tripletail throughout its range. Tag-recapture data from the northern Gulf of Mexico indicate spring arrival and summer residency of tripletail, departure in fall (typically late October when water temperature becomes diminished), and winter residency off South Florida since anglers are tagging fish in the Florida Keys (Franks unpublished data). Franks (personal communication) also noted that some of the South Florida fish were recaptured in the same region where they were tagged.

Table 3.12 Average, minimum, and maximum values of days at large and growth on recaptured tripletail from the GADNR Cooperative Angler Tagging Program from 2001-2016 and includes fish tagged as part of the tripletail acoustic telemetry survey and recaptured by recreational anglers from 2009-2014.

	Average	Minimum	Maximum
Change in inches (TL)	2.11	0	12.11
Days at liberty	109	0	1030

Table 3.13 Days at liberty, release/recapture locations, and growth at liberty for 17 tagged tripletail that were recaptured greater than one year following release reported by anglers from the GADNR Cooperative Angler Tagging Program from 2001-2016 and includes fish tagged as part of the tripletail acoustic telemetry survey and recaptured by recreational anglers from 2009-2014.

Days at Liberty	Location	Distance (miles)	Length at Release[1] (inches TL)	Length at Recapture[1] (inches TL)	Total Change (inches)
1030	Ossabaw Sound to Canaveral	250	19.9	26.5	+6.6
814	Ossabaw Sound to Canaveral Channel	250	24.6	28.0	+3.4
800	St Simons sound, GA to Port Canaveral, FL	190	28.0	35.3	+7.3
786	Ossabaw Sound to Canaveral Offshore	265	25.0	NA	NA
619	Altamaha sound, GA to Port Canaveral, FL	198	23.5	29.0	+5.5
595	Ossabaw sound, GA to Port Canaveral, FL	230	28.0	34.9	+6.9
595	Ossabaw Sound to Canaveral Offshore	265	21.1	28.0	+6.9
472	Ossabaw Sound to Canaveral Shipping Channel	250	22.6	24.5	+1.9
436	St Simons sound, GA to Indian River, FL	233	22.5	29.0	+6.5
397	Ossabaw Sound to St Andrews Sound	65	22.5	27.0	+4.5
371	St Simons sound, GA to St Simons sound, GA	0	18.5	24.5	+6.0
369	St Simons sound, GA to St Andrew sound, GA	5	22.0	27.0	+5.0
311	Ossabaw Sound to Palm Bay/Indian River FL (ICW)	310	18.8	24.0	+5.2
276	Ossabaw Sound to Canaveral Offshore	265	22.2	NA	NA
243	Ossabaw Sound to Canaveral Offshore	265	19.1	NA	NA
231	Ossabaw Sound to Titusville FL	350	23.9	NA	NA
163	Ossabaw Sound to Canaveral Offshore	265	28.0	NA	NA

[1]Some lengths were reported by anglers so not all could be independently verified for accuracy.

It is suspected that some tripletail in the region (juveniles and adults) may overwinter beyond the continental shelf. Minimal data are currently available to ascertain the seasonal migratory pathways of tripletail between the Gulf of Mexico and Southern Atlantic. Movements of tagged tripletail between the Gulf of Mexico and the U.S. Southern Atlantic were recorded for only one recapture (Cape Canaveral, Florida to Ft. Myers, Florida; 383 days at liberty; Table 3.11).

Georgia-Florida Corridor

Conventional Tagging

Since 2010, 37 tripletail tagged through the Georgia Cooperative Angler Tagging Project and the Georgia Tripletail Acoustic Survey were recaptured in Florida waters by recreational anglers. These recaptures show that tripletail tagged in Georgia can travel great distances, often as much as 200 to 500 miles. The average change in size from tagging to recapture was 2.11 inches (Table 3.12) with a maximum of 12.11 inches. Average days at liberty for tagged tripletail are 109 days with a maximum of 1,030 days. In addition to these long-term recaptures, there are many instances of fish captured shortly after initial tagging, oftentimes only a short distance from where they were initially captured. There have even been reports of a tripletail being recaptured the same day it was tagged but by a different angler. Most tripletail (85%) were recaptured in the same area they were tagged. Of those fish, most (91%) were recaptured within 100 days of being tagged. The rest were captured from the same location beyond 100 days at large. Two fish were even recaptured in the same area beyond one year at large. All this suggests that tripletail have a high degree of site fidelity and tend to remain in the same area for long periods of time.

About 10% of the overall recaptures were from nearby systems, still within Georgia, and the remaining 13% came from North Carolina and Florida waters (Table 3.13). Six tripletail tagged in Georgia were double-recaptured in Georgia. Two were double-recaptured within a month or so in the same waters they were first tagged (25 and 38 days total). Two additional fish were at liberty nearly a month before their first recapture and 60-80 additional days until their double-recapture. The longest double-recaptured tripletail was first captured six days after tagging and then was not recaptured a second time until 619 days later, traveling from Altamaha Sound, Georgia to Port Canaveral, Florida.

Acoustic Tagging

The majority of the 57 tripletail surgically implanted with acoustic tags in Georgia stayed within the study area throughout most of the summer and fall of the respective tagging season. Counts of monthly 'fish days' were used to examine temporal residence in the study area and within the FACT delineated region (Figure 14B). A 'fish day' is defined as a single count of each fish on each day detected within a month. This measure provides an indication of presence (or residence) within the study area and is independent of total detections which can often be skewed by individual fish behavior or bias from station location or loss. Average monthly fish days (in Georgia) began to increase in March, peaked in August and September, and began to drop in October as water temperatures began to decrease (Figure 3.15). There were very few detections in November, indicating most fish had exited the study area by then. These findings support the results of Streich et al. (2013) who found that fish presence within Ossabaw Sound was strongly correlated with water temperatures.

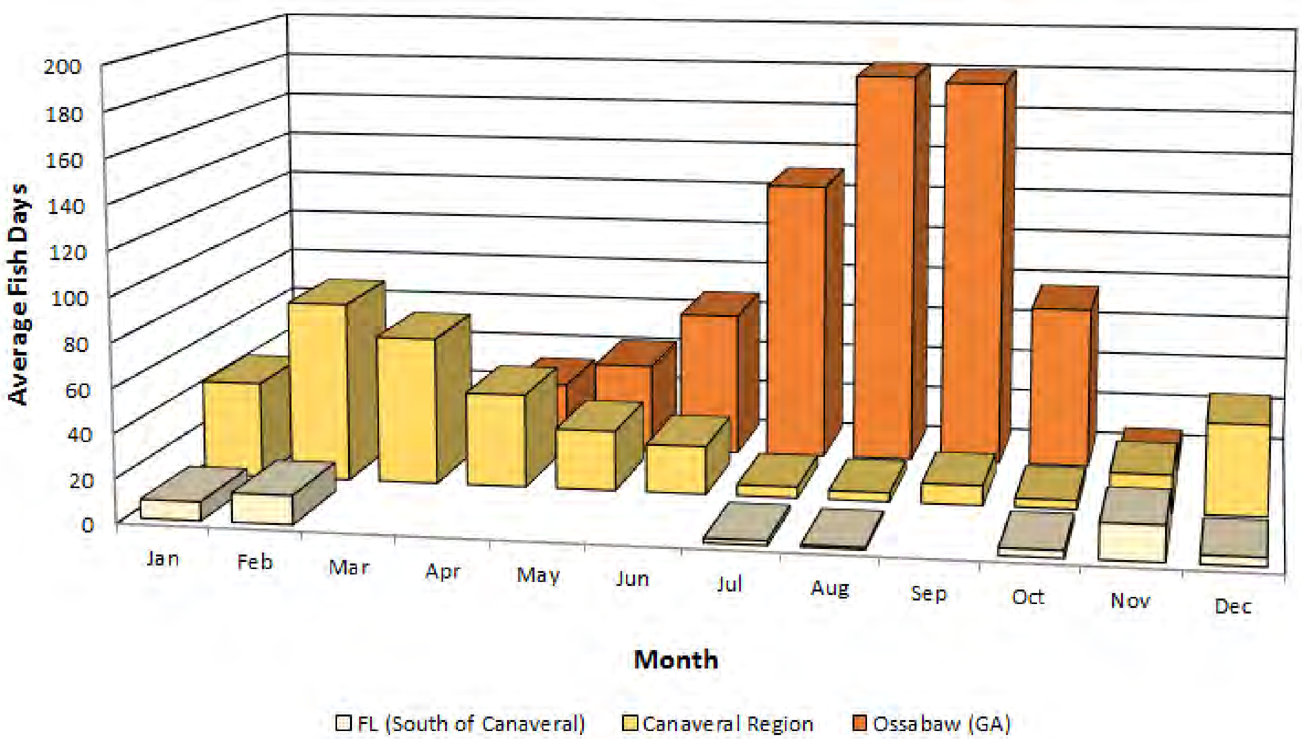


Figure 3.15 Average monthly fish days by region 2009-2012 from the GADNR acoustic tagging study. South Florida region includes waters south of Canaveral to Jupiter Inlet, Florida (GADNR 2015).

Subsequent to their exit from the study area in Georgia, fish were detected during fall and winter months on receivers deployed by other researchers throughout southeastern Florida. Most of these researchers were members of the FACT Network. The majority of fish detected outside of Georgia were detected by receivers stationed in and around the Cape Canaveral area (Figure 3.14C). Given that the majority of detections (96.3%) and fish days (89%) for fish detected outside of Georgia came from Canaveral, it is most likely that this area is an important overwintering habitat for the species in the Southern Atlantic.

In some years, fish moved further south past the Canaveral area temporarily, continuing to the nearshore waters around Jupiter Inlet/Port St. Lucie. Even though a majority of fish made this migration, the number of detections in that region is only a small percentage (2.5%) of all detections. It should be noted that this reduction in detections could be the result of fewer receivers in the area. Likewise, fish days from this region are only a small portion of the total fish days observed when compared to the other regions (Figure 3.16). Fish days for this area were highest in November. After their short migration to South Florida, most fish returned to the Canaveral area where they spent the rest of the winter. Fish days in the Canaveral area were highest in February and March.

There is not a good indicator of what draws tripletail to the Canaveral area to overwinter other than perhaps temperature. The threshold temperature for tripletail appears to be around 20°C and, when local water temps drop in Georgia (Streich et al. 2013), fish begin moving south following the temperature change (Figure 3.17A). Water temperature data provided by the NOAA Data Buoy near the beach at Cape Canaveral (Buoy 41113) indicates that most winters, the water temperatures remain around 20°C in that area (Figure 3.17B; NDBC unpublished data). As temperatures begin to rise in the later winter, fish seem to begin their migration north again.

Some fish returned to Ossabaw Sound and were detected during subsequent years. These returning fish were indicators of the onset of immigration back into Georgia waters. The earliest date that a fish returned to the study area was March; however, abundances were typically low that early in the season. The NDBC water temperature data for the area around Ossabaw Sound is derived from Buoy Station FPKG1 - 8670870 - Fort Pulaski, GA (NDBC unpublished data; Figure 17A).

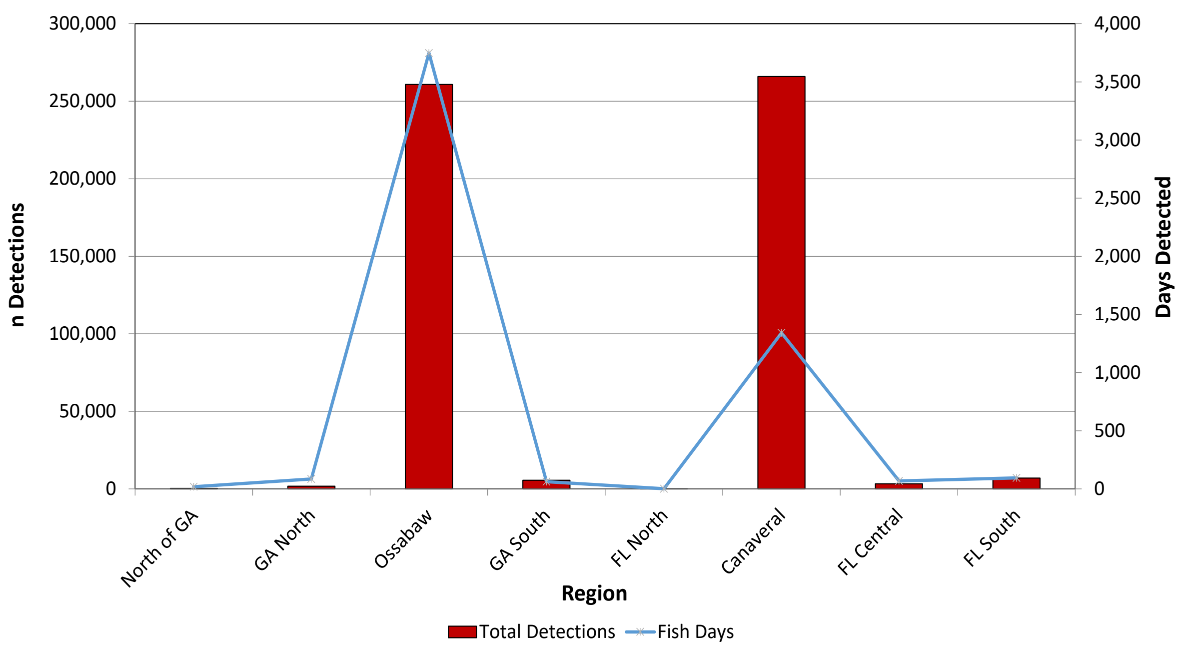


Figure 3.16 Total detections and total number of fish days by region 2009 (GADNR 2015).

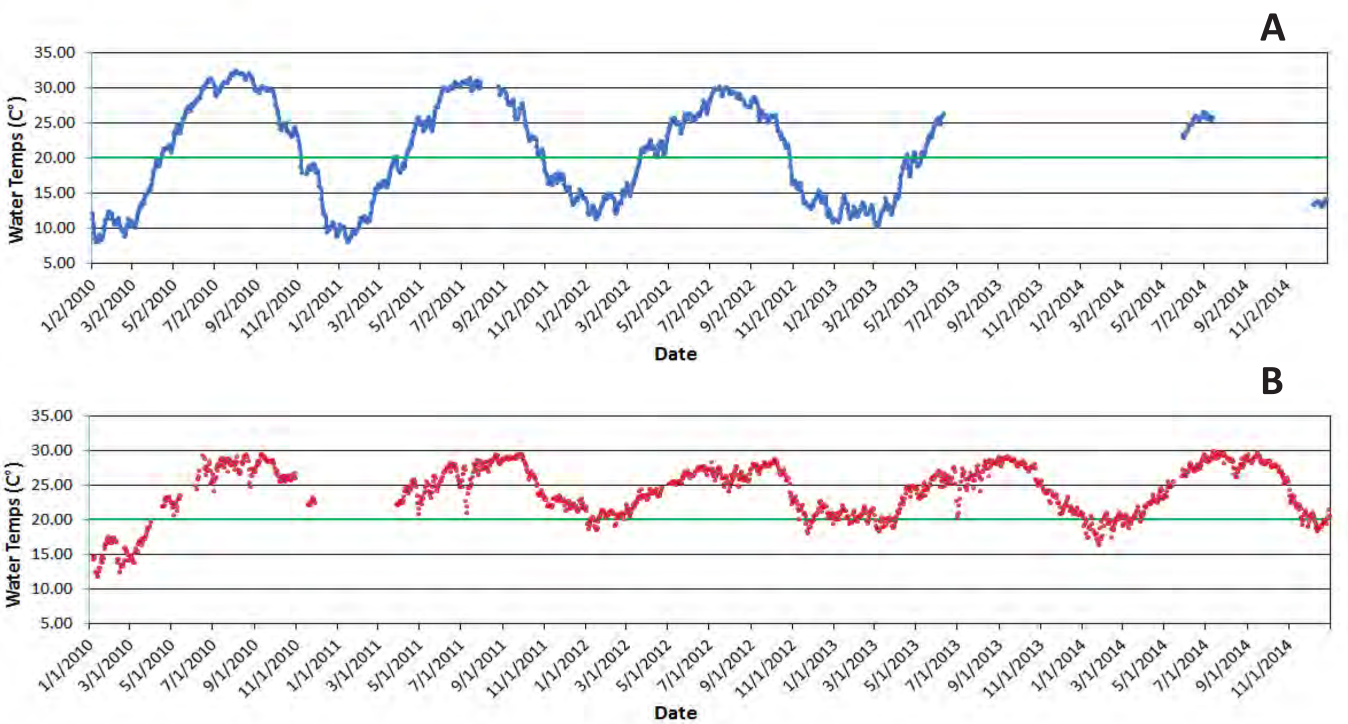


Figure 3.17 Daily water temperatures (°C) at A). NOAA Buoy Station FPKG1 - 8670870 - Fort Pulaski, GA and B). Cape Canaveral, Florida recorded by the NOAA Data Buoy #41113 from January 2010 to December 2014 (NDBC unpublished data). The green horizontal line indicates the 20°C temperature threshold.

Additionally, a small number of fish (n=6) remained at large long enough to return to Ossabaw sound during their third year at large. At least three of these fish were detected multiple times in Florida and Georgia across sampling years. These recurrent returns suggest that Georgia's estuarine environment plays an important role in the life history of the species.

Data from this study showed that tripletail exhibit strong site fidelity through repeated returns to the estuarine habitat of Ossabaw Sound during the months of April through October. This information suggests that similar estuarine systems throughout coastal Georgia could prove equally important as spring/summer habitat for tripletail in Georgia. This high degree of site fidelity raises concerns over the potential for localized overfishing due to the site specific behavior shown by telemetered fish. Eight (14%) of the telemetered fish were captured within the study area during their first year at large. Although this exploitation rate may not seem excessive, when the additional harvest from outside the study area is considered, the exploitation rate increases to 32%. Additionally, this exploitation estimate could be an underestimate because there were no tag return or retention studies conducted (Kalinowsky personal communication).

The use of acoustic tags provides much greater resolution of movement and migration than that of conventional dart tagging studies. Additionally, the current network of FACT researchers extends from North Carolina to south Florida. This collaboration allows for the analysis of long range movement and migration of fish far beyond individual study areas and on a level never seen before in the industry. By analyzing daily detection logs of transmitters, researchers can generate a much greater level of detail beyond that of just days-at-liberty. Individual fish logs can show area site fidelity, habitat utilization, residence, and seasonal movement patterns.

To illustrate the seasonality and strong site fidelity of tripletail, two individual tagged fish are presented in Figure 18A and 18B. The first fish (Tripletail #30677; Figure 18A) was tagged and released on July 11, 2012 in Ossabaw Sound, Georgia; it stayed in the Ossabaw Sound Array (Figure 14B) through the summer of 2012 until October at which point it left the area. It was not detected again until December 2012 on a FACT receiver in the Cape Canaveral Area (Figure 14C). Tripletail #30677 remained in the Cape Canaveral area through March of 2013 at which point it began a movement northward where it was detected again in Ossabaw Sound starting in April and remained through August. The fish was detected briefly on receivers in Murrels Inlet, South Carolina in September and around Charleston, South Carolina in October before making a southern migration, arriving back in the Cape Canaveral/Indian Harbor Beach area in December (Figure 18A). The fish spent another winter in the Canaveral region through April of 2014 and returned north for a third summer in Ossabaw Sound Georgia starting in May. By July, Tripletail #30677 was either harvested or the Vemco® transmitter battery ran out on the acoustic transmitter.

The second example shows the daily detection log for Tripletail #47572. The fish was tagged on July 20, 2010 and it remained within the Ossabaw Sound array through its first summer until October (Figure 18B). The fish left the Ossabaw Sound array and headed south where it was detected in the Cape Canaveral region in November 2010 where it remained in through the winter until April of 2011. The fish was once again picked up on receivers in the Ossabaw Sound array in April. Tripletail #47572 remained within range of the Ossabaw Sound array from May through October then returned south to Cape Canaveral where it was again detected in November 2011 in the FACT array (Figure 14C). The fish overwintered at Canaveral until February 2012 and headed north again where it was re-detected in the Ossabaw Sound array in March. The same summer/winter pattern occurred a final time in the fall of 2012. The last few detections on this fish show it in the Cape Canaveral area, presumably for a third winter in that region at which point it is believed that the Vemco® transmitter battery ran out.

The daily logs for both of these fish show a clear pattern of seasonal residence, migration, and overwintering (Figures 18A and 18B). Tripletail tagged in the study area remained in that vicinity of Ossabaw Sound through the summer months (April – October on average) until water temperatures began to decrease. Both fish departed the Ossabaw Sound area when regional water temperatures typically drop below 20°C. Both fish were subsequently redetected in the Cape Canaveral array within a few weeks after leaving Georgia. They remained in the Cape Canaveral area through the winter where regional water temperatures averaged 16.1-22.30°C from 2010-2014 (the duration of the acoustic tags life). Fish left the Canaveral area in the spring to return to Georgia where they remained through the summer. This clear, repeated migration between Georgia and the Cape Canaveral, Florida region suggest these two areas are significantly important to the life cycle of tripletail in the western Central Atlantic.

Parasites and Diseases

All fish harbor disease organisms, and the potential for outbreak of disease always exists, especially following periods of stress (White and Stickney 1973). While tripletail have not been extensively sampled for parasites, a few specimens have been examined and potential infections could be inferred from their prevalence in other species.

Blaylock et al. (2004) reported the presence of a myxozoan parasite *Kudoa* (*Kudoa hypoepicardialis*), which infects the space between the epicardium and the compact myocardium of several species of Gulf of Mexico fishes. This species of parasite was only found in a small portion of tripletail samples examined, but in a "heavily infected" state when present. Externally, the fish show no signs of infection and the parasite probably does not incapacitate the fish; however, there may be heart lesions associated with *Kudoa* in some infected fish. The *Kudoa* parasite may affect marketability of its host through myoliquefaction, or softening of the flesh, post mortem. There does not seem to be a specific habitat

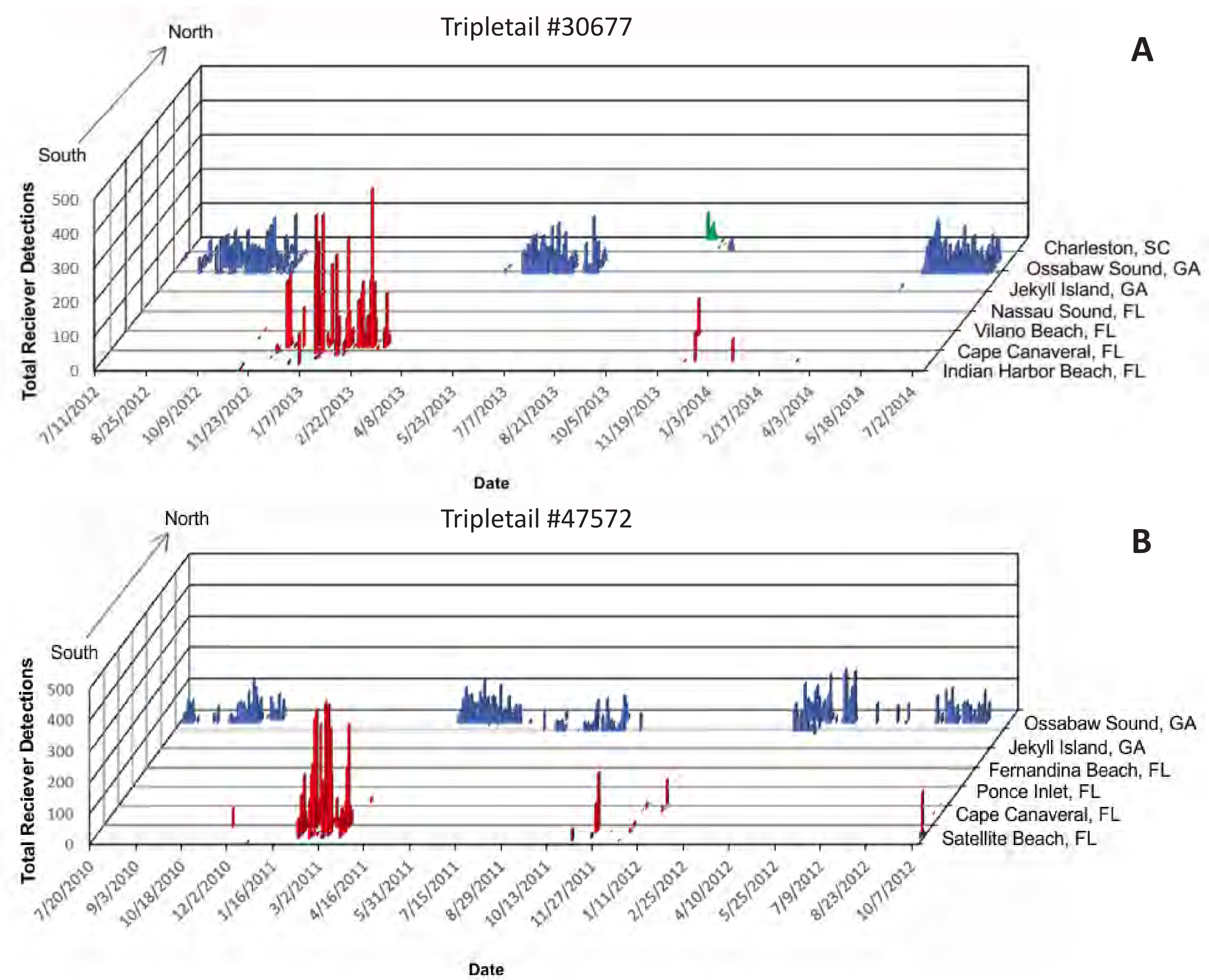


Figure 3.18 Seasonal patterns of two individual tripletail tagged in the GADNR acoustic tagging study. Tripletail #30677 (A.) was tagged and released in July 2012 and at liberty 727 days. Tripletail #47572 (B.) was tagged and released in July of 2010 and was at liberty 816 days. The relative location of each fish is indicated by the bars representing the total number of detections at a receiver on a single day. Florida receivers are represented in red, Georgia receivers are represented in blue, and South Carolina receivers are represented in green.

parameter that determines whether a fish could be infected with *Kudoa*, nor does the parasite seem to be host-specific.

Though observances have not been published, *Amyloodinium ocellatum* has been observed on tripletail (Franks personal communication). *Amyloodinium ocellatum* is one of several dinoflagellate parasite species that infects a wide range of marine fish species. The parasite infects the gill filaments, and an infection in nature is normally not a large parasite burden, though Lawler (1980) discusses the ability of *A. ocellatum* to cause extensive mortality in confinement, which could include an aquaculture setting.

Several intestinal parasites were reported in tripletail by Baughman (1943). These include an acanthocephalid (*Echinochinchus pristis*), a trematode (*Gasterostonium ovatum*), and two nematode species (one species of *Ascaris* and *Ichthonema globiceps*). The *Ichthyonema* infestation was described as very heavy.

An external isopod parasite, *Nerocila lanceolate,* was described on a juvenile tripletail from *Sargassum* offshore of Bermuda, and it represents the first description of this parasite on this host or in this habitat (Williams et al. 1994). *Nerocila lanceolate* is normally found on bottom-dwelling fishes in the nearshore habitat.

In the culture of tripletail, Franks (personal observation) found a high rate of infestation from *Neobenedenia* (Figure 3.19), an external flatworm parasite which is common in public aquariums and aquaculture systems but does exist in the wild. Following this infestation in culture tanks, the condition of the infected tripletail declined and they died in less than one week (Franks personal communication). This flatworm attaches to its host by a pair of suckers at the anterior end and two pairs of anchors at the posterior. While the parasite is not considered infectious to humans, it causes skin erosion, poor feeding, and stunting of growth in the fish (D-PAF website). *Neobenedenia* is becoming more common throughout the Gulf of Mexico and has been found in wild fish from Mississippi waters (Bullard et al. 2003).

Feeding, Prey, and Predators

Tripletail have a number of common names (such as snag-drifter) which are based upon their behavior of floating on the surface near or associated with structures. It has been speculated that tripletail floating on the surface with no structure near them may be creating their own shade and attracting bait (Balboa personal communication). Anglers have noted that tripletail are ambush predators, often 'lying-in-wait' for prey then striking quickly to capture it (Hughes 1937, Baughman 1941, Franks personal observation).

Other than a few studies conducted in recent years on tripletail feeding habits, relatively little research has focused on tripletail feeding ecology. Since there is little research, the types of bait used by anglers to successfully target tripletail may give insight into the types of prey that are generally consumed. It seems

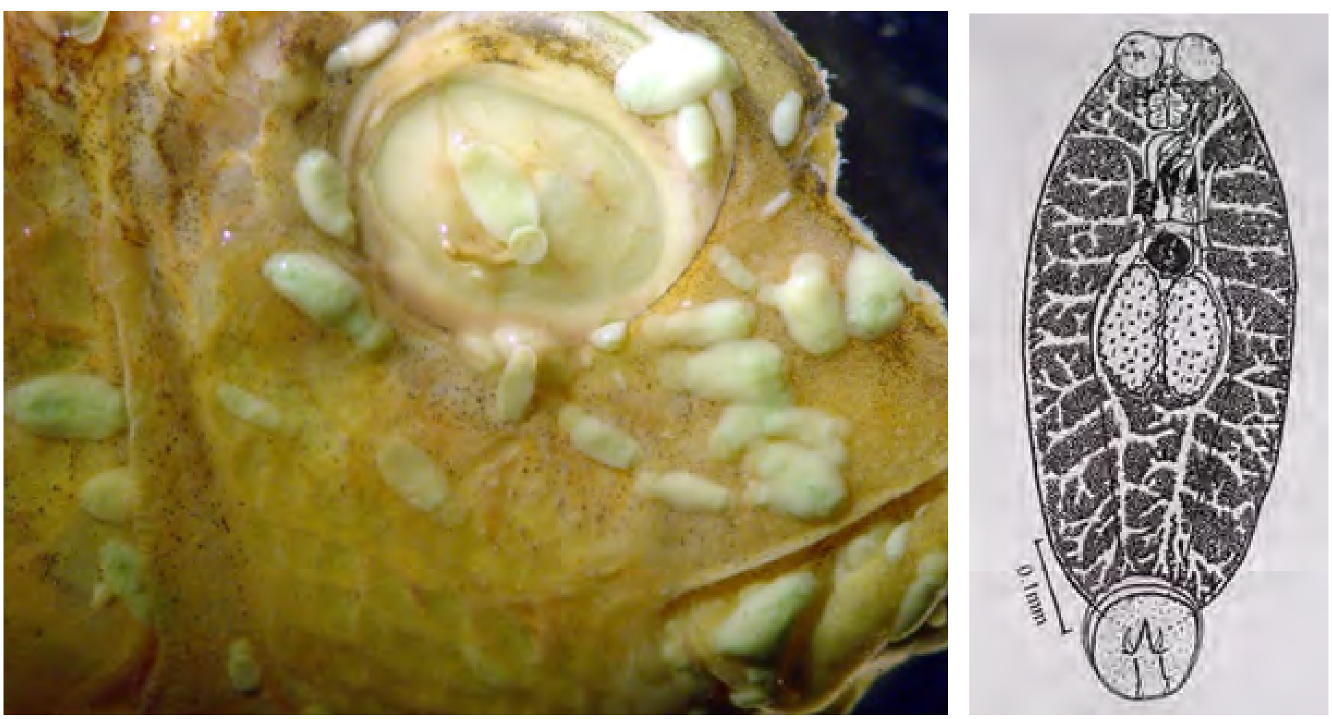


Figure 3.19 *Neobenedenia* infestation of tripletail (*Lobotes surinamensis*) in captivity (left photo by GCRL) and the parasite (right image *from* Hargis 1955).

that anglers in different locations throughout the tripletail's range utilize slightly different bait types to target tripletail; however, it is unclear whether this is based on angler bait preference or tripletail prey preference. Grudger (1931) reported that anglers have been known to use mullet, clams, squid, and shrimp as bait when targeting tripletail, while Baughman (1941) noted that crabs and cut bait were most commonly used along the Texas coast. There are some early accounts of tripletail that include reports on stomach contents and feeding behavior, although the sample sizes were small. The stomach contents in these accounts include fish remains (Grudger 1931, Merriner and Foster 1974), shrimp, crab, and squid (Merriner and Foster 1974). Baughman (1941) noted that tripletail were reported to feed on spawning crabs near Texas beaches during the spring and also on young barnacles.

A 2003 study that examined stomach contents of 136 tripletail from the northern Gulf of Mexico found prey representative of a variety of oceanic zones including open-water, benthic, nektonic, and demersal (Franks et al. 2003). The variety of prey and the zones where the prey are typically found suggest that tripletail are opportunistic predators (Franks et al. 2003, Strelcheck et al. 2004) and are able to utilize different types of foraging behaviors (Franks et al. 2003). Additionally, since most of the identifiable prey found in stomach contents were consumed whole, it is likely that tripletail utilize suction feeding even though they have sharp incisors (Franks et al. 2003). While Franks et al. (2003) found the proportion of fish to crustacean prey to be roughly equal in both number and volume (72.2% crustaceans, 65.4% fish), Strelcheck et al. (2004) found that proportion (weight) to be skewed slightly in favor of fish.

Of the stomachs examined by Franks et al. (2003), shrimp accounted for almost 70% by volume of all crustaceans identified, with brown shrimp (*Farfantepenaeus aztecus*) accounting for half of the shrimp volume. Crabs, primarily small blue crabs (*Callinectes sapidus*), made up 30% by volume of the remaining crustacean prey. Although blue crabs were encountered in 53 of the 136 stomachs they accounted for only 5.6% of the total prey volume. Gulf menhaden (*Brevoortia patronus*) was the most common fish prey species identified by Franks et al. (2003) and accounted for approximately 50% of the total volume of fish (25% of total prey volume). In contrast, Strelcheck et al. (2004) found Gulf menhaden made up a smaller portion of the tripletail diet, accounting for only 12.15% of the stomach contents by weight. Strelcheck et al. (2004) found penaeid shrimps in 60.6%, portunid crabs in 10.1%, and fishes in 66.3% of the stomachs containing prey. Roughly half of the fish prey items found by Strelcheck et al. (2004) were Gulf butterfish (*Peprilus burti*), but they only accounted for approximately 5% of the total prey weight.

Strelcheck et al. (2004) reported that fish account for an increasingly large portion of the diet as tripletail grow; fish were approximately 50% of prey by weight for tripletail ≤500 mm and 63-76% for tripletail >501 mm TL. Also, crabs were less frequent prey items for larger tripletail, only accounting for 0-5% of prey by weight for tripletail >501 mm TL, compared to around 9% for tripletail ≤500 mm TL.

In addition to reporting respective observations on prey items, Franks et al. (2003) and Strelcheck et al. (2004) determined the index of relative importance (IRI) for each prey species/group identified. Franks et al. (2003) found the combined IRI of fish prey to be substantially higher than crustaceans while Strelcheck et al. (2004) found the opposite. It is interesting to note, however, that Franks et al. (2003) found that the prey species with the highest IRI was brown shrimp, which agrees with Strelcheck et al. (2004).

Based on the current literature, there also may be regional differences in types of prey that tripletail target. While diet studies focused in the Gulf of Mexico found crustaceans (by weight or volume) to represent between one third and one half of identifiable prey items, Merriner and Foster (1974) found that clupeids dominated the diet of tripletail (n=13) collected in North Carolina with crustaceans and squid being only minor components. In contrast, crustaceans were the only organisms found in the stomachs of tripletail (n=3) harvested from the Indian Monsoon Gyres province (Ménard et al. 2013). While it is not entirely unexpected that tripletail may have regional differences in diet since their geographic range is so large, the sample sizes in each location are so small that definite conclusions on diet cannot be drawn based on the current literature. Additionally, sizes of the sampled tripletail were not included in many of the studies, so based on the findings of Strelcheck et al. (2004), the apparent variation in prey type could also be due to differences in the size of sampled tripletail.

Predation on Tripletail

To date, there has been no directed research to determine what preys upon tripletail; however, tripletail have been found in the stomachs of other marine organisms. Tripletail was found in the stomach contents of a blue marlin (*Makaira nigricans*) and a dolphinfish (*Coryphaena hippurus*) caught off North Carolina (Rudershausen et al. 2010). In both instances, tripletail accounted for only about 3% of total prey by weight. Butler et al. (2015) found two tripletail in the stomach contents of an Atlantic bluefin tuna (*Thunnus thynnus*) collected in the Gulf of Mexico which accounted for approximately 8% of the total prey weight. Franks (unpublished data) examined the stomach contents of 1,286 yellowfin tuna (*Thunnus albacares*) and found no tripletail, despite the overlapping offshore habitat preferences of both species. Considering the propensity for pelagic species to feed near pelagic *Sargassum* features (mats and/or weedlines) some occurrence of tripletail in their diets would not be surprising, although the scarcity of tripletail in diet studies of pelagic fishes suggests that consumption of tripletail is minimal and probably incidental.

Mariculture

There currently is no published information on successful captive spawning of tripletail but there is a report on work conducted at GCRL by Saillant et al. (2014). Details of these efforts are provided below as a general overview of those spawning trials.

Experiments on the captive spawning of tripletail were conducted by GCRL personnel at GCRL's Thad Cochran Marine Aquaculture Center. Wild-caught juvenile and adult tripletail responded extremely well to captivity up to three years (Franks personnel communication). Captive juveniles and adults fed regularly to satiation and grew rapidly in culture tanks. Broodstock for spawning trials conducted in 2005, 2010, and 2011 included both mature adults and juveniles that had matured in captivity.

In GCRL aquaculture studies, hormone-induced females produced both hydrated and non-hydrated oocytes on more than one occasion during spawning trials. Strip-spawning of females was successful. Additionally, previously strip-spawned females continued to release eggs volitionally into holding tanks both with and without adult males for up to two days post-strip-spawn. However, periodic sampling of volitionally released eggs from tanks with males and females indicated that fertilization had not occurred.

Successful fertilization and hatching of eggs occurred during only a few of the GCRL spawning trials despite the large number of hydrated eggs produced in 2005 and 2010. For example, in the 2005 trial >200,000 hydrated eggs were collected from a large hormone-induced, strip-spawned 10.8 kg specimen. The number of eggs produced was estimated volumetrically, and the fertilization rate was estimated by directly counting developing embryos and unfertilized eggs under a dissecting microscope. Fertilization of eggs from the 2005 spawn (6.5% fertilization rate) was accomplished by manually mixing eggs with viable sperm extracted either from a sacrificed male or from live males. Eggs hatched (10% hatch rate) ~24hrs post-fertilization at ~28.0°C temperature and ~30 ppt salinity. Two hours post-hatch, it was estimated that 20% of the larvae were alive. Post-two-hour old larvae ranged in size from 1.7 – 2.9 mm body length (BL; avg. 1.9 mm), and 20 hours following hatch larvae ranged in size from 2.4 – 2.8 mm BL (avg. 2.7 mm; Figure 3.3A).

In the 2010 spawning trial, the largest hormone-induced, volitional release of eggs from a single female occurred and was estimated at >700,000 (representing a variety of stages) with a 9.8% fertilization rate, but with no hatching. In addition, the only successful tank-spawning, egg fertilization, and hatching resulting in several viable larvae occurred in 2010. Following egg yolk absorption, active feeding by the larvae on live foods (e.g., copepods) was not observed. By 10 days post-hatch, 100% larval mortality occurred. This was the longest duration of larval survival observed for any trial over all years. Although active feeding by these larvae was not observed, periodic sampling of larvae revealed open mouths at three days post-hatch, an indication of near-term exogenous feeding. Since some of the larvae grew in size and developed a compartmented digestive tract, it is presumed that some larvae initiated feeding.

Numerous challenges and bottlenecks were confronted during the GCRL spawning trials; among them were difficulty in determining the sex of captive specimens, unresponsiveness of some females to a suite of hormone applications, and lack of observed first-feeding by larvae. Regardless of these issues, tripletail appear to be a promising aquaculture candidate based, in part, on rapid growth in culture conditions and its highly desirable flesh.

Chapter 4
DESCRIPTION OF THE HABITAT OF THE STOCK(S) COMPRISING THE MANAGEMENT UNIT

Circulation Patterns

Considering the importance of the major currents and circulation patterns which supply the U.S. Gulf of Mexico and southern Atlantic with tripletail and many other pelagic species, a short description is provided here of those processes for the Atlantic Ocean, the Sargasso Sea, the Caribbean Sea, and the Gulf of Mexico proper.

Circulation patterns in the Gulf of Mexico are dominated by the influence of the upper-layer transport system of the western North Atlantic. Driven by the northeast trade winds, the Caribbean Current flows westward from the junction of the Equatorial and Guiana currents (Figure 4.1), crosses the Caribbean Sea, continues into the Gulf of Mexico through the Yucatán Channel, and eventually becomes the Gulf Loop Current. The flow (volume) of water through the Yucatan Straits into the Gulf of Mexico is estimated between 2.38-2.8M m^3/sec (Johns et al. 2002, Sheinbaum et al. 2002).

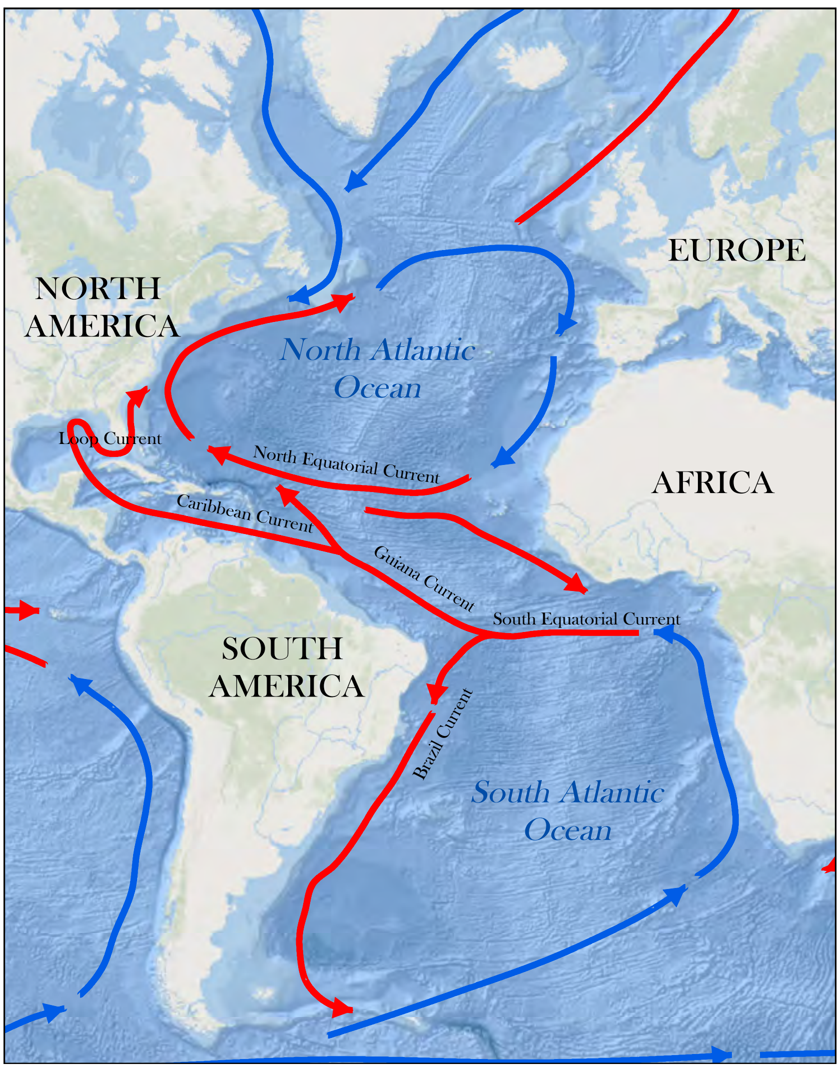


Figure 4.1 The major currents of the North and South Atlantic Oceans.

Equatorial Currents

There are two equatorial currents which contribute to the flow both north and south as they approach Cape São Roque , Brazil. The Atlantic North Equatorial Current makes up the southern component of the North Atlantic subtropical gyre. The northern current becomes the Antilles, Caribbean (via the Guiana), and Florida currents, which eventually become the Gulf Stream (Bischof et al. 2004). The Atlantic South Equatorial Current splits as it approaches the coast of Brazil into the Guiana Current flowing to the north and flowing south as the Brazil Current, eventually becoming the South Atlantic Current (Stramma 1991).

Caribbean Current

The Caribbean Current is fed from the equatorial currents as they join along with the North Brazil and Guiana currents. It enters from the southern Lesser Antilles and tends to meander producing many eddies (Alvera-Azcarate et al. 2009). The Caribbean Current flows generally northwest through the Caribbean Sea and into the Gulf of Mexico via the Yucatan Straits (Centurioni and Niiler 2003).

Loop Current

Moving clockwise, the Loop Current dominates surface circulation in the northeastern Gulf of Mexico and generates eddies that move over the northwestern Gulf of Mexico (Figure 4.2). During late summer and fall, the progressive expansion and intrusion of the Loop Current reaches as far north as the continental shelf off the Mississippi River Delta. The Loop Current directly affects species dispersal throughout the Gulf of Mexico (including tropical species from the Caribbean) while discharge from the Mississippi/Atchafalaya Rivers creates areas of high productivity that are used by many commercially and recreationally important marine species.

Figure 4.2 Generalized circulation pattern of the Loop Current in the Gulf of Mexico. Also included are some geologic features of the Gulf of Mexico, including shallower continental shelf regions and geologic breaks such as the DeSoto Canyon off the Florida Panhandle and Mississippi Canyon off the Mississippi River Delta.

Gulf of Mexico

Galtsoff (1954) summarized the geology, marine meteorology, oceanography, and biotic community structure of the Gulf of Mexico. Later summaries include those of Jones et al. (1973), Beckert and Brashier (1981), Holt et al. (1982), and the Gulf of Mexico Fishery Management Council (GMFMC 1998). In general, the Gulf of Mexico is a semi-enclosed basin connected to the Atlantic Ocean and Caribbean Sea by the Straits of Florida and the Yucatan Channel, respectively. The Gulf of Mexico has a surface area of approximately 1,510,000 km^2 (Wiseman and Sturges 1999), a coastline measuring 2,609 km, one of the most extensive barrier island systems in the United States, and is the outlet for 33 rivers and 207 estuaries (Buff and Turner 1987). Water depths of the Gulf of Mexico basin are 1,615 m on average but have maximum depths approaching 4,400 m (Turner 1999). Continental shelf areas are generally less than 200 m deep and the intertidal regions are less than 20 m on average (Turner 1999). Oceanographic conditions throughout the Gulf of Mexico are influenced by the Loop Current and major episodic freshwater discharge events from the Mississippi/Atchafalaya Rivers, resulting in high productivity which benefits numerous finfish and invertebrate species that use the northern Gulf of Mexico as a nursery ground. Nearshore currents are driven by the impingement of regional Gulf of Mexico currents across the shelf, passage of tides, and local and regional wind systems. The orientation of the shoreline and bottom topography may also place constraints on speed and direction of shelf currents. Hydrographic studies depicting general circulation patterns of the Gulf of Mexico include those of Parr (1935), Drummond and Austin (1958), Cochrane (1965), Jones et al. (1973), and Ochoa et al. (2001).

The Gulf of Mexico's coastal wetlands and estuaries provide habitat for an estimated 95% of the finfish and shellfish species landed commercially in the Gulf of Mexico and 85% of the recreational catch of finfish (Thayer and Ustach 1981). Commercial fishing accounted for an estimated 1.76B lbs of harvested fish and shellfish in 2011, or 17.8% of the nation's total commercial landings (NMFS 2012). These landings were worth an estimated $817M in dockside value (NMFS 2012). Gulf of Mexico coastal wetlands, estuaries, and barrier islands also provide important feeding, breeding, and cover habitat to wildlife species such as waterfowl, shorebirds, and wading birds; improve water quality; and play a significant role in lessening flood and storm surge damage in addition to minimizing erosion.

Gulf of Mexico tides are smaller than those along the Atlantic or Pacific coasts. Tides range from 0.5-1.0 m and are driven mostly by atmospheric pressure and wind direction (Solis and Powell 1999). Despite the small tidal range, tidal current velocities are occasionally high, especially near the constricted outlets that are associated with many bays and lagoons. Tide type varies widely throughout the Gulf of Mexico with diurnal tides (one high tide and one low tide each lunar day of 24.8 hours) existing from St. Andrew's Bay, Florida, to western Louisiana. The tide is semidiurnal from Apalachicola Bay, Florida through Florida Bay and mixed in western Louisiana and Texas.

Estuaries

The U.S. Gulf of Mexico coastline contains 31 major estuarine systems extending from the Rio Grande River in Texas eastward to Florida Bay off southern Florida. Estuaries typically include wetlands and open bay waters in which nutrients from river inflows, adjacent runoff, and the sea support a productive community of plants and animals. Estuarine tidal mixing is limited by the small tidal ranges that occur within the Gulf of Mexico, but shallow estuarine depths tend to amplify the mixing effect. Estuaries in Florida and south Texas generally are clearer and have lower nutrient concentrations than those in other parts of the Gulf of Mexico.

A detailed description of the estuaries in each Gulf of Mexico state can be found in the Blue Crab Fisheries Management Plan (Perry and VanderKooy 2015). Additional information on the Gulf of Mexico in general can be found in the GSMFC's Habitat Profile for the Gulf of Mexico (Rester in prep).

U.S. Southern Atlantic

Much of the U.S. southern Atlantic coastline where tripletail frequent is made up of a number of barrier islands from Palm Beach, Florida in the south to Tybee Island, Georgia in the north. The chain of islands develops multiple high energy beaches along the seaward coasts, brackish water estuaries or lagoons along the inside, and estuarine marshes along the mainland coasts. Florida's northern and central nearshore environments contain hardbottom derived from coquina and worm reefs and between the hardbottoms are long stretches of sand bottom with periodic corals interspersed (Watson 2005). Beginning near the St. Lucie Inlet, natural corals comprise the Florida Reef Tract, which runs south throughout the Florida Keys and Dry Tortugas (Walker and Gilliam 2013). Floating *Sargassum* is a common pelagic habitat along the southern Atlantic Coast (Coston-Clements et al. 1991).

Throughout Georgia and the northern coast of Florida, the natural estuarine coasts are dominated by large expanses of tidal marshes of emergent plant species such as smooth cordgrass (*Spartina alterniflora*) and black needlerush (*Juncus roemerianus*; Watson 2005, Wiegert and Freeman 1990). These low marshes tend to have exposed mudflats on low tides and are driven by periodic inundation. Below the freeze line near St. Augustine, Florida, a shift occurs towards a shoreline surrounded by mangrove forest, and in areas with deeper waterbottoms, a variety of seagrasses (Wiegert and Freeman 1990, Yarbro and Carlson 2011). Mangrove communities in the Indian River Lagoon and Mosquito Lagoons include three species: red (*Rhizophora mangle*), black (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*). The most common is the red mangrove which forms large clumps which extend far into the waters of tidal rivers and channels. It is recognized by its tangled prop roots, which form high above the water's surface and grow down into substrate forming legs. Mangroves stabilize the shoreline and help prevent storm surge and erosion damage to coastal property as well as help maintain water quality and clarity by trapping sediments and absorbing nutrients from runoff. Although mangrove forests have been protected for several decades or longer, many estuaries in Florida have been highly degraded from decades of altered water flow and, as a result, are impaired by poor water quality such as high nutrient loads, poor light penetration for seagrass growth, and high suspended solids leading to an accumulation of muck (Ogden et al. 2005, Sime 2005). There are currently large restoration efforts to restore south Florida's estuaries by restoring more natural freshwater flows (Ogden et al. 2005).

North Brazil Shelf

The South American coastline of the Caribbean Sea is tropical rainforest marked by a number of river mouths forming bays and estuaries with expansive sand beaches and mangrove forests. The coastal currents along the North Brazil Shelf are primarily driven by the Guiana Current (Figure 4.1) which flows parallel to Brazil's coast and is an extension of the South Equatorial Current coming from the east and eventually joins the Caribbean Current to the west. The principle sources of freshwater are from the Amazon and the Orinoco Rivers which flush the inland areas during the June-October rainy season (Alcalá and Sánchez-Duarte 2011). Additional smaller rivers such as the Tocantins, Maroni, Corentyne, Essequibo, and Parnaíba in Brazil, and the Demerara and Berbice rivers in Guyana also contribute to the brackish estuaries.

The Amazon River is the largest contributor to the brackish system along the North Brazil Shelf, with an annual average discharge of 180,000 m^3/s. The Amazon Basin watershed includes a total drainage area of around 6.9M km^2. Phillips (2007) reported that

> "[The Amazon] River outflow is deflected towards the northwest and influences the coastal environment in an area situated west of each estuary. It has been estimated that 40-50% of the annual Amazon run-off transits along the Guyana coast. In fact, Amazon waters can be detected as far away as the island of Barbados. As a result, most of the coastal area of the Guianas-Brazil region has been described as an 'attenuated delta of the Amazon'."

The Orinoco River has its headwaters in Colombia but emerges into the Caribbean Sea along the eastern Venezuelan coast at the Gulf of Paria. The drainage basin is referred to as the Orinoquia and covers 880,000 km2 (López et al. 2013). During high flow periods, discharge from the Orinoco can reach 70,000 m^3/s.

Red, black, and white mangroves dominate most of the coastal regions along the North Brazil Shelf which play a critical role as both refuge and nursery for juvenile fishes, crabs, shrimps, and mollusks that, in turn, are critical resources for other fishes, sea turtles, birds, and mammals (Schaeffer-Novelli et al. 2000). The amount of mangrove forested areas was summarized by Lacerda et al. (1993) based on the published literature. At that time, Brazil estimated 1.01M ha of mangroves along their coastline, Guyana held 150,000 ha, Suriname had around 115,000 ha, French Guiana had just over 5,000 ha, and Venezuela estimated 250,000 ha of mangrove forest (Lacerda et al. 1993). Schaeffer-Novelli et al. (2000) reported that of Brazil's 7,408 km of total coastline, about 6,800 km, or 91%, contained mangrove forest. However, current estimates are difficult to generate as a number of mangrove areas have been drained or cut for agriculture, industry, tourism/resort development, or general urban sprawl (Phillips 2007).

Along the deltas of the major rivers, sediments are deposited over mud flats and sand bars during the rainy season. The recharging of estuarine areas is substantial, even though primary production can become limited due to low light penetration in the highly turbid discharge (Phillips 2007). The settled sediments support a large invertebrate community which includes a number of important commercial shrimp species all along the North Brazil Shelf (FAO 2005). During the dry season (November to May), reduced freshwater flows shift the faunal community from estuarine back to marine, with salt water penetrating upriver as much as 80 km on the Orinoco (Cervigón 1985). During the non-flooding, dry season, the majority of the rivers along the shelf become strongly tidal with fluctuations as much as 1-2 m in amplitude (Cervigón 1985).

Sargassum

The *Sargassum* community is a worldwide circumtropical phenomenon comprising a unique and diverse association of organisms (Dooley 1972) and can be found in both nearshore and offshore waters. Pelagic *Sargassum* is a brown macroalgae complex consisting of two holopelagic species (*Sargassum natans* ≈90% and *S. fluitans* ≈10%) which provide a dynamic structural habitat in the surface waters of the Gulf of Mexico (Hernandez 2011). Pelagic *Sargassum* propogates asexually by vegetative fragmentation (SAFMC 1998) and is characterized by a highly branched stem, leaf-like blades, and numerous grape-like pods (air bladders) keeping it at or near the sea surface, typically in the upper 3-m (Casazza and Ross 2010). Undisturbed plants may reach several meters in length (Coston-Clements et al. 1991). The high complexity of *Sargassum* encourages the formation of dense mats or rafts which tend to remain interlocked until storms or prevailing winds cause them to disassociate and fragment, dispersing the algae widely on the Equatorial, Caribbean, and Yucatan currents (Franks personal communication, Comyns et al. 2002). *Sargassum* constitutes a concentration of productivity in the otherwise nutrient-poor epipelagic. If it sinks, it adds organic carbon to deep bottom sediments and constitutes a major nutrient source for deep-sea benthos (Schoener and Rowe 1970). If it drifts, it provides habitat and food resources that would not otherwise be present to a variety of organisms. If it is blown ashore, it provides a source of organic material to beaches and other coastal habitats.

Associated with this floating macroalgae is a diverse community of epibiota including algae; fungi; at least 100 species of attached, sessile, or motile invertebrates; more than 100 species of fish; and four species of sea turtles (Dooley 1972, Coston-Clements et al. 1991, Calder 1995). Shrimp and crabs comprise the bulk of the invertebrates and serve as the major source of food for *Sargassum* associated fishes. Major groups of invertebrates include hydroids, anthozoans, flatworms, bryozoans, polychaetes, gastropods, nudibranchs, bivalves, cephalopods, pycnogonids, isopods, amphipods, copepods, decapod crustaceans, insects, and tunicates. Nearly 10% of *Sargassum*-associated invertebrates and two species of fish are endemic (Dooley 1972).

Dooley (1972) found 54 species of fish associated with the *Sargassum* complex. The jacks (carangids) were one of the most numerous and diverse fish groups associated with *Sargassum*. Greater amberjack (*Seriola dumerili*), almaco jack (*S. rivoliana*), gray triggerfish (*Balistes capriscus*), and dolphinfish (*Coryphena hippurus*) are major predators in the *Sargassum* complex and rely heavily on the complex for food (Dooley 1972).

Comyns et al. (2002) studied the fish communities associated with *Sargassum* in the northern Gulf of Mexico and collected 135 fish species representing 57 families during 2001-2002. The most numerically abundant fishes were flying fishes (family Exocoetidae; 28%), jacks (family Carangidae; 27%), and triggerfishes (family Balistidae; 12%).

Wells and Rooker (2004) examined the distribution and abundance of fish associated with *Sargassum* mats sampled from areas off of Galveston and Port Aransas in the northwestern Gulf of Mexico. A total of 36 species were identified in the samples. Planehead filefish (*Monacanthus hispidus*), blue runner (*Caranx crysos*), gray triggerfish, chain pipefish (*Syngnathus louisianae*), sergeant major (*Abudefduf saxatilis*), *sargassum*fish (*Histrio histrio*), and greater amberjack composed over 97% of the catch. Wells and Rooker (2004), using a larval purse seine, found that over 95% of the fishes were in their early life stage with 72% of the fish being less than 50 mm (SL). The researchers stated that *Sargassum* was more abundant off Port Aransas than off Galveston. Wells and Rooker (2004) concluded that because of the abundance of juvenile fish collected in association with *Sargassum,* these mats serve as important nursery habitat for pelagic fish.

Sargassum functions as a vehicle for the dispersal of some of its inhabitants and is important in the life histories of many species of pelagic, littoral, and benthic fish by operating as a refuge from predators, a source of prey (such as small shrimp and crabs) for juvenile fishes, a spawning substrate for some fishes, and a habitat providing shade and a visual reference in the open Gulf of Mexico (Dooley 1972). In addition, many of the associated organisms have adapted a high degree of crypsis, using the color and patterning of *Sargassum* as a camouflage (Coston-Clements et al. 1991, Russell and Dierssen 2015). *Sargassum* serves as spawning habitat for the sargassumfish and likely provides spawning habitat for multiple other fishes, as yet undocumented.

Dooley (1972) felt that the *Sargassum* found in the Gulf of Mexico was carried from the North Atlantic via the North Atlantic Gyre through the Straits of Florida on the Florida Current into the Gulf of Mexico (Figures 4.1 and 4.2). Gower and King (2011) proposed that *Sargassum* originates in the Gulf of Mexico and is carried into the southern Atlantic each year via the Florida Current in July and August each year. Gower and King (2011), using satellite data for the years 2003-2007, hypothesized that the Gulf of Mexico is the dominant source of *Sargassum*. Gower and King (2011) stated that *Sargassum* is first detected in a small area of the northwest Gulf of Mexico in March, and expands and spreads eastward. In July, *Sargassum* is present in both the Gulf of Mexico and the Atlantic off Cape Hatteras, and by September is spread eastward to about 45°W by the Gulf Stream. The northeast trade winds then move the *Sargassum* south and west over autumn and winter (October to February). The *Sargassum* then dies about a year later in the Atlantic in the area northeast of the Bahamas. Franks et al. (unpublished data) suggest that the North Equatorial Recirculation Region (NERR) is a more recent source for *Sargassum* in the Caribbean and Western Tropical Atlantic.

Tripletail Habitat

Spawning Habitat

Spawning habitats for tripletail have never been identified or described; however, SEAMAP collections of tripletail larvae (n=79) from the Gulf of Mexico indicate that tripletail may spawn offshore near the continental shelf (Ditty and Shaw 1994). Additionally, tripletail larvae have never been reported in inshore collections. However, collections from Georgia and Mississippi indicate that spawning-capable females occur inshore in shallow estuaries from May through September (GADNR and GCRL unpublished data). Despite their strong site fidelity, recently spawned females are rarely captured inshore, suggesting that tripletail may move elsewhere to reproduce, returning to the estuary to forage (Kalinowsky personal communication). Reports of tripletail inhabiting deeper water in association with structure such as wrecks (Hughes 1937) may provide support for the fish using these areas for purposes other than just foraging. Further confounding the identification of a primary spawning habitat for tripletail is the presence of early juveniles (≈10 mm) in both inshore and offshore collections (GADNR and GCRL unpublished data).

Larval Habitat

Larval tripletail have been reported from offshore waters in the northern Gulf of Mexico. Ditty and Shaw (1994) examined specimens from several museum collections and monitoring studies (SEAMAP). Though the collections covered a large swath of the northern Gulf of Mexico, most of the larval tripletail were found offshore of the Mississippi River Delta. Larvae were generally captured between July and September where water temperatures exceeded 28.8˚C and salinities were above 30.3 ppt. Though primarily captured in surface tows, tripletail larvae were only found at stations with a water depth greater than 70 m. Larvae less than 5 mm were only found further offshore in stations over 110 m deep (Ditty and Shaw 1994). No larvae have ever been reported in the literature or in collections from inshore waters of the Gulf of Mexico or Western Central Atlantic.

Juvenile and Adult Habitat

Juvenile and adult tripletail are found worldwide in a variety of offshore, nearshore, and inshore habitats. In the southeastern U.S. and Gulf of Mexico, they are associated with open water in marine, estuarine, and riverine habitats and are frequently found near debris and hard structures.

In offshore waters, juvenile and adult tripletail are often found in the ichthyofaunal communities associated with pelagic *Sargassum*. Dooley (1972) reports capturing small tripletail from *Sargassum* off southeastern Florida from summer through winter. Wells and Rooker (2004) collected tripletail (11.6-463.6 mm TL) from *Sargassum* in the Gulf of Mexico. The *Sargassum* likely provides shade for tripletail, as well as a site for aggregating potential prey for tripletail (Hoffmayer et al. 2005). Tripletail are frequently found with other types of natural and manmade drifting materials in the offshore environment which can provide shade or cover (Ditty and Shaw 1994). The drifting vegetation and flotsam can be small in area, only available to a single fish, or form much larger aggregations that attract numerous tripletail and other species. There are likely tripletail associated with offshore oil and gas structure (rigs, towers, etc.) but there have been no reports in the literature or from interviews with fishermen.

In the nearshore waters (generally state jurisdictional waters), juvenile and adult tripletail are most commonly found in direct association with structure. Early juvenile tripletail (<20mm TL) are frequently found floating on the water surface near piers, pilings, and bulkheaded shorelines (Franks personal observation, Kalinowsy personal observation). Early juveniles have also been reported associating with mangrove leaf litter, debris, and floating grass and weeds (Baughman 1941, Breder 1949, Sazima et al. 2006). As noted in the MIMICRY description in Chapter 3, tripletail have been referred to as 'leaf fish' since they can adjust their shape and coloration, giving them the appearance of a floating leaf (Breder

1949). The close association with these habitats may provide refuge from predators, shade, protection from strong currents, and prey aggregation (Sazima et al. 2006).

Late juveniles (sub-adults) and adult tripletail can be found throughout inshore bays, inlets, and passes, especially during warmer months (April-October). Both late juvenile and adult tripletail have an inclination for floating objects such as vegetation and flotsam but are frequently encountered by anglers on shallow water structures such as channel markers and navigation lights, PVC pipes, and various buoys and floats, such as those used in traps fisheries. Tripletail from the Gulf of Mexico and the southeastern U.S. generally behave similarly; however, there is a region off Jekyll Island, Georgia where late juvenile and adult tripletail have less direct association with fixed structure. In this particular area, tripletail can be found free-swimming in shallow open water (1-3m). It is unclear what draws tripletail to this area as they move from more southern waters to northern Georgia (GADNR unpublished data). Although Harper (personal communication) indicates that this free-swimming behavior can be seen occasionally in Matagorda Bay, Texas (but with fewer fish), this behavior seems relatively unique to the Jekyll Island area.

Tripletail in inshore habitats, bordering on nearly freshwater, have been reported along the Georgia Coast from acoustic tag data (Kalinowsky unpublished data). In addition, there have been several accounts in coastal Central America of tripletail staying in brackish water regions of the upper estuaries and mouths of rivers to forage. Those fish are displaced during the 'rainy season' as tripletail are pushed out of the lower rivers into the estuarine and nearshore habitats. Both juvenile and adult tripletail are commonly seen in association with floating debris that also washes out of the rivers in several other parts of the world (Staley personal communication, Costa Rica; Geijskes 1968, Suriname and Guyana). Use of riverine habitats is reported in other regions as well, including the eastern Pacific (Costa Rica and Panama), in the range of Pacific tripletail (*Lobotes pacificus*; Arguedas-Soto personal communication, White personal communication).

SALINITY

Adult tripletail are euryhaline and have been collected from nearly freshwater to hypersaline waters (Table 3.3). Streich et al. (2013) posit that the tidally drifting nature of tripletail may help them to stay within a narrow range of salinity, thus helping them conserve energy that would otherwise be used for osmoregulation. In Florida's Indian River Lagoon area, tripletail have been observed entering the system when the lagoon is in hypersaline condition, approximately 40 ppt (Ditty and Shaw 1994). In contrast, occurrence of tripletail has been noted in pure freshwater in the St. John's River above the Jacksonville area (Mather 1881).

While tripletail are not regularly encountered during FWC's Fishery Independent Monitoring (FIM) program, they have been found in salinities ranging from 1.3 to 36.4 ppt, supporting other reports that tripletail are euryhaline (FWC unpublished data). Similarly, tripletail are not a commonly captured species in Alabama's Fishery Independent Data (FID) sampling program (gillnets). The majority of the tripletail samples on record came from the Mississippi Sound, a few from Mobile Bay south of Mullet Point, and one specimen from the northwestern shore of Mobile Bay. The salinity at capture ranged from 3.4 ppt (from the northwestern shore) to 24.4 ppt (from the southern bay), with an average salinity of 17.0 ppt. The majority of tripletail captures were recorded mostly in the month of May, and the highest recorded salinity (24.4 ppt) at capture occurred in July (AMRD unpublished data). Tripletail have been captured in TPWD gill nets set in inshore waters at salinities ranging from 2.8 in Galveston Bay to 53.4 ppt in the Upper Laguna Madre with a coastwide average salinity of 23.5 ppt (TPWD unpublished data).

TEMPERATURE

Movement of tripletail may be spurred by temperature changes. Streich et al. (2013) documented tripletail entering the Ossabaw Sound estuary in Georgia when water temperatures exceeded 20°C. The earliest that the fish were documented entering the estuary was in the month of March but the water temperature had already reached 21°C during that portion of the study. Fish typically left the estuary during the month of October while water temperatures were about 24°C and the last tripletail were documented leaving the estuary at a temperature of 21°C.

Of the tripletail sampled through FWC's FIM program, only 2.5% were sampled from waters cooler than 20°C. The warmest water in which tripletail were encountered during FWC's FIM sampling was 32.4°C and the coldest was an approximately 200 mm specimen captured in 15°C water in December (FWC unpublished data). Alabama's FAMP sampling data includes tripletail that were captured at a range of 22-29°C with an average of 27°C (AMRD unpublished data). In a study by De Angelo et al. (2014), tripletail were found at temperatures of 28.04°C in Charlotte Harbor, Florida and in Tampa Bay, Florida at 27.8°C (AMRD unpublished data). TPWD has sampled tripletail in Texas inshore waters at temperatures ranging from 16-34.1°C with an average of 27.7°C (TPWD unpublished data).

DISSOLVED OXYGEN (DO)

State fishery-independent sampling programs have collected tripletail on occasion in a variety of gears. Basic hydrology is recorded at each station, including those sites which reported tripletail. Dissolved oxygen (DO) levels where tripletail were found varied widely.

In FWC's FIM, DO where tripletail were encountered ranged from 3.0-11.6 ppm, with the majority falling in the 5-8 ppm range (FWC unpublished data). In Alabama, tripletail were found at FID sampling stations with a DO range of 5.4-7.7 ppm, with an average of 6.7 ppm (AMRD unpublished data).

DEPTH

Throughout literature and reports on tripletail, the majority note that tripletail have a strong affinity for surface waters (Gudger 1931, Hughes 1937, Baughman 1941, Franks et al. 2003, Strelcheck et al. 2004) despite tripletail occurring over a wide range of depths from less than 1 m inshore to pelagic *Sargassum* occurring over the deepest waters in the Gulf of Mexico. Kalinowsky (personal observation) has found tripletail occupying most of the water column inshore around pilings and other hard structures, not always associated with the surface. Conversely, Hughes (1937) reported that large (32 lb) tripletail were taken offshore of Canaveral, Florida in association with a wreck in 50 feet of water. These may be the only published accounts of deep water catches. Franks (personal communication) has heard anecdotal reports from divers who have spotted tripletail several meters deep around oil structures.

SUBSTRATE

As with depth, substrate may not be as critical to tripletail since they are generally a surface-dwelling fish. However, several studies and collection efforts have documented adult tripletail over mud and sand bottoms. The Ossabaw Estuary (Streich et al. 2013) system contains both mud and sand substrates and is one of the primary tripletail habitats along the Georgia coast. Tripletail have also been collected over seagrasses. De Angelo et al. (2014) collected one tripletail specimen over shallow, muddy seagrass areas in Charlotte Harbor, Florida where grass coverage was estimated at 73%. In the same study, one tripletail specimen was collected in Tampa Bay, Florida over deep, sandy bottom in an area containing a dense seagrass shoal with about 83% seagrass coverage.

Anthropogenic Factors Affecting Localized Abundance

Human activities have the potential to significantly impact tripletail abundance. Examples of activities that may have this effect include habitat alteration, changes to water chemistry, and activities that increase or redirect fishing effort. As interest in the species and the fishery grows, the effects of fishing may become more pronounced. This section will focus on a couple of these threats that could directly impact tripletail abundance or landings in the future.

Fish Aggregating Devices (FADs)/Debris

Fish aggregating devices (FADs) are any manmade structures that attract and aggregate fish species and can have a variety of legal and non-legal constructions. Since tripletail are attracted to materials (organic or non-organic) on or near the surface, they may be susceptible to artificial habitat placed or anchored on or near water's surface. As indicated by the landings, there is likely a minimum number of fishing guides who network offering tripletail-specific fishing trips in the Gulf of Mexico, and tripletail are generally considered an incidental species in charter catches; however, there are reports that tripletail have become a more frequently targeted species in recent years due to diminished (actual or perceived) availability of the primary inshore target species. In recent years, there are (unverified) reports of anglers using illegal FADs to specifically target tripletail along the Panhandle region of Florida (FWC personal communication). Although some reports indicate that guides may be responsible for placing FADs in the water to aid in their businesses, there are also reports that recreational (non-guide) anglers are deploying and using FADs. It has also been reported that FADs are heavily used during the cobia run, and anglers will use those FADs (that others anglers have placed in the water) to target tripletail.

FADs can take on a variety of shapes and sizes and be constructed with varying levels of complexity and, while some FADs are legal, the majority are not. An example of a potentially-legal FAD is a blue crab or pinfish trap where tripletail are attracted to the trap's buoy. Although a FAD of this type is not illegal in principle, it still must conform to all regulations for each type of trap, such as closed season, closed areas, marking requirements, dimensions, and tending requirements.

Another type of legal FAD is a permitted artificial reef. In 1985, NOAA and a number of regional marine agency partners developed a National Artificial Reef Plan (NARP) under the provisions of the National Fishing Enhancement Act of 1984 that defined and managed the materials placed in the ocean for the purpose of enhancing fishing. Many coastal states throughout the U.S. have adopted their own plans based on NARP guidance. In 2007, the NARP was revised and updated to further the development and management of these structures (NARP 2007). Although artificial reefs are legal structures that attract fish, it is unlikely that permitted artificial reefs would be effective at attracting tripletail due to their affinity for the surface. As of today, there are no provisions in any of the state artificial reef plans or the NARP for use of FADs; however, state artificial reef plans may provide guidance for what items may be appropriate for placement in the marine environment when following proper processes (such as obtaining required permits).

Illegal FADs have a wider range of design possibilities than legal FADs. In their simplest form, they can consist of intentionally-placed, floating debris such as wooden pallets; floating barrels; and plastic materials, such as PVC or plastic fencing, lashed together such that they form a floating mat or subsurface structure. Another simple form of a FAD is a cinderblock attached to a typical crab float and used as a stationary FAD. Although simple FADs that utilize buoys are likely used, quantifying the scale of their use and enforcement of them is very difficult since they resemble regular trap gear from the surface (FWC personal communication). Other reports include towels, tarps, sheets of roofing tar-paper, etc. attached to floats of some sort and weighted so that they float at or just below the surface (Figure 4.3). These types of illegal FADs are considered marine debris and, depending on their materials, may be a violation of MARPOL which has strict limitations on the at-sea disposal of trash, specifically plastics [MARPOL V

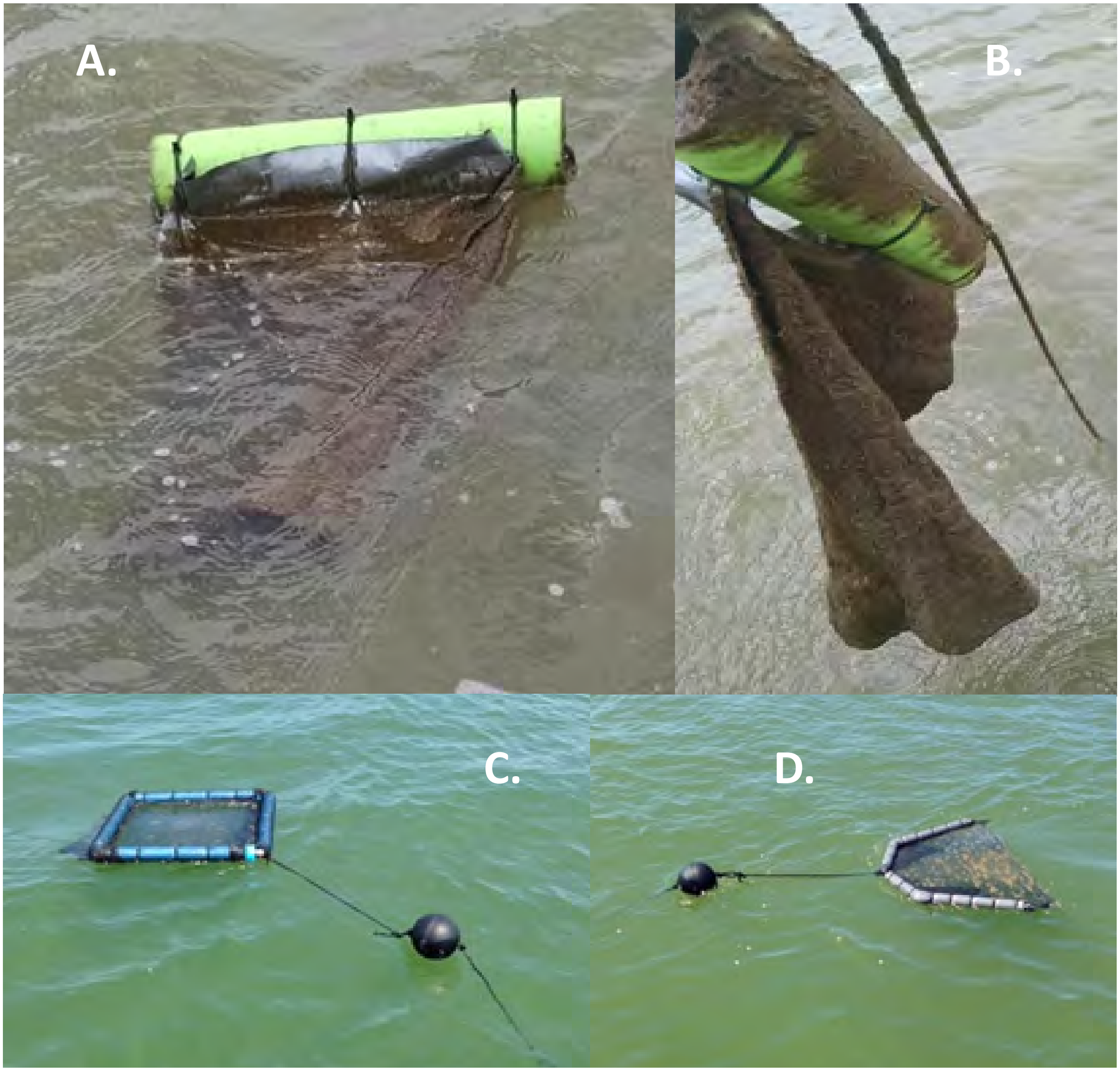


Figure 4.3 Illegal fish aggregating devices (FADs) found deployed off the Florida panhandle. The FAD A) and B) is comprised of a short section of foam 'noodle' with dark bath towel zip-tied to it, all of which was anchored with an unidentified weighted object, creating an artificial floating habitat for sportfishing (photos by Alan Peirce, FWC). FADs C) and D) were anchored and utilized foam 'noodles' with fine plastic mesh attached through the center (photos by Jim Brown).

REVISED MEPC.201(62) 2011]. As noted in Chapter 5, the MARPOL revision includes specific language defining plastics as:

> "a solid material which contains as an essential ingredient one or more high molecular mass polymers and which is formed (shaped) during either manufacture of the polymer or the fabrication into a finished product by heat and/or pressure. Plastics have material properties ranging from hard and brittle to soft and elastic. For the purposes of this annex, 'all plastics' means all garbage

that consists of or includes plastic in any form, including synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products."

This definition would make the majority of free-floating FADs described above illegal and prosecutable by marine enforcement.

Each Gulf state and Georgia's artificial reef plans contain specific descriptions of the materials that are approved and appropriate for the purpose of creating reefs and developing fishing opportunities. The FADs which have been encountered and recovered to-date include a number of materials which would not be appropriate in the approved state plans. Table 4.1 lists materials that states have recovered which were being used as FADs. These materials are not approved for placement in the Gulf of Mexico and some FADs recovered combined multiple of these materials into a single FAD. There are also structures which have been attached to existing reefs and structures, such as permitted vessels and ships to enhance the structures.

In addition to the use of unapproved materials, many of the FADs currently being used are illegal because the anchoring of materials is strictly regulated and managed by the U.S. Army Corp of Engineers (USACOE), the U.S. Coast Guard, and the state marine agencies. Any materials anchored and deployed in the water column must be permitted by the appropriate agencies in legally permitted areas. USACOE requires prior approval of any construction activities that take place in the waters of the US; however, these are typically related to seabottom, not the water column [Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403); Section 404 of the Clean Water Act of 1972 (33 U.S.C. § 1344); Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. § 1413)]. Coast Guard requirements include the placement of structures outside of navigable waterways and any areas, including the subsurface, which would pose a hazard to navigation. This would require the marking and use of aids for navigation of those permitted structures or materials that could impact ocean transit. In addition, it is required that the structure or material remain on station, not moving or being a drifting hazard (Title 33 CFR 74 – July 1999).

The ASMFC and the GSMFC provide recommendations on appropriate materials for artificial reef development through the Guidelines for Marine Artificial Reef Material (Guidelines), published in 1997 and revised in 2004 (GSMFC 2004). Until the Guidelines were published, most artificial reef development was dependent on scrap materials due to their low cost and ready availability. They were often referred to

Table 4.1 Cumulative list of materials encountered in state and federal waters by marine agencies deployed as fish aggregating devices (FADs).

Materials Encountered or Recovered To Date	
Snow Fencing	Construction Bricks and Cinder Blocks
PVC Pipe	Mushroom Anchors
Foam Pool Noodle	Yellow Polypropylene Ropes
Newspaper Pages	Household Carpeting
Cotton Beach Towels	Black Polyethylene Plastic Sheeting
Square Mesh Netting	High Density Polyethylene Drums
Blue Polyethylene Tarpaulin	Closed Pore Styrofoam
Roofing Tar Paper	Polyethylene Plastic Strips (Streamers)
5-Gallon Plastic Bucket	Sheet Plywood
Black Polyethylene Plastic Trash Bags	Sheet Cardboard

as ‘materials of opportunity’. More recent interpretations refer to these materials as ‘secondary use’ and the Guidelines outline those materials that are appropriate to meet the long-term goals of responsible reef building for fisheries enhancement. Therefore, FADs placed anywhere in the ocean environments should follow the reef building procedures laid out in the NARP and utilize materials that allow any FADs to meet the Coast Guard safety requirements and objectives of the NARP.

The current issue with illegal FADs of these types is the use of materials that do not have long-term compatibility in the aquatic environment, unknown and unapproved placement, and that maintenance of these structures is usually absent. In most cases, these are materials that are essentially dumped into the ocean, fished on for a short time, and essentially become lost.

Media Awareness

Although tripletail landings have remained relatively stable over the last decade or so, the popularity of tripletail has seemingly increased. Baughman (1941) suggested that there was neither a market demand nor a public interest in consuming tripletail since so few people had actually harvested them and therefore, “had never had any opportunity to acquire a taste for tripletail.” Gudger (1931), Hughes (1937), and Baughman (1941) all reported that along the coasts of the Atlantic and the Gulf of Mexico, most tripletail were taken on hook-and-line by anglers but not in large numbers.

Following increased restrictions and closures of historically exploited species, including reef fishes and red drum, there has been an increase in the number of online fishing publications mentioning tripletail as an alternative species for recreational anglers. A quick query of saltwater-fishing-related websites shows a steady increase in articles that are specific to, or at least mention, fishing for tripletail in the Gulf of Mexico and the Atlantic (Figure 4.4). Although these data were gathered using an approach that was not statistically valid or standardized, the data illustrate the increasing public interest in this fish and the readily available information on the internet. If the catch of other species becomes further restricted, tripletail may experience increased harvest pressure, potentially reducing their abundance in nearshore waters.

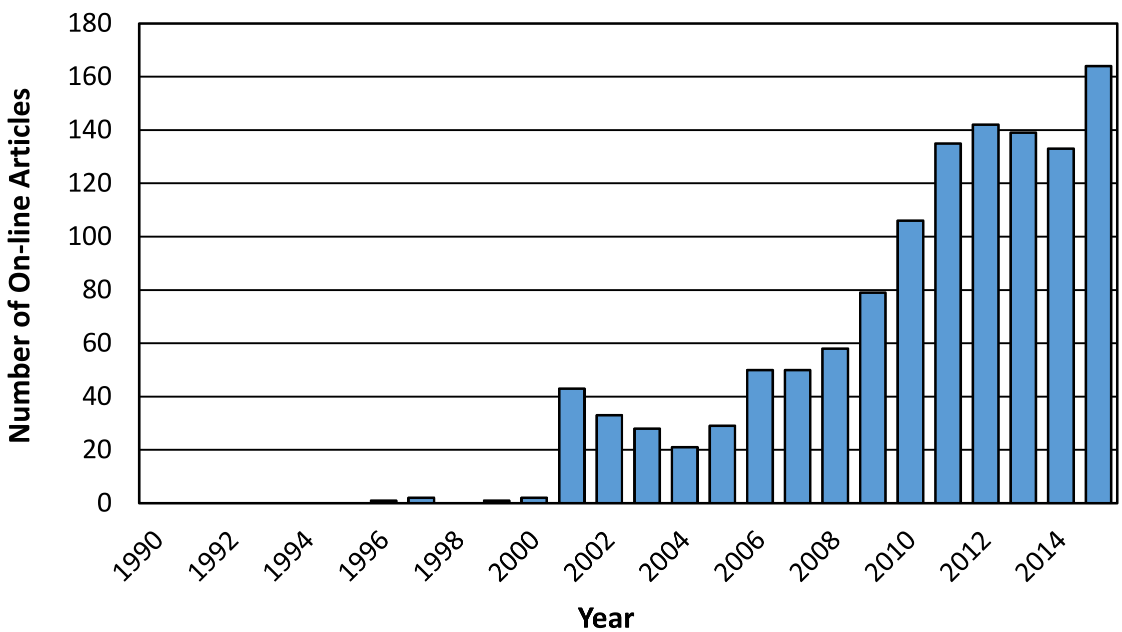


Figure 4.4 The number of online fishing articles that included tripletail in their content from 2001-2015. Sportfishing articles were filtered using the advanced search option in Google© search by year within the archived Google© database (“allintext: tripletail fish angler fishing”) and excluded blogs and bulletin board type sites.

Chapter 5

FISHERY MANAGEMENT JURISDICTIONS, LAWS, AND POLICIES AFFECTING THE STOCK(S)

Tripletail are unique in the Gulf of Mexico in that while they spend the majority of their lives as a migratory, pelagic species, a large portion of the commercial and recreational fisheries occur in nearshore, state territorial waters. Considering their wide-range throughout the world, a number of state and federal management institutions have jurisdiction over this species. The following is a partial list of some of the important agencies and a brief description of the laws and regulations that directly or indirectly affect tripletail throughout the Gulf of Mexico and the U.S. Exclusive Economic Zone (EEZ). Individual Gulf states and federal agencies should be contacted for specific and up-to-date state laws and regulations, which are subject to change on a state-by-state basis. Additional U.S. laws, treaties, and agencies may have jurisdiction over habitat and the environment affecting tripletail and can be found in detail in GSMFC's other fishery management plans.

Federal

Management Institutions

Tripletail are found throughout the EEZ of both the Gulf of Mexico and the South Atlantic up through the Carolinas. However, the close association with *Sargassum* and flotsam somewhat restrict the commercial harvest and create a larger recreational component both offshore and inshore. The regional councils (below) have not developed management plans for tripletail in federal waters so state regulations may be applied to fish landed in each respective state if the state chooses.

National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), U.S. Department Of Commerce (USDOC)

The Secretary of Commerce, acting through the NMFS, has the ultimate authority to approve or disapprove all federal fishery management plans (FMPs) prepared by regional fishery management councils. Where a council fails to develop a plan, or to correct an unacceptable plan, the Secretary may do so. The NMFS also collects data and statistics on fisheries and fishermen. It performs research and conducts management authorized by international treaties. The NMFS has the authority to enforce the Magnuson-Stevens Fishery Conservation and Management Act of 1996 (Mag-Stevens), the Lacey Act, other federal laws protecting marine organisms, including the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA), and is the federal trustee for living and nonliving natural resources in coastal and marine areas.

The USDOC, in conjunction with coastal states, administers the National Estuarine Research Reserve and National Marine Sanctuaries Programs as authorized under Section 315 of the Coastal Management Act of 1972. Those protected areas serve to provide suitable habitat for a multitude of estuarine and marine species and serve as sites for research and educational activities relating to coastal management issues.

The NMFS exercises no management jurisdiction with regard to tripletail in any of the regions in which it occurs. Under Section 306 of the Mag-Stevens, states have the authority to regulate vessels fishing in the EEZ for stocks where there is no federal FMP.

> "(3) A State may regulate a fishing vessel outside the boundaries of the State in the following circumstances:

> (A) The fishing vessel is registered under the law of that State, and (i) there is no fishery management plan or other applicable Federal fishing regulations for the fishery in which the vessel is operating; or (ii) the State's laws and regulations are consistent with the fishery management plan and applicable Federal fishing regulations for the fishery in which the vessel is operating."

Therefore, a state would have the right to require state regulations apply to vessels registered in that state landing any unregulated species caught in the EEZ such as tripletail.

Regional Fishery Management Councils

Eight regional fishery management councils were established by the Magnuson-Stevens Fishery Conservation and Management Act (Mag-Stevens) to advise the NOAA Fisheries Service on federal fishery management issues. The regional councils include the Gulf, Caribbean, South Atlantic, Mid-Atlantic, New England, Pacific, Western Pacific, and North Pacific. These Councils develop fishery management plans and submit recommended regulations to the U.S. Secretary of Commerce based on public comment and scientific data. NOAA and the councils have jurisdiction in the EEZ to manage federal fish species. In the absence of a federal management plan, states are free to extend their own regulations into federal waters; however, not all states have extended their tripletail landing requirements (bag, size, and possession limits) to federal waters. Some states allow fish legally harvested from federal waters that do not meet state regulations to be landed, as long as the harvesters transit through state waters without stopping.

South Atlantic Fishery Management Council

The South Atlantic Fishery Management Council manages fisheries in federal waters (beyond three nautical miles) off the east coast of Florida, Georgia, South Carolina, and North Carolina.

Gulf Of Mexico Fishery Management Council

The Gulf of Mexico Fishery Management Council manages fisheries in federal waters (beyond nine nautical miles) off the west coast of Florida and the coast of Texas and the federal waters (beyond three nautical miles) off the coasts of Alabama, Mississippi, and Louisiana.

Caribbean Fishery Management Council

The Caribbean Fishery Management Council manages fisheries in federal waters (beyond three nautical miles) off the Commonwealth of Puerto Rico and the U.S. Virgin Islands (St. Thomas, St. John, St. Croix, and Water Island).

Treaties and Other International Agreements

There are no treaties or other international agreements that affect the harvesting or processing of tripletail. No foreign fishing applications to harvest tripletail have been submitted to the United States.

Federal Laws, Regulations, and Policies

The following federal laws, regulations, and policies may directly and indirectly influence the quality, abundance, and ultimately the management of tripletail.

Magnuson Fishery Conservation and Management Act of 1976 (MFCMA); Magnuson-Stevens Fishery Conservation and Management Act of 1996 (Mag-Stevens), Also Called The Sustainable Fisheries Act (P.L. 104-297)

The MFCMA mandates the preparation of FMPs for important fishery resources within the EEZ. It sets national standards to be met by such plans. Each plan attempts to define, establish, and maintain the optimum yield for a given fishery. The 1996 Mag-Stevens reauthorization included three additional national standards (eight through ten) to the original seven for fishery conservation and management, included a rewording of standard number five, and added a requirement for the description of essential fish habitat and definitions of overfishing.

1. Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry;
2. Conservation and management measures shall be based on the best scientific information available;
3. To the extent practicable, an individual stock shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or close coordination;
4. Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various U.S. fishermen, such allocations shall be:
   - fair and equitable to all such fishermen;
   - reasonably calculated to promote conservation; and
   - carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.
5. Conservation and management measures shall, where practicable, consider efficiency in the utilization of the resources; except that no such measures shall have economic allocation as its sole purpose.
6. Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fisheries resources, and catches.
7. Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.
8. Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to:
   - provide for the sustained participation of such communities, and
   - to the extent practicable, minimize adverse economic impacts on such communities.
9. Conservation and management measures shall, to the extent practicable,
   - minimize bycatch and
   - to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.
10. Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The 2006 reauthorization builds on the country's progress to implement the 2004 Ocean Action Plan which established a date to end over-fishing in America by 2011, use market-based incentives to replenish America's fish stocks, strengthen enforcement of America's fishing laws, and improve information and decisions about the state of ocean ecosystems.

Interjurisdictional Fisheries Act (IFA) of 1986 (P.L. 99-659, Title III)

The IFA of 1986 established a program to promote and encourage state activities in the support of management plans and to promote and encourage regional management of state fishery resources throughout their range. The enactment of this legislation repealed the Commercial Fisheries Research and Development Act (P.L. 88-309).

Federal Aid in Sport Fish Restoration Act (Sfra); The Wallop-Breaux Amendment of 1984 (P.L. 98-369)

The SFRA, passed in 1950, provides funds to states, the USFWS, and the three interstate marine fisheries commissions to conduct research, planning, and other programs geared at enhancing and restoring marine sportfish populations. The 1984 amendment created the Aquatic Resources Trust Fund which is a 'user pays/user benefits' program. The amendment allows transfer of fishing and boating excise taxes and motorboat gas taxes (user pays) to the improvement of fishing and boating programs (user benefits) and provides equitable distribution of funds between freshwater and saltwater projects in coastal states.

Marpol Annex V and United States Marine Plastic Research and Control Act of 1987 (MPRCA), Revised MEPC.201(62) 2011

MARPOL Annex V is a product of the International Convention for the Prevention of Pollution from Ships, 1973/1978. Regulations under this act prohibit ocean discharge of plastics from ships; restrict discharge of other types of floating ship's garbage (packaging and dunnage) for up to 46 km from any land; restrict discharge of victual and other recomposable waste up to 22 km from land; and require ports and terminals to provide garbage reception facilities. The MPRCA of 1987 and 33 CFR, Part 151, Subpart A, implement MARPOL V in the United States.

The revision includes specific language prohibiting the at sea disposal of 'plastics' as

> "a solid material which contains as an essential ingredient one or more high molecular mass polymers and which is formed (shaped) during either manufacture of the polymer or the fabrication into a finished product by heat and/or pressure. Plastics have material properties ranging from hard and brittle to soft and elastic. For the purposes of this annex, 'all plastics' means all garbage that consists of or includes plastic in any form, including synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products."

State

The following sections outline the specific state information related management of any commercial and recreational fisheries for Atlantic tripletail. Table 5.1 outlines the various state management institutions and authorities in the Gulf of Mexico with jurisdiction over tripletail. Table 5.2 summarizes the current size and bag regulations by state for recreationally and commercially harvested tripletail in state or federal waters.

Florida

Florida Fish and Wildlife Conservation Commission (FWC)

Florida Fish and Wildlife Conservation Commission
620 South Meridian Street
Tallahassee, FL 32399
Telephone: (850) 487-0554
MyFWC.com

The agency charged with the administration, supervision, development, and conservation of natural resources in Florida is the FWC. This commission is not subordinate to any other agency or authority of the state's executive branch. The administrative head of the FWC is the executive director. Within the FWC, the Division of Marine Fisheries Management is empowered to manage marine and anadromous fisheries in the interest of the people of Florida. The Division of Law Enforcement is responsible for enforcement of all marine-resource-related laws, rules, and regulations of the state.

The FWC, a seven-member board appointed by the governor and confirmed by the senate, was created by constitutional amendment in November 1998, effective July 1, 1999. This Commission was delegated authority over all aspects of rulemaking concerning marine life with the exception of requiring fees.

Table 5.1 State management institutions in the Gulf of Mexico and southern Atlantic.

State	Administrative Body and its Responsibilities	Administrative Policy-Making Body and Decision Rule	Legislative Involvement in Management Regulations
Florida	**FWC**		
	-administers management programs -enforcement -conducts research	-creates rules in conjunction with management plans -seven member commission	-responsible for setting penalties and fees, including for licenses
Alabama	**ADCNR**		
	-administers management programs -enforcement -conducts research	-Commissioner of department has authority to establish management regulation -Conservation Advisory Board is a thirteen- member board and advises the commissioner -has authority to amend and promulgate regulations	-authority for detailed management regulations delegated to commissioner -statutes concerned primarily with licensing
Mississippi	**MDMR**	**COMMISSION ON MARINE RESOURCES**	
	-administers management programs -enforcement -conducts research	-five-member board establishes regulations on recommendation of executive director (MDMR)	-authority for detailed management regulations delegated to commission statutes concern licenses, taxes and some specific fisheries laws
Louisiana	**LDWF**	**WILDLIFE AND FISHERIES COMMISSION**	
	-administers management programs -enforcement -conducts research -makes recommendations to legislature	-seven-member board establishes policies and regulations based on majority vote of a quorum (four members constitute a quorum) consistent with statutes	-detailed regulations contained in statutes -authority for detailed management regulations delegated to commission
Texas	**TPWD**	**PARKS AND WILDLIFE COMMISSION**	
	-administers management programs -enforcement -conducts research -makes recommendations to Texas Parks & Wildlife Commission (TPWC)	-nine-member body establishes regulations based on majority vote of quorum (five members constitute a quorum) -granted authority to regulate means and methods for taking, seasons, bag limits, size limits and possession	-licensing requirements and penalties are set by legislation

Table 5.1 State management institutions (Con't).

State	Administrative Body and its Responsibilities	Administrative Policy-Making Body and Decision Rule	Legislative Involvement in Management Regulations
Georgia	**GADNR**	**Board of Natural Resources**	
	-conducts research, administers management, develops activities associated with recreational and commercial fishery resources -administers permitting under the Coastal Marshlands Protection and Shore Protection Acts -GADNR Commissioner may open and close seasonal fisheries or for emergency purposes	-19 member board appointed by the Governor -responsible for setting rules and regulations ranging from air and water quality to hunting seasons, and size and creel limits, gear and methods for fish	-legislature establishes licensing and penalties -legislative statutes control most aspects of commercial shrimping and crabbing -through statute, legislature establishes parameters for board and departmental management of fish and wildlife resources

Florida has habitat protection and permitting programs, and a federally-approved Coastal Zone Management (CZM) program.

Legislative Authorization

Prior to 1983, the Florida Legislature was the primary body that enacted laws regarding management of marine species in state waters. In 1983, the Florida Legislature established the Florida Marine Fisheries Commission (MFC) and provided the MFC with various duties, powers, and authorities to promulgate regulations affecting marine fisheries. Beginning January 1, 1996, Title 46, Chapter 49 contained regulations regarding tripletail. On July 1, 1999, the MFC, parts of the Florida Department of Environmental Protection (DEP) including the Florida Marine Patrol and the Florida Game and Freshwater Fisheries Commission (GFC) were merged into one commission, the FWC. Marine fisheries rules of the FWC are now codified under Division 68B, Florida Administrative Code (FAC).

Reciprocal Agreements and Limited Entry Provisions

RECIPROCAL AGREEMENTS

Florida statutory authority provides for reciprocal agreements related to fishery access and licenses. Florida has no statutory authority to enter into reciprocal management agreements.

LIMITED ENTRY

Florida has no provisions for limited entry in the tripletail fishery with the exception of a Restricted Species Endorsement (RS). In order to receive an RS, an individual must be at least 16 years old and meet the qualification requirements designed to demonstrate that the individual is a professional commercial fisher. The primary means of qualifying is to demonstrate that the applicant has harvested and sold at least $5,000 worth of saltwater products during one of the previous three years or that at least 25% of that person's income for one of the previous three years was attributed to the sale of saltwater products, whichever is less. All RS qualification criteria and exemptions can be found in 68B-2.006, FAC.

Table 5.2 Current tripletail state and federal regulations on tripletail for the Gulf of Mexico, Georgia, and federal waters or the Exclusive Economic Zone (EEZ).

State	Sector	Minimum Length (inches)	Bag/Possession
Florida	Commercial	15 TL	10/vessel/day Permit required (Incidental bycatch 2/vessel/day)
	Recreational	15 TL	2/person/day Specific to certain counties
Alabama	Commercial	18 TL	3/person
	Recreational	18 TL	3/person
Mississippi	Commercial	18 TL	3/person
	Recreational	18 TL	3/person
Louisiana	Commercial	18 TL	100lb trip limit
	Recreational	18 TL	5 fish bag and possession
Texas	Commercial	17 TL	3/person & 6 possession
	Recreational	17 TL	3/person & 6 possession
Georgia	Commercial	18 TL	2/person/day
	Recreational	18 TL	2/person/day
EEZ	Commercial	No limit	No limit
	Recreational	No limit	No limit

Commercial Landings Data Reporting Requirements

Florida requires wholesale dealers to maintain records of each purchase of saltwater products by filling out a Marine Fisheries Trip Ticket (Chapter 379.361 of the Florida Statutes grants rule making authority and Chapter 68E-5.002 of the Administrative Code specifies the requirements). Information to be supplied for each trip includes Saltwater Products License number; vessel identification; wholesale dealer number; date; time fished; area fished; county landed; depth fished; gear fished; number of sets; whether a head boat, guide, or charter boat; number of traps; aquaculture or lease number; species code; species size; amount of catch; unit price; and total dollar value (optional). The wholesale dealer is required to submit trip tickets weekly if the tickets contain quota-managed species such as Spanish mackerel; otherwise, trip tickets must be submitted every month.

Penalties for Violations

Penalties for violations of Florida laws and regulations are established in Florida Statutes, Section 379.407. Additionally, upon the arrest and conviction of any license holder for violation of such laws or regulations, the license holder is required to show just cause why their saltwater license should not be suspended or revoked.

License Requirements

In the state of Florida, a license is required to land tripletail recreationally or commercially along either the Gulf of Mexico or Atlantic coasts. Recreational saltwater fishing licenses are required of residents and non-residents fishing in state territorial waters or the EEZ off the state and current regulations must be adhered to. Check with the FWC for current tripletail regulations. All children under the age of 16, regardless of residency, and resident seniors who are 65 or older are not required to purchase most recreational licenses. Other exemptions exist for active military and individuals with disabilities, check with the FWC for details.

A commercial fishing license (Saltwater Products License; SPL) and additional endorsements are required to harvest commercial quantities and/or to sell tripletail from Florida waters or from the EEZ and landed in Florida. There are also reporting requirements (outlined above). Check with the FWC prior to participating in any commercial harvest of tripletail.

Laws and Regulations

Florida's laws and regulations regarding the harvest of tripletail are statewide. The following discussions are general summaries of laws and regulations, and the FWC should be contacted for more specific information. The restrictions discussed in this section are current through the publication of this profile, and are subject to change at any time thereafter.

Size Limits

A minimum size limit of 15 inches TL for both commercial and recreational harvest.

Quotas and Bag/Possession Limits

No recreational harvester shall harvest in or from state waters more than a total of two tripletail per day, nor possess while in or on state waters more than two such fish. No commercial harvester shall harvest in or from state waters more than a total of 10 tripletail per day, nor possess while in or on state waters more than 10 such fish per vessel, regardless of the number of licensed or license-exempt persons on board. A commercial harvester may not harvest or possess more than two tripletail per day as incidental bycatch of gear that is being used to lawfully harvest another target species.

Gear Restrictions

Tripletail may be harvested with hook-and-line only. Tripletail may be harvested as an incidental bycatch by gears not specifically authorized for the harvest of tripletail (e.g., trawls), provided that the harvester possesses a valid SPL with an RS, the gear is being lawfully used to harvest another target species, and the number of tripletail so harvested and in possession does not exceed two tripletail per day. Spearing tripletail in state waters is prohibited.

Closed Areas and Seasons

There are no closed areas for the harvest of tripletail in Florida with the exception of areas of Everglades National Park, the sanctuary preservation areas within the Florida Keys National Marine Sanctuary, other state and national parks and reserves, and the waters of Warren Bayou (January, February, November, and December only).

Other Restrictions

Tripletail must be landed in a whole condition. The use of any multiple hook (e.g., treble hook) with live or dead natural bait and spearing or snagging (snatch hooking) to catch tripletail is prohibited.

Historical Changes to Regulations in Florida Effecting Tripletail

The following regulatory changes may have notably influenced the landings during a particular year and are summarized here for informative purposes.

1991: Prohibited use of gill or trammel nets with a total length greater than 600 yards. No more than two nets to be possessed aboard a boat and no more than one net to be used from a single boat. Required net to be tended and marked according to certain specification in the waters of Brevard through Palm Beach Counties.

1993: Set a maximum mesh size for seines at two-inches stretched mesh, excluding wings. Set a maximum length of 600 yards for all gill and trammel nets and seines. Allowed only a single net to be fished by any vessel or individual at any time. Prohibited the use of longline gear. Prohibited the harvest of marine fish from any waters of the Warren Bayou (Bay County) from November through February each year. Prohibited the use of gill and trammel nets in any bayou, river, creek, or tributary of waters between Collier and Pinellas counties from November 1 – January 31 each year.

1994: Prohibited the use of gill and trammel nets and seines in state waters of Martin County.

1995: Prohibited the use of any gill or entangling net in Florida waters and prohibited the use of any net with a mesh area greater than 500 ft2.

1996: Established a 15 inch minimum tripletail size limit for all harvesters and a two fish daily recreational harvest and possession limit. Established a 10 fish daily commercial vessel limit. Allowed only hook-and-line gear (with a 2 fish commercial daily vessel bycatch allowance for tripletail otherwise legally harvested in nonconforming gear).

Tripletail designated a "restricted species" and required fish to be landed in a whole condition. Prohibited the use of any multiple hook in conjunction with natural bait, and snagging (snatch hooking) to harvest tripletail in state waters.

1998: Prohibited sale of tripletail harvested in or from state waters that are less than 15 inches.

2013: Tripletail chapter of Florida Administrative Code (68B-49) reorganized and reformatted as part of rule cleanup process.

Alabama

ALABAMA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES (ADCNR); ALABAMA MARINE RESOURCES DIVISION (AMRD)

Alabama Department of Conservation and Natural Resources
Marine Resources Division
P.O. Box 189
Dauphin Island, Alabama 36528
(251) 861-2882
www.outdooralabama.com

Management authority of fishery resources in Alabama is held by the Commissioner of the ADCNR. The Commissioner may promulgate rules or regulations designed for the protection, propagation, and conservation of all seafood. He may prescribe the manner of taking, times when fishing may occur, and designate areas where fish may or may not be caught; however, all regulations are to be directed at the best interest of the seafood industry.

Most regulations are promulgated through the Administrative Procedures Act approved by the Alabama Legislature in 1983; however, bag limits and seasons are not subject to this act. The Administrative Procedures Act outlines a series of events that must precede the enactment of any regulations other than those of an emergency nature. Among this series of events are: (a) the advertisement of the intent of the regulation; (b) a public hearing for the regulation; (c) a 35-day waiting period following the public hearing to address comments from the hearing; and (d) a final review of the regulation by a Joint House and Senate Review Committee.

Alabama also has the Alabama Conservation Advisory Board (ACAB) that is endowed with the responsibility to provide advice on policies and regulations of the ADCNR. The board consists of 10 members appointed by the Governor for alternating terms of six years, and three ex-officio members in the persons of the Governor, the Commissioner of Agriculture and Industries, and the Director of the Alabama Cooperative Extension System. The Commissioner of the Department of Conservation and Natural Resources serves as the ex-officio secretary to the board.

The Marine Resources Division (MRD) has responsibility for enforcing state laws and regulations, for conducting marine biological research, and for serving as the administrative arm of the commissioner with respect to marine resources. The MRD recommends regulations to the Commissioner.

Alabama has a habitat protection and permitting program and a federally-approved CZM program.

Legislative Authorization

Chapters 2 and 12 of Title 9, Code of Alabama, contain statutes that affect marine fisheries.

Reciprocal Agreements and Limited Entry Provisions

Reciprocal Agreements

Alabama statutory authority provides for reciprocal agreements with regard to access and licenses. Alabama has no statutory authority to enter into reciprocal management agreements.

Limited Entry

Alabama law provides that commercial net and seine permits shall only be issued to applicants who purchased such licenses in two of five years from 1989 through 1993 and who show proof (in the form of Alabama state income tax returns) that they derived at least 50% of their gross income from the capture and sale of seafood species in two of the five years; or applicants that purchased such licenses in all five years and who (unless exempt from filing Alabama income tax) filed Alabama income tax returns in all five years. Furthermore, beginning June 1, 2008, resident gillnet licenses were no longer available to anyone other than a current license holder. Each license holder must renew the license annually or the license becomes void. In addition, non-resident gill net licenses were no longer available for purchase therefore eliminating the non-resident fishery. Other restrictions apply, and the ADCNR, MRD should be contacted for details.

Commercial Landings Data Reporting Requirements

Alabama law requires that wholesale seafood dealers file monthly reports by the tenth of each month for the preceding month. Under a cooperative agreement, records of sales of seafood products are now collected jointly by NMFS and ADCNR port agents.

Penalties for Violations

Violations of the provisions of any statute or regulation are considered Class A, Class B, or Class C misdemeanors and are punishable by fines up to $6,000 and up to one year in jail.

License Requirements

In Alabama waters, a license is required to land tripletail commercially or recreationally. Recreational saltwater fishing licenses are required of residents and non-residents fishing in state territorial waters as well as the EEZ and current regulations must be adhered to. Check with the ADCNR, MRD for current tripletail limits and license requirements.

Residents and non-residents under the age of 16 and residents over the age of 65 are exempt from the purchase of a recreational license. Saltwater angler registration is required for residents who are not required to purchase an annual saltwater license such as those 65 or older, have a lifetime saltwater license, or fish exclusively on a pier that has purchased a pier fishing license. Resident and non-resident anglers under the age of 16 do not have to register.

Laws and Regulations

Alabama laws and regulations regarding the harvest of tripletail are very limited. The following is a general summary of these laws and regulations and are current through the publication of this profile. The ADCNR MRD should be contacted for specific and up-to-date information.

Gear Restrictions

Gill nets must be marked every 100 feet with a color-contrasting float and every 300 feet with the fisherman's permit number. Recreational nets may not exceed 300 feet in length and must be marked with the licensee's name and license number. Commercial gill nets, trammel nets, and other entangling nets may not exceed 2,400 feet in length; however, depth may vary by area.

During the period January 1st through October 23rd of each year, gill nets, trammel nets, and other entangling nets used to catch any fish in Alabama coastal waters under the jurisdiction of the MRD must have a minimum mesh size of 1.5-inch bar (knot to knot). A minimum mesh size of two-inch bar is required for such nets used to take mullet during the period October 24 through December 31 of each year for all Alabama coastal waters under the jurisdiction of the MRD as provided in Rule 220-2-42 and defined in Rule 220-3-04(1), and any person using a two-inch or larger bar net during the period October 24 through December 31 of each year shall be considered a roe mullet fisherman and must possess a roe mullet permit. These net-size restrictions do not apply to coastal rivers, bayous, creeks, or streams. In these areas, the minimum mesh size is six-inch stretch mesh.

Commercial and recreational gill net fishermen may use only one net at any time; however, commercial fishermen may possess more than one such net. The use of purse seines to catch tripletail is prohibited. No hook-and-line device may contain more than five hooks when used in Alabama coastal waters under the jurisdiction of the MRD.

Tripletail may also be taken by ordinary hook-and-line, cast net, gig, spear, and bow and arrow.

Closed Areas and Seasons

Gill nets, trammel nets, seines, purse seines, and other entangling nets are prohibited in any marked navigational channel, Theodore Industrial Canal, Little Lagoon Pass, or any man-made canal; within 300 feet of any man-made canal or the mouth of any river, stream, bayou, or creek; and within 300 feet of any pier, marina, dock, boat launching ramp, or certain 'relic' piers. Recreational gill nets may not be used beyond 300 feet of any shoreline, and they may not extend into the water beyond the end of any adjacent pier or block ingress or egress from any of the aforementioned structures.

From October 24 through December 31 of each year, it shall be unlawful to use any set nets (gill nets, trammel nets, or other entangling nets, etc.) in the waters of Bon Secour Bay south of the Gulf Intracoastal Waterway from Oyster Bay west to the last Waterway navigational marker and from that point southwestward to the northwestern tip of the Fort Morgan Peninsula. During this time period, this area shall be open to strike nets but these nets cannot be used within 300 feet of any pier, wharf, dock, or boat launching ramp in this area. 'Strike net' means a gill net, trammel net, or other entangling net, that is set and used from a boat in a circular pattern and is not anchored or secured to the water bottom or shore and which is immediately and actively retrieved. This is to protect the flounder spawning area.

From January 1 through the day after Labor Day of each year, entangling nets are prohibited in certain waters in and around Dauphin Island.

For other seasonal closures, contact ADCNR, AMRD.

Size Limits

Alabama has an 18-inch TL minimum size limit for recreationally and commercially caught tripletail.

Quotas And Bag/Possession Limits

There is a bag/possession limit of three fish/person for the recreational and commercial tripletail fishery.

Other Restrictions

All nets must be constantly attended by the licensee, and no dead fish or other dead seafood may be discarded within 500 feet of any shoreline or into any river, stream, bayou, or creek.

Historical Changes to Regulations in Alabama Effecting Tripletail

The following regulatory changes may have notably influenced the landings during a particular year and are summarized here for informative purposes.

2000: 16-inch TL minimum size limit and three (3) per person commercial/recreational regulation enacted.

2012: 18-inch TL minimum size limit enacted.

Mississippi

Mississippi Department of Marine Resources (MDMR)

Mississippi Department of Marine Resources
1141 Bayview Avenue
Biloxi, Mississippi 39530
(228) 374-5000
www.dmr.ms.gov

The MDMR administers coastal fisheries and habitat protection programs. Authority to promulgate regulations and policies is vested in the Mississippi Commission on Marine Resources (MCMR), the controlling body of the MDMR. The MCMR consists of five members appointed by the Governor. One member is also a member of the Mississippi Commission on Wildlife, Fisheries and Parks (MCWFP) and serves as a liaison between the two agencies. The MCMR has full power to "manage, control, supervise and direct any matters pertaining to all saltwater aquatic life not otherwise delegated to another agency" (Mississippi Code Annotated 49-15-11).

Mississippi has a habitat protection and permitting program and a federally-approved CZM program. The MCMR is charged with administration of the Mississippi Coastal Program (MCP) which requires authorization for all activities that impact coastal wetlands. Furthermore, the state has an established CZM program approved by NOAA. The CZM program reviews activities which would potentially and cumulatively impact coastal wetlands located above tidal areas. The Executive Director of the MDMR is charged with administration of the CZM program.

Legislative Authorization

Title 49, Chapter 15 of the Mississippi Code of 1972, annotated, contains the legislative regulations as related to the harvest of marine species in Mississippi. Chapter 15 also describes the regulatory duties of the MCMR and the MDMR regarding the management of marine fisheries. Title 49, Chapter 27 involves the utilization of wetlands through the Wetlands Protection Act and is also administered by the MDMR.

Title 49, Chapter 15 of the Mississippi Code of 1972 §49-15-2 "Standards for fishery conservation and management; fishery management plans," was implemented by the Mississippi Legislature on July 1, 1997 and sets standards for fishery management as related to Mag-Stevens (1996).

In 1993 the Mississippi Commission on Wildlife, Fisheries and Parks, pursuant to the authority in Miss. Code Ann. §25-43-9 (1972), adopted Public Notice No. 3306 (re-codified as Miss. Admin. Code 40-4:2.5) and established the dividing line between marine and fresh waters. Specifically, Public Notice No. 3306 provides: "Be it ordered that the southern boundary of Interstate 10 extending from the Alabama state line to the Louisiana state line is hereby declared to be the boundary line between salt and fresh waters for the purposes of the game and fish laws of this state. Be it further ordered that on all waters south of I-10 and north of U.S. Highway 90, either a salt or fresh water sportfishing license will be valid for the purpose of recreational fishing." This adopted Public Notice became effective on September 24, 1993.

Reciprocal Agreements and Limited Entry

Reciprocal Agreements

Section §49-15-15 (h) provides statutory authority to the MDMR to enter into or continue any existing interstate and intrastate agreements, in order to protect, propagate, and conserve seafood in the state of Mississippi.

Section §49-15-30 (1) gives the MCMR the statutory authority to regulate nonresident licenses in order to promote reciprocal agreements with other states.

Limited Entry

Section §49-15-16 gives the MCMR authority to develop a limited entry fisheries management program for all resource groups.

Section §49-15-29 (3), when applying for a license of any kind, the MCMR will determine whether the vessel or its owner is in compliance with all applicable federal and/or state regulations. If it is determined that a vessel or its owner is not in compliance with applicable federal and/or state regulations, no license will be issued for a period of one year.

Section §49-15-80, no nonresident will be issued a commercial fishing license for the taking of fish using any type of net, if the nonresidents state of domicile prohibits the sale of the same commercial net license to a Mississippi resident.

Commercial Landings Data Reporting Requirements

Ordinance Number 9.001 of the MDMR establishes data reporting requirements for marine fisheries' operations, including confidentiality of data and penalties for falsifying or refusing to make the information available to the MDMR. Furthermore, Ordinance Number 9 Chapter 6.100 states that each seafood dealer/processor is hereby required to complete Mississippi trip tickets provided by the MDMR. Commercial fishermen, who sell their catch to individuals other than a Mississippi dealer/processor, are hereby required to complete Mississippi trip tickets provided by the MDMR and be in possession of a fresh product permit. Commercial fishermen who transport their catch out-of-state are required to purchase and possess a Dealer/Processor License and are required to comply with all regulations governing Mississippi dealers/processors.

Mississippi implemented a trip ticket program under these guidelines beginning January 1, 2012. Under this rule, fishermen and dealer/processors must submit their completed trip tickets as well as a monthly summary form to the MDMR by the tenth of the following month.

Penalties for Violations

Section §49-15-63 provides penalties for violations of Mississippi laws and regulations regarding tripletail in Mississippi.

License Requirements

A license is required to land tripletail commercially or recreationally from all Mississippi marine waters and the EEZ. Recreational saltwater fishing licenses are required of residents and non-residents fishing in state territorial waters as well as the EEZ and current relations must be adhered to. A saltwater fishing license is required to fish south of Highway 90. Above Highway 90 and below Interstate 10 either a saltwater or freshwater license will suffice. Above Interstate 10 a freshwater license is required. Persons under the age of 16 are exempt. Residents 65 years of age or older can purchase a lifetime license for a one-time fee. Check with the MDMR for all current license requirements.

Laws and Regulations Recreational and Commercial

Mississippi laws which regulate the harvest of tripletail are primarily limited to size and creel as well as geographical locations under Mississippi Title 22 Part 7 Chapters 08 and 09 and apply statewide. They are current to the date of this publication and are subject to change at any time thereafter. The MDMR should be contacted for specific and up-to-date information.

Size Limits

Mississippi has an 18-inch TL minimum size limit for recreationally and commercially caught tripletail.

Quotas and Bag/Possession Limits

There is a bag/possession limit of three fish/person for the recreational and commercial tripletail fishery.

Closed Areas And Seasons

With the exception of those areas where commercial fishing is prohibited, there are no closed areas or seasons related to tripletail in Mississippi waters.

Historical Changes in Regulations In Mississippi Effecting Tripletail

The following regulatory changes may have notably influenced the landings during a particular year and are summarized here for interpretive purposes.

2014: An 18-inch TL minimum size limit and a daily bag and possession limit of three (3) fish per day established for commercially and recreationally harvested tripletail in Mississippi waters.

Louisiana

Louisiana Department Of Wildlife And Fisheries (LDWF)

Louisiana Department of Wildlife and Fisheries
P.O. Box 98000
Baton Rouge, Louisiana 70898-9000
Marine Fisheries: (225) 765-2384
Law Enforcement: (225) 765-2989
www.wlf.louisiana.gov

The Louisiana Department of Wildlife and Fisheries (LDWF) is one of 21 major administrative units of the Louisiana government. The Governor appoints a seven-member board, the Louisiana Wildlife and Fisheries Commission (LWFC). Six of the members serve overlapping terms of six years, and one serves a term concurrent with the Governor. The commission is a policy-making and budgetary-control board with no administrative functions. The legislature has authority to establish management programs and policies; however, the legislature has delegated certain authority and responsibility to the LWFC and the LDWF. The LWFC may set possession limits, quotas, places, seasons, size limits, and daily take limits based on biological and technical data. The Secretary of the LDWF is the executive head and chief administrative officer of the department and is responsible for the administration, control, and operation of the functions, programs, and affairs of the department. The Governor, with consent of the Senate, appoints the Secretary.

Within the administrative system, an Assistant Secretary is in charge of the Office of Fisheries. The Office of Fisheries performs the functions of the state relating to the administration and operation of programs, including research relating to oysters, water bottoms and seafood including, but not limited to, the regulation of oyster, shrimp, and marine fishing industries.

The Enforcement Division, in the Office of the Secretary, is responsible for enforcing all marine fishery statutes and regulations.

Louisiana has habitat protection and permitting programs and a federally-approved CZM program. The Department of Natural Resources is the state agency that monitors compliance of the state Coastal Zone Management Plan and reviews federal regulations for consistency with that plan.

Legislative Authorization

Title 56, Louisiana Revised Statutes (L.R.S.) contains statutes adopted by the Legislature that govern marine fisheries in the state that empower the LWFC to promulgate rules and regulations regarding fish and wildlife resources of the state. Title 36, L.R.S. creates the LDWF and designates the powers and duties of the department. Title 76 of the Louisiana Administrative Code contains the rules and regulations adopted by the LWFC and the LDWF that govern marine fisheries.

Section 320 of Title 56 (L.R.S.) establishes methods of taking freshwater and saltwater fish. Additionally, Sections 325.1 and 326.3 of Title 56 (L.R.S.) give the LWFC the legislative authority to set possession limits, quotas, places, season, size limits, and daily take limits for all freshwater and saltwater finfish based upon biological and technical data.

Reciprocal Agreements and Limited Entry Provisions

Reciprocal Agreements

The LWFC is authorized to enter into reciprocal management agreements with the states of Arkansas, Mississippi, and Texas on matters pertaining to aquatic life in bodies of water that form a common boundary. The LWFC is also authorized to enter into reciprocal licensing agreements.

Louisiana seniors, 65 years of age and older, are not required to purchase a nonresident license to fish in all public waters in Texas. These anglers will be allowed to fish Texas water bodies with a Louisiana Senior fishing license but shall comply with Texas law. Senior anglers are advised that anglers turning 60 before June 1, 2000 are also required to possess a Louisiana Senior fishing license when fishing in Texas, except in border waters. Louisiana residents from 17-64 years of age are still required to purchase a nonresident fishing license when fishing in Texas, except when fishing in border waters.

In all border waters, except the Gulf of Mexico, Texas and Louisiana anglers possessing the necessary resident licenses, or those exempted from resident licenses for their state, are allowed to fish the border waters of Louisiana and Texas without purchasing nonresident licenses. Border waters include Caddo Lake, Toledo Bend Reservoir, the Sabine River, and Sabine Lake.

Louisiana is also allowing Texas senior residents 65 years of age and older to fish throughout Louisiana's public waters if they possess any valid Special Texas Resident licenses for seniors as issued by Texas Parks and Wildlife in any type of water. Even Texas residents born before September 1, 1930 must possess the Texas Special Resident Fishing license when fishing in Louisiana, except in border waters.

Limited Entry

No limited entry exists to commercially take tripletail with legal commercial gear other than with a commercial rod and reel. Louisiana has adopted limited access restriction for the issuance of a commercial rod and reel license. Sections 325.4 and 305B (14) of Title 56 (L.R.S.), as amended in 1995, provide that rod and reel licenses may only be issued to a person who has derived 50% or more of his income from the capture and sale of seafood species in at least two of the years 1993, 1994, and 1995 and has not applied for economic assistance for training under 56:13.1(C). Additionally, any person previously convicted of a Class 3 or greater violation cannot be issued a commercial rod and reel license.

Commercial Landings Data Reporting Requirements

Wholesale/retail seafood dealers who purchase tripletail from fishermen are required to report those purchases by the tenth of the following month on trip tickets supplied by the LDWF for that purpose. Commercial fishermen who sell tripletail directly to consumers must be licensed as a wholesale/retail seafood dealer or Fresh Products Licensee and comply with the same reporting requirements.

Penalties for Violations

Violations of Louisiana laws or regulations concerning the commercial or recreational taking of tripletail by legal commercial gear shall constitute a Class 3 violation which is punishable by a fine from $250 to $500 or imprisonment for not more than 90 days, or both. Second offenses carry fines of not less than $500 or more than $800 and imprisonment of not less than 60 days or more than 90 days and forfeiture to the LWFC of any equipment seized in connection with the violation. Third and subsequent offenses have fines of not less than $750 or more than $1,000 and imprisonment for not less than 90 days or more than 120 days and forfeiture of all equipment involved with the violation. Civil penalties may also be imposed.

In addition to any other penalty, for a second or subsequent violation of the same provision of law, the penalty imposed may include revocation of the permit or license under which the violation occurred for the period for which it was issued, and barring the issuance of another permit or license for that same period.

License Requirements

A license is required to land tripletail commercially or recreationally from all Louisiana marine waters and the EEZ. Recreational saltwater fishing licenses are required of residents and non-residents fishing in state territorial waters as well as the EEZ and current regulations must be adhered to. Residents and non-residents younger than 16 years of age and residents who have reached 60 years of age prior to June 1, 2000 and have lived in the state for two years prior to application are not required to obtain a saltwater fishing license. However, proof of age must be carried on person. Other exemptions may exist for active military and the disabled; check with the LDWF for details.

Commercial fishermen must have appropriate fishing licenses and permits, gear licenses, and vessel permits to be properly licensed whenever taking or possessing fish for sale in Louisiana saltwater areas. All tripletail possessed by a commercial fisherman shall have the head and caudal fin intact until set or put on shore or when sold and are subject to mandatory reporting. Contact the LDWF for specific regulations regarding the commercial harvest and/or sale of tripletail from Louisiana waters.

Laws and Regulations

Louisiana laws and regulations regarding the harvest of tripletail include gear restrictions and other provisions. The following is a general summary of these laws and regulations. They are current to the date of this publication and are subject to change at any time thereafter. The LDWF should be contacted for specific and up-to-date information.

Size Limits

There is an 18-inch recreational and commercial minimum size limit for tripletail in Louisiana.

Quotas and Bag/Possession Limits

There is a five fish recreational bag limit and 100 lb. commercial trip limit (no more than one vessel trip limit per day) on tripletail.

Gear Restrictions

Licensed commercial fishermen may take tripletail commercially with a pole, line, yo-yo, hand line, trotline wherein hooks are not less than 24 inches apart, trawl, skimmer, butterfly net, cast net, scuba gear using standard spearing equipment, and rod and reel (if permitted). It is also legal to harvest tripletail with hoop nets with the proper gear license.

Licensed recreational fishermen may take tripletail recreationally with a bow and arrow, scuba gear, hook-and-line, and rod and reel.

Closed Areas and Seasons

Commercial activities including harvest of tripletail are prohibited in designated refuges and state wildlife management areas.

Other Restrictions

The use of aircraft to assist fishing operations is prohibited. Tripletail must be landed 'whole' with heads and tails attached; however, they may be eviscerated and/or have the gills removed. For the purpose of consumption at sea aboard the harvesting vessel, a person shall have no more than two lbs. of finfish parts per person on board the vessel, provided that the vessel is equipped to cook such finfish. The provisions do not apply to bait species.

Historical Changes in Regulations in Louisiana Effecting Tripletail

The following regulatory changes may have notably influenced the landings during a particular year and are summarized here for interpretive purposes.

2014: Regulations were promulgated that established both size and harvest limits for tripletail. An 18-inch minimum total length size limit for both the recreational and commercial fisheries was established. Regulations also established a five fish bag and possession limit for the recreational fishery and a 100lb trip limit for the commercial fishery (no more than one trip/vessel/day).

Texas

Texas Parks and Wildlife Department (TPWD)

Texas Parks and Wildlife Department
Coastal Fisheries Division
4200 Smith School Road
Austin, Texas 78744
(512) 389-4863
www.tpwd.texas.gov

The TPWD is the administrative unit of the state charged with management of the coastal fishery resources and enforcement of legislative and regulatory procedures under the policy direction of the Texas Parks and Wildlife Commission (TPWC). The TPWC consists of nine members appointed by the Governor for staggered six-year terms. The TPWC selects an Executive Director who serves as the administrative officer of the department. The Executive Director selects a Deputy Executive Director for Natural Resources who, in turn, selects the Director of Coastal Fisheries, Inland Fisheries, Wildlife, and Law Enforcement Divisions. The Coastal Fisheries Division, headed by a Division Director, is under the supervision of the Deputy Executive Director for Natural Resources.

Texas has habitat protection and permitting programs and a federally-approved Coastal Zone Management (CZM) program. The Texas General Land Office (TGLO) is the lead agency for the Texas CZM. The Coastal Coordination Council monitors compliance of the state Coastal Management Program and reviews federal regulations for consistency with that plan. The Coastal Coordination Council is an 11-member group whose members consist of a chairman (the head of TGLO) and representatives from Texas Commission on Environmental Quality, TPWC, the Railroad Commission, Texas Water Development Board, Texas Transportation Commission, and the Texas Soil and Water Conservation Board. The remaining four places of the council are appointed by the governor and are comprised of an elected city or county official, a business owner, someone involved in agriculture, and a citizen. All must live in a coastal zone.

Legislative Authorization

Chapter 11, Texas Parks and Wildlife Code, established the TPWC and provided for its make-up and appointment. Chapter 12, Texas Parks and Wildlife Code, established the powers and duties of the

TPWC, and Chapter 61, Texas Parks and Wildlife Code, provided the TPWC with responsibility for marine fishery management and authority to promulgate regulations. Chapter 47, Texas Parks and Wildlife Code, provided for the commercial licenses required to catch, sell, and transport finfish commercially, and Chapter 66, Texas Parks and Wildlife Code, provided for the sale, purchase, and transportation of protected fish in Texas. All regulations pertaining to size, bag, and possession limits, and means and methods pertaining to fish and marine life are adopted by the TPWC and included in the Texas Statewide Hunting and Fishing Proclamations.

Reciprocal Agreements and Limited Entry Provisions

Reciprocal Agreements

Texas statutory authority allows the TPWC to enter into reciprocal licensing agreements in waters that form a common boundary, i.e., the Sabine River area between Texas and Louisiana. Texas has no statutory authority to enter into reciprocal management agreements.

Limited Entry

Chapter 47, Texas Parks and Wildlife Code, provides that no person may engage in business as a commercial finfish fisherman unless a commercial finfish fisherman's license has been obtained. Beginning September 1, 2000, a commercial finfish license could only be sold to a person who documented, in a manner acceptable to the department, that the person held a commercial finfish license during the period after September 1, 1997 through April 20, 1999. In order to qualify for entry into the finfish license management program, the person was required to file an affidavit with the department at the time the license was applied for that stated:

1. the applicant was not employed at any full-time occupation other than commercial fishing; and,
2. during the period of validity of the commercial finfish fisherman's license, the applicant did not intend to engage in any full-time occupation other than commercial fishing.

Commercial Landings Data Reporting Requirements

Wholesale/retail seafood dealers who purchase tripletail from fishermen are required to report those purchases by the tenth of the following month on trip tickets supplied by the TPWD for that purpose. Commercial fishermen who sell tripletail directly to consumers must be licensed as a wholesale/retail seafood dealer and comply with the same reporting requirements.

Penalties for Violations

Penalties for violations of Texas' proclamations regarding tripletail are provided in Chapter 61, Texas Parks and Wildlife Code, and most are Class C misdemeanors punishable by fines ranging from $25 to $500. Under certain circumstances, a violation can be enhanced to a Class B misdemeanor punishable by fines ranging from $200 to $2,000; confinement in jail not to exceed 180 days; or both.

Annual License Fees

A license is required to land tripletail recreationally or commercially from all Texas marine waters and the EEZ. Recreational saltwater fishing licenses are required of residents and non-residents fishing in state territorial waters as well as the EEZ and current regulations must be adhered to. Check with the TPWD for current tripletail regulations. Residents of Texas under the age of 17 and residents who were born before January 1, 1931, are not required to obtain a recreational fishing license. Other exemptions may exist for active military and the disabled, check with the TPWD for details.

Senate Bill 1303 authorizes the TPWC under Parks and Wildlife Code 47, to establish a license limitation plan for the Texas commercial finfish fishery. Commercial fishermen must have appropriate fishing licenses and permits, gear licenses and vessel permits to be properly licensed whenever taking or possessing fish for sale in Texas saltwater areas. Contact the TPWD for specific regulations regarding the commercial harvest and/or sale of tripletail from Texas waters.

Laws and Regulations

Various provisions of the Statewide Hunting and Fishing Proclamation adopted by the TPWC affect the harvest of tripletail in Texas. The following is a general summary of these laws and regulations. It is current through the end of August 2016 and is subject to change at any time thereafter. The TPWD should be contacted for specific and up-to-date information.

Size Limits

A minimum size limit of 17-inches TL has been established for tripletail in Texas.

Quotas and Bag/Possession Limits

The recreational daily bag for tripletail is three (3) fish per person and the possession limit is equal to two times the daily bag limit. The same daily bag and possession limit applies to all commercial fisherman since tripletail are a gamefish in Texas. The bag limit for tripletail retained incidental to a legal shrimping operation is equal to a recreational bag limit.

Gear Restrictions

Gill nets, trammel nets, seines, purse seines, and any other type of net or fish trap are prohibited in the coastal waters of Texas. Tripletail is a game fish and may be legally taken by pole and line only.

Closed Areas and Seasons

There are no closed areas or seasons for the taking of tripletail in Texas.

Other Restrictions

Tripletail must be kept in a 'whole' condition with heads and tails attached until landed on a barrier island or the mainland; however, viscera and gills may be removed.

Historical Changes in Regulations in Texas Effecting Tripletail

The following regulatory changes may have notably influenced the landings during a particular year and are summarized here for informative purposes.

1981: House Bill 1000, prohibition of red drum and spotted seatrout sale (game fish status), therefore commercial pressure on tripletail may have been increased.

1988: Net ban, affecting immediate commercial as well as future commercial and recreational landings.

1995: Senate Bill 750, limited entry for shrimpers may have redistributed commercial pressure.

1999: On June 18, 1999, Senate Bill 1303 authorized the TPWC under Parks and Wildlife Code 47, to establish a license limitation plan for the Texas commercial finfish fishery with the goal of improving the economic stability of the commercial finfish fishery while providing long-term sustainability of finfish stocks. The Finfish License Management Program became effective September 1, 2000.

2006: On September 1, 2006, tripletail was designated as game fish by the TPWC, a 17-inch (TL) minimum size limit, and a three fish bag limit were established.

Georgia

Georgia Department of Natural Resources (GADNR)

Georgia Department of Natural Resources
Coastal Resources Division
One Conservation Way
Brunswick, GA 31520
Telephone: (912) 264-7218
CoastalGADNR.org

The agency charged with the administration, supervision, development, and conservation of natural resources is the Georgia Department of Natural Resources (GADNR). This agency is not subordinate to any other agency or authority of the state's executive branch. The administrative head of the GADNR is the Commissioner. Within the Department, the Coastal Resources Division (CRD) is empowered to manage marine and anadromous fisheries in the interest of all people of Georgia. The Law Enforcement Division (LED) is responsible for enforcement of all marine-resource-related laws, rules, and regulations of the state.

GADNR has existed in various forms since establishment by the Georgia legislature in 1911. The legislature also created the regulatory authority in the Board of Natural Resources (Board). The Board regulates marine resources, within parameters set by the legislature, with the exception of licensing, penalties, and most aspects of commercial shrimping and crabbing which the legislature retained. The Board is composed of nineteen members appointed by the governor which representing each of the congressional districts in Georgia as well as four at-large members and one coastal member.

In addition to day to day management of marine resources, CRD maintains habitat protection and permitting programs, and a federally-approved CZM program.

Legislative Authorization

Prior to 2012, the Georgia Legislature was the primary body that enacted laws regarding management of tripletail in state waters. Title 27, Chapter 4 of the Georgia Statutes, annotated, contained the specific laws directly related to harvest and possession. In 2012, the legislature provided the Board and Department with various duties, powers, and authorities to promulgate regulations affecting marine fisheries. Rule 391-2-4-.04 Saltwater Finfishing contains regulations regarding tripletail.

Reciprocal Agreements and Limited Entry Provisions

Reciprocal Agreements

Georgia statutory authority provides for reciprocal agreements; however, there are no established agreements between Georgia and South Carolina or Florida in saltwater.

Limited entry

Georgia has no provisions for limited entry into the tripletail fishery with the exception of a commercial fishing license requirement.

Commercial Landings Data Reporting Requirements

Georgia requires commercial harvesters and seafood dealer to submit trip tickets monthly. Information to be supplied for each trip includes trip date; vessel identification; trip number; species; quantity; units of measure; disposition; value; county or port landed; state landed; dealer identification; unloading date; market; grade; gear; quantity of gear; days at sea; number of crew; fishing time; and number of sets.

Penalties for Violations

Penalties for violations of Georgia laws and regulations are established in Georgia Statutes. Most violations of game and fish laws are misdemeanors though some may be elevated to misdemeanors of high and aggravated nature, Title 27, Chapter 4.

License Requirements

In Georgia, a license is required to land tripletail recreationally or commercially. Recreational fishing licenses are required of residents and non-residents fishing in state territorial waters as well as the EEZ. All persons under the age of 16, regardless of residency, and resident seniors who are 65 or older are not required to purchase recreational licenses. Other exemptions exist for active military and individuals with disabilities, check with the GADNR for details.

Commercial fishing licenses are required to sell tripletail from Georgia waters or from the EEZ and landed in Georgia.

Laws and Regulations

Georgia's laws and regulations regarding the harvest of tripletail are statewide. The restrictions discussed in this section are current through the publication of this profile and are subject to change at any time thereafter.

Size Limits

There is a minimum size limit of 18-inches TL for both recreational and commercial harvest.

Quotas And Bag/Possession Limits

No recreational or commercial harvester may harvest or possess in or from state waters more than two tripletail per day. Furthermore, any tripletail caught in federal waters are restricted to the state waters bag limit if the vessel returns to or transits through state waters.

Gear Restrictions

There are few restrictions on recreation gear for the harvest of tripletail; only gig and gillnet are prohibited. Commercially, tripletail may be harvested using trawl nets, cast nets, seines, and pole-and-line, though only pole-and-line are practical considering the restrictive creel limit.

Closed Areas and Seasons

There are no closed areas for the harvest of tripletail in Georgia.

Other Restrictions

Tripletail must be landed with head and fins intact. Transfer between vessels at sea is prohibited.

Historical Changes to Regulations in Georgia Effecting Tripletail

The following regulatory changes may have notably influenced the landings during a particular year and are summarized here for informative purposes.

1957: Gill nets prohibited in state waters.

1986: State of Georgia Game and Fish Law: 27-4-10 and –11 establishes an 18-inch minimum-size and 5 fish per person for tripletail.

2006: O.C.G. 27-4-130.1 (c) reduces tripletail creel limit reduced to 2 fish per person per day and maintains the 18-inch TL size limit.

Regional/Interstate

Gulf States Marine Fisheries Compact (P.L. 81-66)

The Gulf States Marine Fisheries Commission (Commission) was established by an act of Congress (P.L. 81-66) in 1949 as a compact of the five Gulf states. Its charge is:

"to promote better utilization of the fisheries, marine, shell and anadromous, of the seaboard of the Gulf of Mexico, by the development of a joint program for the promotion and protection of such fisheries and the prevention of the physical waste of the fisheries from any cause."

The Commission is composed of three members from each of the five Gulf states. The head of the marine resource agency of each state is an ex-officio member, the second is a member of the legislature, and the third, a citizen who shall have knowledge of and interest in marine fisheries, is appointed by the governor. The chairman, vice chairman, and second vice chairman of the Commission are rotated annually among the states.

The Commission is empowered to make recommendations to the governors and legislatures of the five Gulf states on action regarding programs helpful to the management of the fisheries. The states do not relinquish any of their rights or responsibilities in regulating their own fisheries by being members of the Commission.

Recommendations to the states are based on scientific studies made by experts employed by state and federal resource agencies and advice from law enforcement officials and the commercial and recreational fishing industries. The Commission is also authorized to consult with and advise the proper administrative agencies of the member states regarding fishery conservation problems. In addition, the Commission advises the U.S. Congress and may testify on legislation and marine policies that affect the Gulf states. One of the most important functions of the Commission is to serve as a forum for the discussion of various problems, issues, and programs concerning marine management.

Tripletail Technical Task Force

The Tripletail Technical Task Force (TTF) is organized with one scientific representative from each of the five Gulf states who is appointed by each state's director serving on the State-Federal Fisheries Management Committee (SFFMC). In addition, the TTF includes a representative from each of the Commission's Commercial Fisheries and Recreational Fisheries Advisory Panels, the Law Enforcement Committee, and the Habitat Subcommittee (the representative is chosen by action of the respective committees). In addition, other experts and specialists from other disciplines may be included on the TTF as needed (i.e., public health, economics, sociology, etc.). As with all of the Commission's TTFs, the committee becomes inactive until there is a need for revision of a profile or work on specific issues related to tripletail in the region. The members of the TTF may be called upon to advise the Technical Coordinating Committee (TCC), the SFFMC, or the Commission on tripletail issues in the Gulf of Mexico.

Interjurisdictional Fisheries Act (IFA) of 1986 (P.L. 99-659, Title III)

The IFA of 1986 established a program to promote and encourage state activities in the support of management plans and to promote and encourage regional management of state fishery resources throughout their range. The enactment of this legislation repealed the Commercial Fisheries Research and Development Act (P.L. 88-309).

Development of Biological and Management Profiles for Fisheries (Title III, Section 308(C))

Through P.L. 99-659, Congress authorized the USDOC to appropriate funding in support of state research and management projects that were consistent with the intent of the IFA. Additional funds were authorized to support the development of interstate management plans by the Gulf, Atlantic, and Pacific States Marine Fisheries Commissions.

Chapter 6
DESCRIPTION OF THE FISHERY

Tripletail are found throughout tropical and subtropical regions worldwide. With a few exceptions, tripletail are rarely found in high densities in the Gulf of Mexico and are rather ephemeral in their occurrence, which is not conducive to supporting a dedicated recreational or commercial fishery. In other regions of the world, they do occur with more frequency but are still a relatively minor component of most fishing activities. This chapter will focus on the two fishing sectors in the Gulf of Mexico but will also include the other countries that share the Gulf and the Caribbean since the majority of the landings for this species are outside U.S. waters.

Commercial Fishery

Tripletail do not make up a large component of the total commercial landings in the U.S., averaging about 0.0002% of the total finfish landings since 1950. Their seasonal occurrence and solitary nature do not make them easy to harvest using traditional commercial gears, such as nets. The majority of landings are derived from rod-and-reel by commercial fishermen opportunistically harvesting tripletail as they are encountered.

In the U.S., most tripletail landings originate from the Atlantic coast of Florida (Table 6.1). Since the year 2000, landings from the east Florida coast have comprised 62% of the total U.S. commercial landings and average 7,000 lbs annually. The U.S. contribution, however, is small compared to landings from other countries bordering the Gulf of Mexico and Caribbean. This will be discussed in more detail later.

History

Baughman (1941) provided several accounts which indicate relatively large schools of tripletail were intercepted by commercial snapper boats in an area around St. Marks, Florida, but they were considered

Table 6.1 Total U.S., Gulf of Mexico, and East Florida commercial landings (lbs) of and the percent of the total contribution to the total U.S. from 2000-2014 (NOAA unpublished data).

Year	Total U.S.	Gulf of Mexico		East Florida	
2000	14,391	5,188	(36%)	8,499	(59%)
2001	12,824	5,325	(42%)	7,059	(55%)
2002	12,008	5,654	(47%)	5,367	(45%)
2003	7,031	3,182	(45%)	3,592	(51%)
2004	7,807	3,225	(41%)	3,901	(50%)
2005	6,966	749	(11%)	5,775	(83%)
2006	8,945	4,616	(52%)	3,764	(42%)
2007	11,100	2,086	(19%)	8,399	(76%)
2008	5,399	788	(15%)	4,136	(77%)
2009	16,695	8,196	(49%)	7,073	(42%)
2010	9,997	229	(2%)	9,347	(93%)
2011	9,649	2,325	(24%)	6,835	(71%)
2012	17,074	5,142	(30%)	10,323	(60%)
2013	22,107	5,644	(26%)	14,842	(67%)
2014	24,246	1,279	(5%)	22,022	(91%)

rare events. Baughman also anecdotally reported that as much as 1,600 lbs of tripletail were reported to be taken using a long seine over the sand flats at the mouth of the Brazos River in Texas in 1937. Again, this appeared to be a rare event. However, the majority of more recent commercial landings (1950 to present) are a result of rod-and-reel fishing, as well as some trawl and seine hauls (Figure 6.1). There was an entanglement fishery in the northern Gulf of Mexico that provided relatively high numbers until the early 1970s despite the species tending to remain more offshore and associate with structure. In the 1980s and 1990s, there was a spike in the landings that was either not reported with a fishing gear or reported as 'combined' gears from the east coast of Florida. The four-year window from 1992-1995 saw the highest total landings in the U.S., reaching just over 48,000 and 39,000 lbs in 1994 and 1995 respectively. The 1996 landings returned to a more typical report. If prevailing currents associated with the Loop Current provide the northern Gulf of Mexico with the majority of tripletail, this could explain such wide inter-annual variation in landings in the Gulf of Mexico and along the east coast of Florida (Figure 6.2 and 6.3). As such, the lack of a reliable influx of fish may have prevented a targeted fishery from developing. Baughman (1941) stated:

> "One thing that militates against its [tripletail] becoming popular is the fact that rarely does a sufficient supply reach the markets at any time to make it worthwhile to handle it. The great majority are taken on hook-and-line and are consumed by the fishermen who take them. Consequently, the general public has never had any opportunity to acquire a taste for tripletail."

State Commercial Fisheries

Commercial landings of tripletail are highly uncertain in the U.S. Gulf of Mexico, not because of poor data but generally due to minimal directed effort. The following provides a state-by-state description of tripletail that are landed and sold commercially in the five Gulf states. Since the majority of U.S. landings are derived by the six states that make up the southern Atlantic and Gulf of Mexico proper, also included are the east coast of Florida and Georgia in summary.

Florida (East and West Coast)

Commercial harvest of tripletail in Florida is primarily isolated to Brevard County on its east coast.

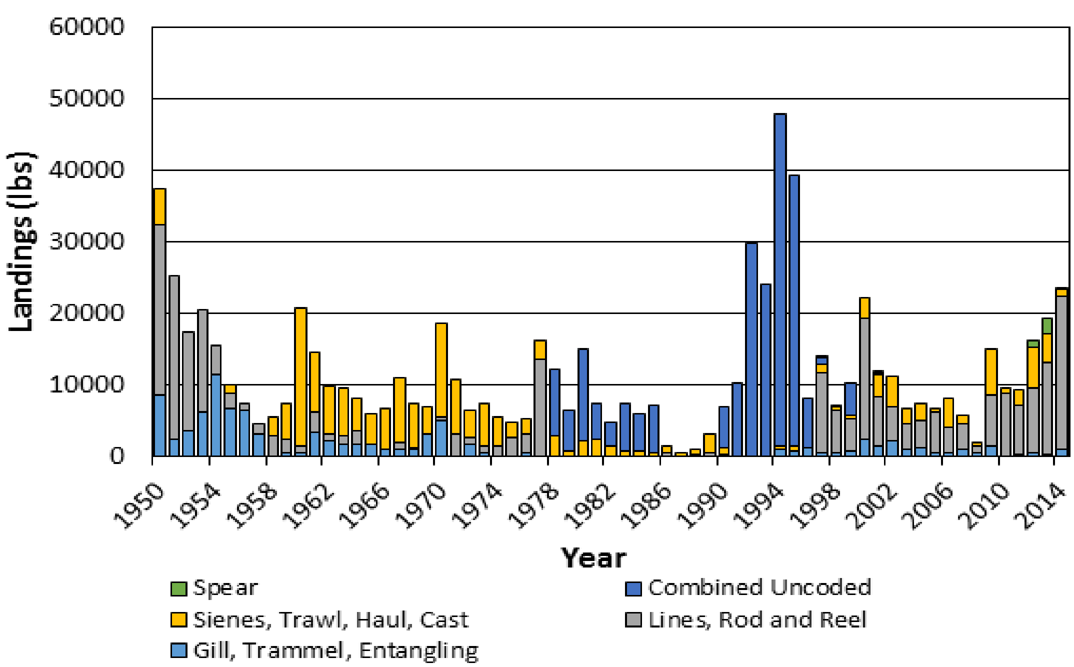


Figure 6.1 Total U.S. Commercial landings of tripletail by gear from 1950-2014 (NOAA unpublished data).

Fishing was historically dominated by hook-and-line and hand lines with around 20,000 lbs landed in the early 1950s. Since the mid-1950s, the east coast of Florida has averaged around 7,000 lbs annually with the exception of several big years in the 1990s. There has been a slight increase since about 2010 (Figure 6.2E). The Florida west coast (Gulf of Mexico) reported very high landings in 1959 but overall landings from Florida's west coast contribute minimally to the total state harvest, averaging just over 1,000 lbs annually with few exceptions.

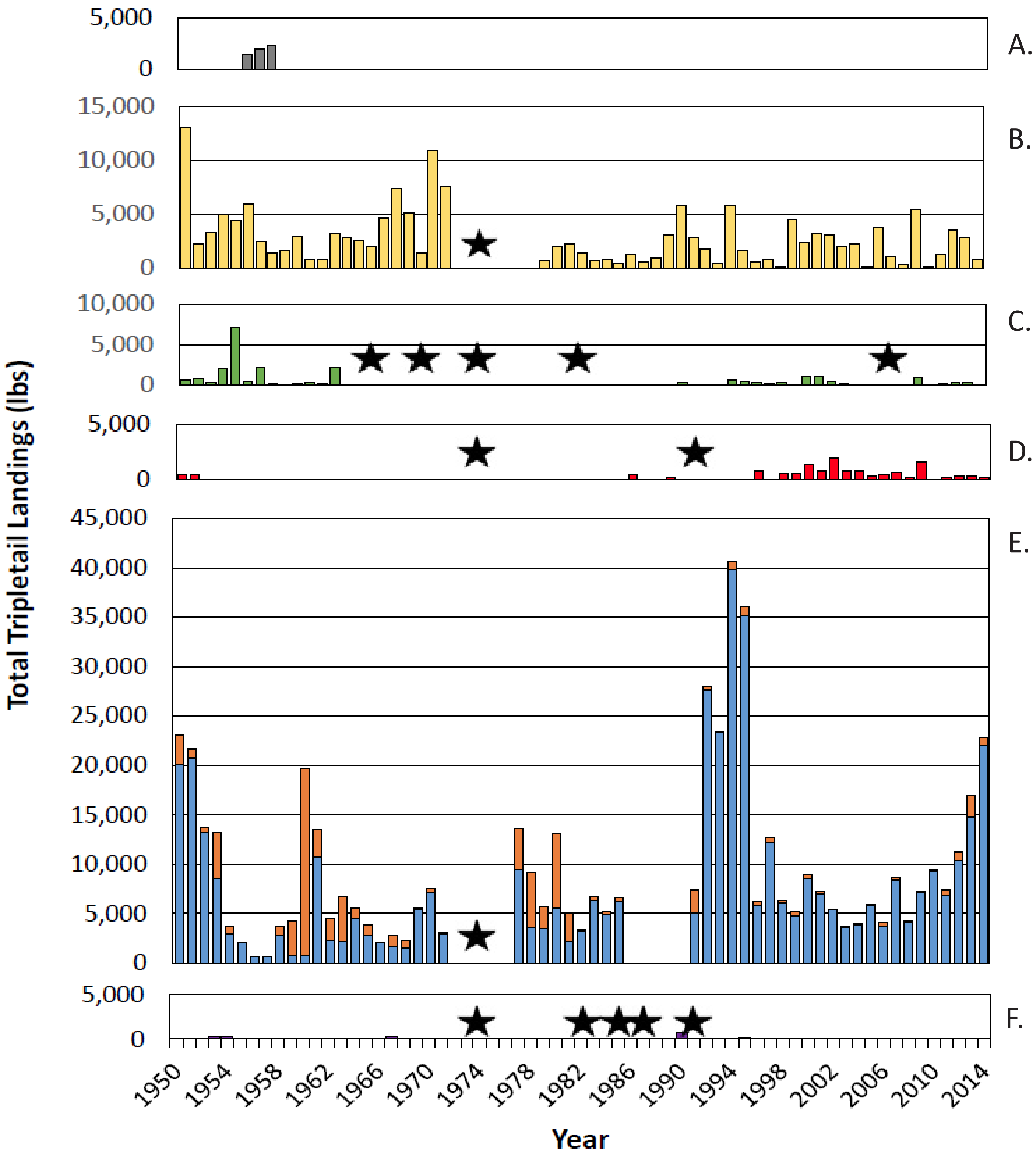


Figure 6.2 All five Gulf states and Georgia total landings of tripletail from 1950-2014; A) Texas B) Louisiana C) Mississippi D) Alabama E) Florida East (blue) and West (orange) and F) Georgia. Star ★ indicates confidential data.

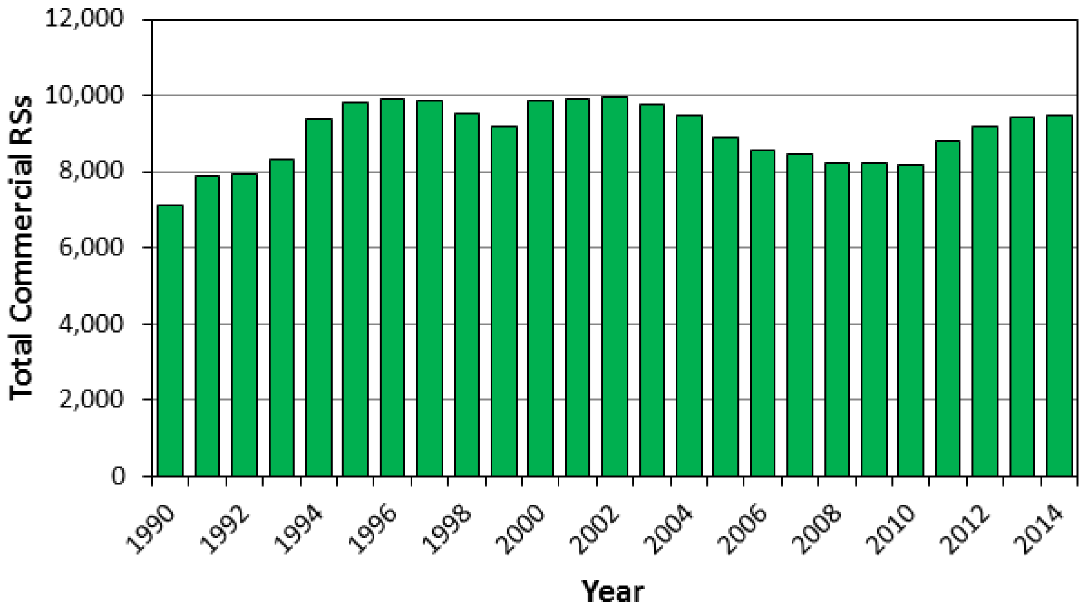


Figure 6.3 Total number of commercial Restricted Species Endorsements (RSs) issued in Florida from 1990 to 2014 (FWC unpublished data).

While there is considerable variation in the fishing gears used for catching tripletail in Florida waters, over the entire 60+ year time series, the majority (78%) of landings were from hook-and-line. The remainder were split at around 10% each for entangling nets and trawls/seines. From 1991-1996, no gears were specified so they were not included in these percentages; however, it likely resulted from inshore trawlers targeting finfish in shallow waters along Florida's east coast around Brevard County. In 1995, recreational anglers spoke out against using bottom trawls and roller-frame trawls to target finfish inshore (Franks personal communication). This included concern over bycatch of groundfish and numerous recreationally important fish harvested from trawls, including spotted seatrout and tripletail. The state approved a restoration bill that designated tripletail a restricted species and set a 10 fish bag and possession limit commercially. In addition, the only gear allowed for harvest was designated as hook-and-line. Since 2000, nearly 90% of the landings have been from hook-and-line.

Interestingly, in 2012 and 2013, a total of 3,000 lbs of tripletail was harvested with spears despite regulations specifically prohibiting spearing or snagging of tripletail in Florida state waters. Prior to this, there were virtually no landings by spear in Florida, suggesting snorkelers, free divers, and SCUBA divers may be harvesting tripletail in increasing numbers in the EEZ where tripletail are unregulated. These are the only commercial spearfishing landings recorded anywhere in the U.S. (Figure 6.1).

In the state of Florida, commercial harvesters are required to have a Saltwater Products License (SPL) Florida's commercial fishing license) and a Restricted Species Endorsement (RS) to commercially harvest or sell any fish designated as restricted, including tripletail. The number of RSs issued since the mid-1990s has remained relatively stable at around 9,000 per year. There was a slight decline in the late 2000s but the number of RSs continues to approach the long-term average (Figure 6.3).

Alabama

Compared to other commonly caught species, Alabama has few tripletail reported through its commercial landings programs (Figure 6.2D). Since 1950, for many of the years with landings information, the majority of tripletail were harvested using gill and entangling nets (NOAA unpublished data). Baughman (1941) reported interviews with dealers and/or fishermen indicating that fish were landed in Bon Secour, Weeks Bay, and Mobile Bay proper but how much ended up in the commercial market is unknown. From the Alabama trip ticket data program, which began in 2000, the landings of tripletail are fairly well split between the two coastal counties of Mobile and Baldwin. Starting in 2000, the state of Alabama restricted the commercial harvest of tripletail to three fish per fishing trip. Since 2000, annual commercial harvest of tripletail averaged just over 620 lbs. Most of the reported harvests in recent years have been below this average.

Mississippi

Mississippi has no significant commercial fishery for tripletail (Figure 6.2C). The handful of landings reported from the 1950s to the early 1960s were by trammel net and hand line landings at around 200-300 lbs annually (NOAA unpublished data). Gill nets contributed around 500 lbs per year in the 1990s and a few hundred pounds were occasionally landed by trawlers. Since 2009, commercial tripletail have been harvested primarily by rod-and-reel. Landings are typically bycatch or opportunistic collection during trips targeting other species. Since tripletail are highly seasonal in Mississippi waters, it is most likely that the commercial fishery will remain minimal with little or no direct targeting of the species.

Louisiana

Tripletail are not landed in large numbers commercially in Louisiana (Figure 6.2B). According to NOAA (unpublished data), commercial effort for tripletail in Louisiana is primarily near the mouth of the Mississippi River. Gudger (1931) reported a conversation with Mr. Percy Viosca, Jr., then Director of Fisheries, Louisiana Department of Conservation, as stating that while there were no recorded commercial landings for tripletail in the early 1900s,

> "it is occasionally taken in trawls, but mainly in trammel nets or seines. It is not a very abundant fish, the largest lots reaching New Orleans rarely exceeding 1,000 pounds." (Gudger 1931).

Since the early 1950s, the landings have been dominated by trawls and seines as reported earlier by Gudger (1931) but there was a short window with minor trammel net landings from the early 1950s into the early 1960s (NOAA unpublished data). With the exception of a few years throughout the series, the average landings by decade have remained around 2,500 to 4,000 lbs of tripletail annually. The significance of Louisiana's tripletail landings is minimal when included in the total annual commercial landings for all species which averaged 1.06 billion lbs since 2000.

Texas

Tripletail in Texas are extremely rare in the commercial catch. Although a couple thousand pounds were reported in the mid-1950s (Figure 6.4a), there is not a species code for tripletail in the Texas trip ticket system, so the dealers may classify them under 'unclassified'. In researching this with the TPWD, it was noted that commercial samplers remarked that they see "about one or two a year but that's all" (TPWD personal communication).

Georgia

Commercial landings in Georgia are minor compared to the east coast of Florida but a few fish are reported each year (Figure 5.4F). Since 1950, commercial tripletail harvests were reported for only nine years, and landings for each of those few years ranged from less than 100 lbs to about 800 lbs. Gudger (1931) noted that a few tripletail were commercially harvested as far north as New York and Virginia but only mentions North Carolina and Florida for landings in the southern Atlantic. Although tripletail were known to inhabit areas off Georgia, there was apparently no sale of these fish recorded prior to the 1950s.

Caribbean (U.S.)

There are limited commercial landings of tripletail in the U.S. Caribbean, which are represented by Puerto Rico exclusively since the U.S. Virgin Islands and other territories have not been fully integrated into the NOAA data collection program at this time. Since 1989, there was an annual average of 135 lbs commercially landed, although there is very little detail regarding those fish (NOAA unpublished data). The landings include a few pounds from gill nets and haul seines, as well as hand line (NOAA unpublished data). All indications suggest no targeted fishery in Puerto Rico, but as in other regions, commercial fishermen will sell tripletail when they encounter them. According to the Puerto Rico Department of Natural and Environmental Resources (PRDNER; personal communication), the majority of all tripletail commercial landings occur along the northern coast of the island on the Atlantic and not on the Caribbean side.

Recreational Fishery

In the U.S. Gulf of Mexico, recreational estimates of tripletail harvest are probably not reliable due to infrequent intercept data since few recreational anglers 'target' tripletail. While the Gulf of Mexico receives some limited numbers of tripletail during the summer months, the largest concentrations in the U.S. are found along the Atlantic coast in the roughly 250 miles from Port Canaveral, Florida, to Jekyll Island, Georgia.

In the Gulf of Mexico recreational fishery, most tripletail are taken by hook-and-line from April to early October and tend to be solitary fish. Natural materials such as mats of *Sargassum*, other marine plants, or logs will hold a number of different species including tripletail. Man-made debris such as trash bags, floating bottles, pallets, and other items will also attract tripletail as they provide a shade oasis in the otherwise habitat-sparse pelagic zone. Anglers have even found them under and inside lost or discarded five-gallon buckets (P. Cooper personal communication). Vessels can also provide shade or refuge for tripletail with a number of anglers reporting catches under and around anchored shrimp boats (Hughes 1937).

Inshore, tripletail can be found near channel buoys, posts and pilings, and even crab trap floats, making them favorite targets for inshore anglers when encountered. Fishing for tripletail is most often 'sight fishing' rather than blind casting, but the fish spook easily which is why many anglers do not often succeed in catching them. One of the primary reasons that many recreational anglers are unfamiliar with this species is angler preference for fishing artificial reefs and petroleum structures for reef fish, like grouper and snapper (P. Cooper personal communication). Because anglers most often are focused on other species, their vessels literally pass by or through *Sargassum*, windrows, and/or rips which potentially hold tripletail (P. Cooper personal communication). In addition, most anglers targeting species like cobia, amberjack, or snappers do not use the appropriate gear/tackle to catch tripletail. Finding tripletail takes time since an angler who approaches a crab float or buoy too quickly risks spooking the fish. A good fishing guide looking for tripletail will idle from site to site, carefully searching out the fish to avoid spooking them. Fishing for tripletail could be described as a cautious stalk and many anglers are not up to the challenge or have the patience (P. Cooper personal communication).

Most recreationally landed tripletail are caught using lightweight casting or spinning gear with less than 30-lb test line. Tripletail are also caught on fly fishing gear. Jigheads tipped with cut bait or small artificial lures are common, as are live baits such as shrimp, crabs, herring, and menhaden (P. Cooper personal communication). However, while tripletail appear to be very opportunistic in their foraging, they can be very selective and can frustrate anglers by making them throw every bait in their arsenal and possibly never get a strike from the fish (P. Cooper personal communication). Tripletail is becoming a popular recreational spearfishing target in a number of areas in the Gulf of Mexico and southern Atlantic (Kalinowsky personal communication, VanderKooy personal communication).

History

Accounts of recreational and commercial anglers catching tripletail in the 1800s can be found in Mitchill (1815) and Gill (1856). Gudger (1931) reported on a number of accounts of tripletail landed recreationally from New York to Texas based on anecdotal reports from fishermen and biologists in the regions. However, Gudger (1931) found very few to examine, most of which were in museum collections. Baughman (1941) also noted a number of locations from North Carolina to Texas where tripletail were caught in addition to the ones reported by Gudger (1931). Generally, most fish were taken on hook-and-line by anglers. Hughes (1937) provided some insight into how tripletail were fished along the middle of Florida's Atlantic coast around Cape Canaveral. Hughes and his fellow anglers in the Canaveral area used sturdy gear and live or dead bait in relatively shallow water. He also reported some fish taken further offshore in association with a wreck in 50 feet of water. In the Gulf of Mexico, Baughman (1941) indicated preferred baits by anglers included live sardines, crabs, and cut bait and that tripletail would rarely strike artificial bait. Cooper (personal communication) observed that fresh broken crabs were a great temptation for tripletail, but that at other times tipping a light jig head with cut bait could work. Cooper reported that tripletail tend to strike "whenever it suits them" noting that he has spent many hours gathering live bait in an effort to entice the finicky fish and not gotten a single hit.

In the Gulf of Mexico and southern Atlantic, several fishing rodeos and tournaments list tripletail as a target, often in a big money category. While a number of small tournaments exist, only a few large ones have a long history of including tripletail; these include the Mississippi Deep Sea Fishing 4th of July Rodeo held in Gulfport (67 yrs), the Southwest Louisiana Fishing Rodeo in Lake Charles (76 yrs), the Alabama Deep Sea Fishing Rodeo held each year on Dauphin Island (86 yrs), and the International Grand Isle Tarpon Rodeo in Louisiana (87 yrs). Additional events include the Crosthwait Fishing Tournament in Palmetto, Florida (32 yrs) and the Conde Cavaliers Mardi Gras Fishing Rodeo also on Dauphin Island, Alabama (33 yrs). Saltwater angling fishing records for tripletail for each state are provided in Table 3.1. The current International Game Fish Association (IGFA) world record of 42.3 lbs was landed in Zululand, South Africa in 1989.

State Recreational Fisheries

Recreational fishing data for landings and effort are derived using the NMFS Marine Recreational Information Program (MRIP), its predecessor the Marine Recreational Fisheries Statistics Survey (MRFSS), and the Texas Recreational Harvest Monitoring Program. The Texas program has been in place since 1974 while the MRFSS was used to sample anglers from Florida to Louisiana from 1979 until 2011. With the implementation of MRIP, the MRFSS landings since 1994 have been revised using the new protocols and are reported below. Since 2014, Louisiana has employed its own recreational survey, the La Creel program, to generate recreational harvest estimates. Together, these four programs provide the best estimates of landings and effort by recreational anglers in the Gulf of Mexico and southern Atlantic regions.

Unlike commercial landings information, the reported recreational landings in the MRFSS/MRIP include both retained (type 'A' and 'B1' that are fish observed and reported catch not observed by samplers) and released fish (type 'B2'). The recreational landings presented in the recreational figures and tables are type A+B1 and actually represent total harvest, as designated by the NMFS. However, it should be noted that there are very large percent standard error (PSEs), measure of precision presented with all estimates, associated with most of these totals due to the low number of angler intercepts which prevents reliable estimates of tripletail harvest (NOAA personal communication). According to NOAA, estimates with PSEs above 50 indicate high variability around the estimate (therefore low precision) and should be viewed cautiously. Gulf-wide, the average PSEs for tripletail recreational landings are around 63% in the 1980s and around 73% since 2005. Along the Atlantic, the average PSEs for Georgia are around 75% but the east Florida coast is only about 35%. The likelihood of intercept of tripletail by MRIP samplers along the Atlantic coast is much greater and far more common than in the Gulf of Mexico.

In general, the NOAA recreational data indicate that landings are dominated (by proportion) by the southern Atlantic, with the Gulf of Mexico varying widely in its contribution (Figure 6.4). Since the addition of the Caribbean to the MRFSS/MRIP data collection program in 2000, there have been frequent landings reported for tripletail in that region, which at this time exclusively represents Puerto Rico.

Florida (East and West Coast)

Recreational anglers in Florida target tripletail seasonally with the majority of fish being caught in conjunction with the arrival of *Sargassum* and other flotsam, which most anglers note begins in about April along the Atlantic coast. Sportfishing articles abound with reports of tripletail arriving in large numbers on the east coast, centered near Cape Canaveral by mid-April and staying through June. Captain Lum of Outcast Sportfishing Charters reported that tripletail seem to leave the coast in July but return in late fall (October-December; Lum personal communication), and that large spawning fish are frequently caught along the coast in mid-June (Cooper 2002). In an oral history of longtime, east coast recreational fisherman Robert Benton (2010) that was conducted by the University of South Florida, he recalled fishing for tripletail as a young man in the 1960s and 1970s at the Fort Pierce Inlet of the Indian River Lagoon. Benton caught many tripletail fishing the channel markers in the river and reported placing crab traps in the river during the summer specifically to create an obstacle to entangle drifting seaweed and bait, and eventually tripletail (Benton 2010). Along the west coast of Florida, anglers who fish the Tampa Bay areas for tripletail report seeing them most of the summer but have the greatest success during the stone crab season when there are many more commercial stone crab traps and floats in the coastal waters (Brown 2013).

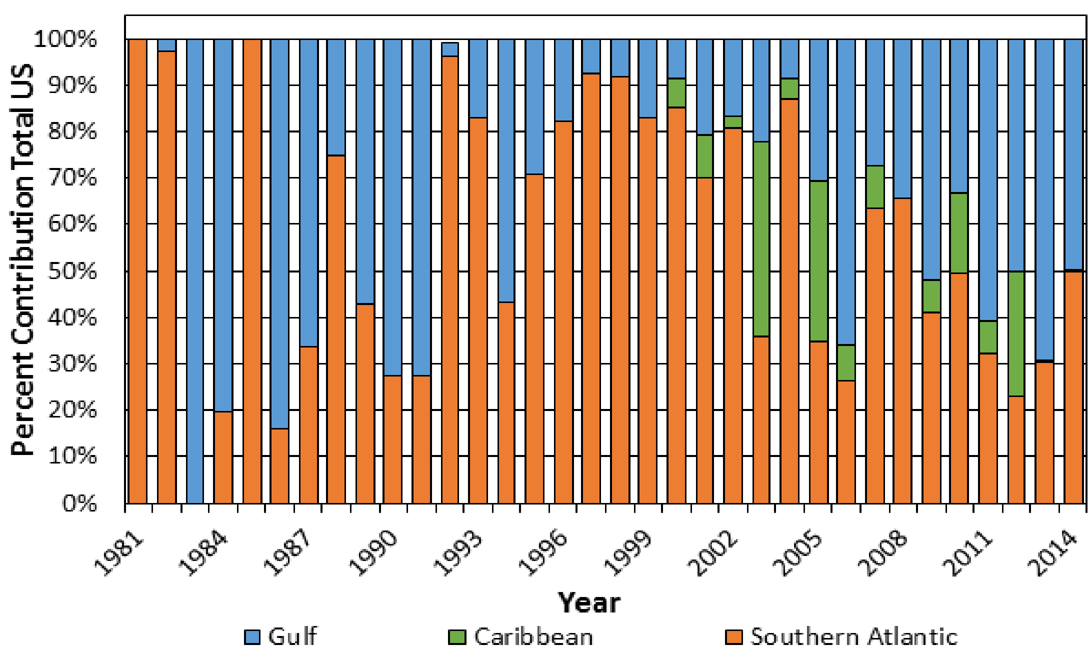


Figure 6.4 The percent contribution by region to the total U.S. recreational landings for tripletail from 1981–2014 (NOAA unpublished data). Southern Atlantic includes East Florida, Georgia, and South Carolina. Caribbean is only Puerto Rico. **Note:** 1992 does not total 100% due to minor landings outside these three regions.

Statewide recreational landings have fluctuated widely in the last few decades. From 1990-1999, the average recreational harvest was just under 310,000 lbs but from 2000-2010 the average declined to around 180,000 lbs. However, the majority of the recreational landings for both time periods were from the Atlantic coast of Florida. There are a couple of outstanding years credited to the west coast of Florida (Gulf of Mexico) when 140K, 300 K, and 112K lbs of tripletail were landed in 1991, 2006, and 2013 respectively; however, these are outliers to the overall trend of 50,000-60,000 lbs (Figure 6.5). When we examine the landings by MRFSS waves (Figure 6.6), the Atlantic coast of Florida has landings of tripletail year-round with peaks from March-June and November-December. Along the west coast of Florida, the peak for landings is later, occurring from May-October.

The number of participants in Florida's recreational fishery since 2000 has increased compared to the 1990s (Figure 6.7). However, the number of anglers targeting tripletail is unknown and likely minimal compared to other recreationally sought species. Despite the notoriety these fish are receiving today, there are still few fishermen with the knowledge, patience, or desire to search random objects in the inshore and offshore waters for tripletail.

Alabama

Many Alabama anglers who target tripletail do so when the fish are entering the Mobile and Perdido Bay systems during the summer months. However, their lack of localized abundance and their life history trait of associating with floating debris mean anglers who catch tripletail with regularity spend a large portion of their trip time searching for debris or driving between fixed items such as pilings and buoys. Since the number of anglers specifically targeting tripletail is relatively low, typical creel surveys are not suited to access this group.

A review of recreational landings between 1981 and 2015 highlight this point as the estimates range from zero to 93,000 lbs (Figure 6.5). The majority of tripletail landings in these estimates were recorded from private recreational vessels, with a small portion of landings from charter vessels (NOAA

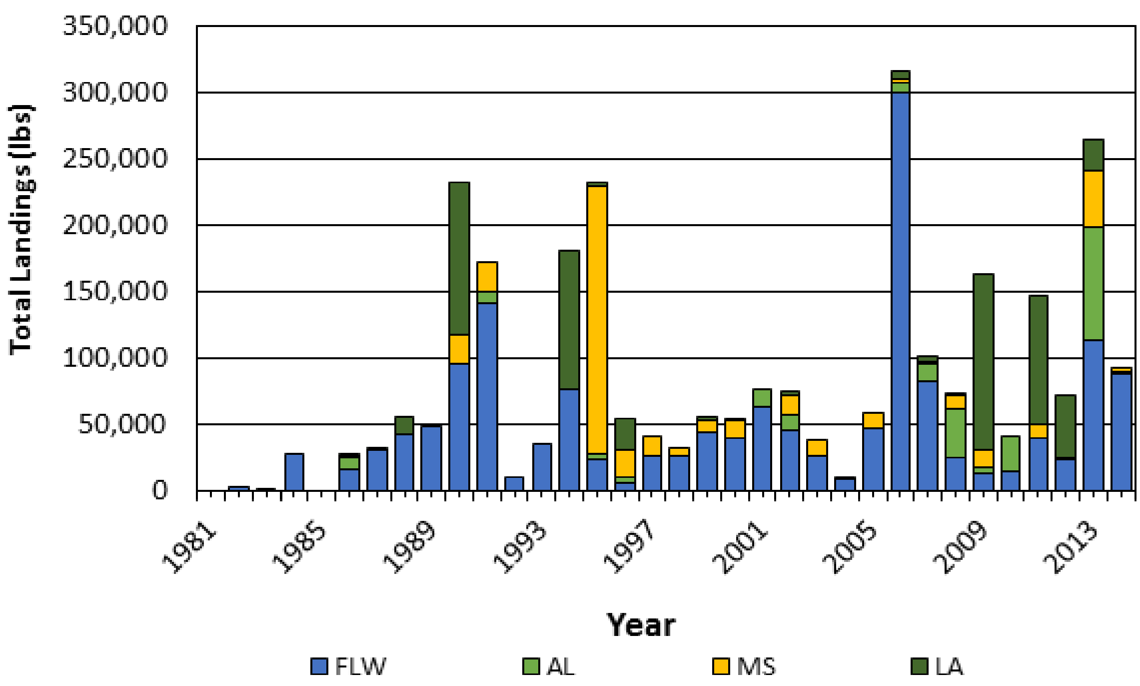


Figure 6.5 Total recreational landings from MRFFS/MRIP for tripletail in the Gulf (not including Texas, which records numbers, not weights, of fish) from 1981-2014 (NOAA unpublished data). **Note:** 2014 Louisiana data collected through LA Creel, not MRIP, and is not included.

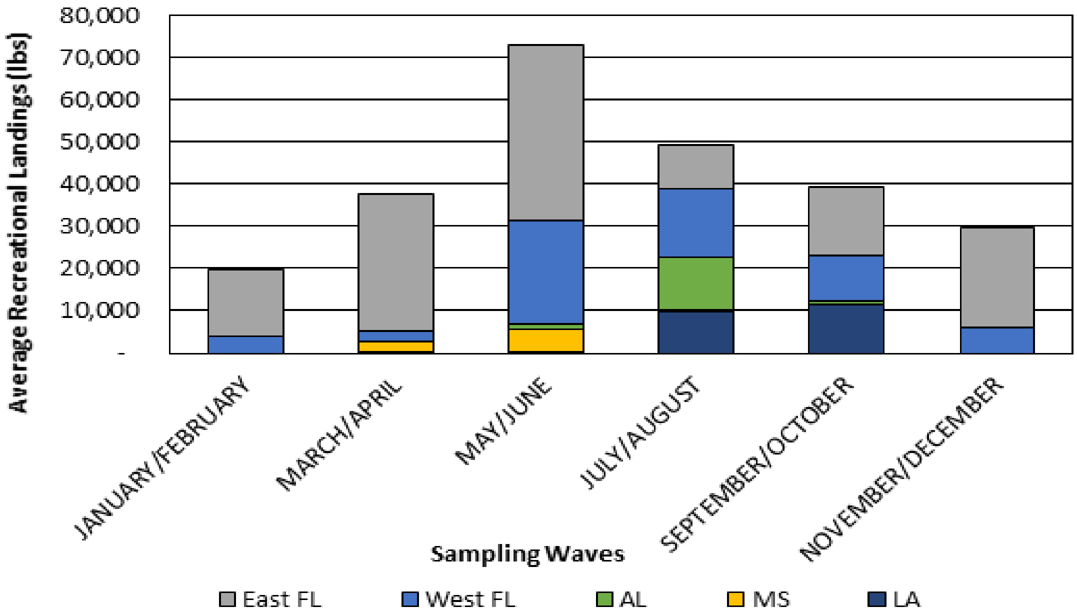


Figure 6.6 Average recreational landings from 2000-2014 by MRFSS/MRIP sampling wave (two-month) for Florida (east and west), Alabama, Mississippi, and Louisiana (NOAA unpublished data). Note: 2014 Louisiana data collected through LA Creel for 2014, not MRIP, and is not included.

unpublished data). Assignment draws for the MRIP Access Point Angler Intercept Survey (APAIS) tend to be weighted toward high-volume Gulf-access launches and marinas during the summer, and specialized tripletail anglers tend to use smaller, low-volume bay-access launches (AMRD personal communication). Also, the shift in NOAA protocols from MRFSS to the APAIS in 2013 could impact the recent estimates of tripletail landings. Under the MRFSS protocol, intercepts of tournament and rodeos were not allowed. This excluded some anglers who targeted tripletail in an attempt to place in tournaments.

The most popular mode of fishing for tripletail is via private/rental boat, encompassing approximately 98% of the MRIP estimate of landings in Alabama from 1981-2014. The remainder of the landings estimates comes from charter vessels and, though some catch is recorded from shore mode fishing, shore

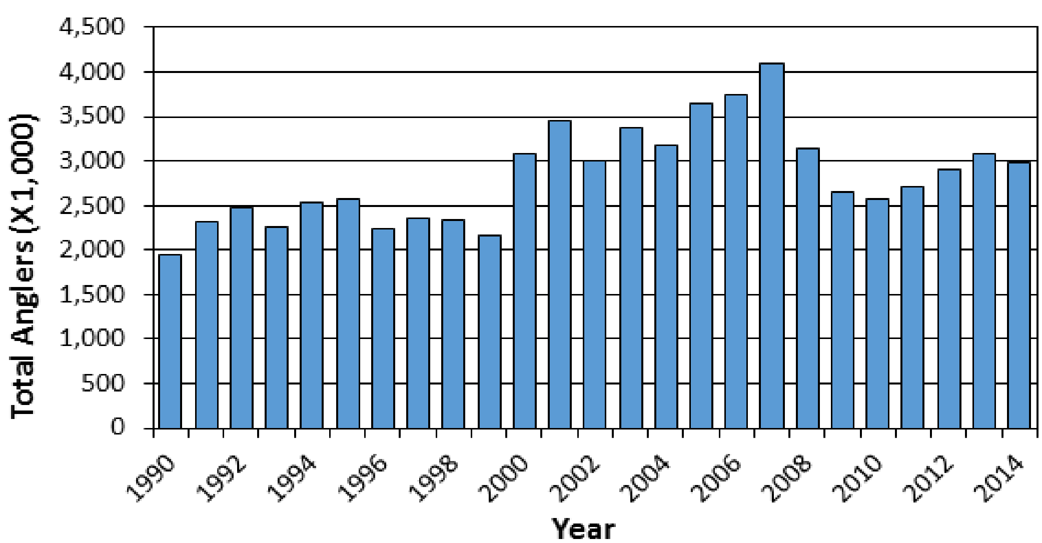


Figure 6.7 Estimate of Florida residents participating in recreational saltwater fishing from 1990-2014 (NOAA unpublished data).

catches are few and typically released. The majority of the reported landings from the aforementioned time period, approximately 77%, come from anglers fishing predominantly inshore waters. A little over 4% of the landings are reported from anglers who described their trips as taking place mostly within Alabama state waters of the Gulf of Mexico (less than three miles), and over 18% of the landings are reported from trips that took place mostly in waters beyond the three-mile boundary.

Anglers in Alabama typically fish for tripletail around crab floats, buoys, and other structures including channel markers, pilings, and, at times, bridge and dock structures. Catches of tripletail occur with highest frequency in July and August though landings have also been reported between the months of May and October (NOAA unpublished data; Figure 6.6). A small group of recreational anglers target tripletail specifically and have developed a technique to capture the wary fish. Locally known as 'blackfishing,' the method involves the angler utilizing a very long cane pole and live bait. The angler can ease the boat toward a piling or crab trap float while maintaining enough distance so as not to spook the fish, then drop the bait near the structure. If there is no bite after a couple of tries, the angler moves on to the next piece of structure (Shipp 1999).

In addition to MRIP, between 1995 and 2010, the AMRD also administered a roving creel survey where samplers encountered anglers on the water within predetermined inshore areas. Anglers were asked about their target species and any fish harvested were weighed and measured. During that period of time, only two tripletail were measured and those measurements were obtained during the peak summer season. (AMRD unpublished data).

Recreational angler participation in the 1990s remained relatively stable; however, between 2000 and 2013, participation in Alabama has more than doubled, (NOAA unpublished data; Figure 6.8). Considering the low estimate tripletail harvest each year, the number of anglers actively targeting tripletail in Alabama is likely a small percentage of the total saltwater anglers in the state. Tripletail are generally considered a 'bonus fish' for Alabama saltwater anglers.

MISSISSIPPI

The Mississippi Sound, which is bordered to the south by five barrier islands, provides a unique fishery for tripletail. These islands allow *Sargassum* and other open water surface structures to enter the sound

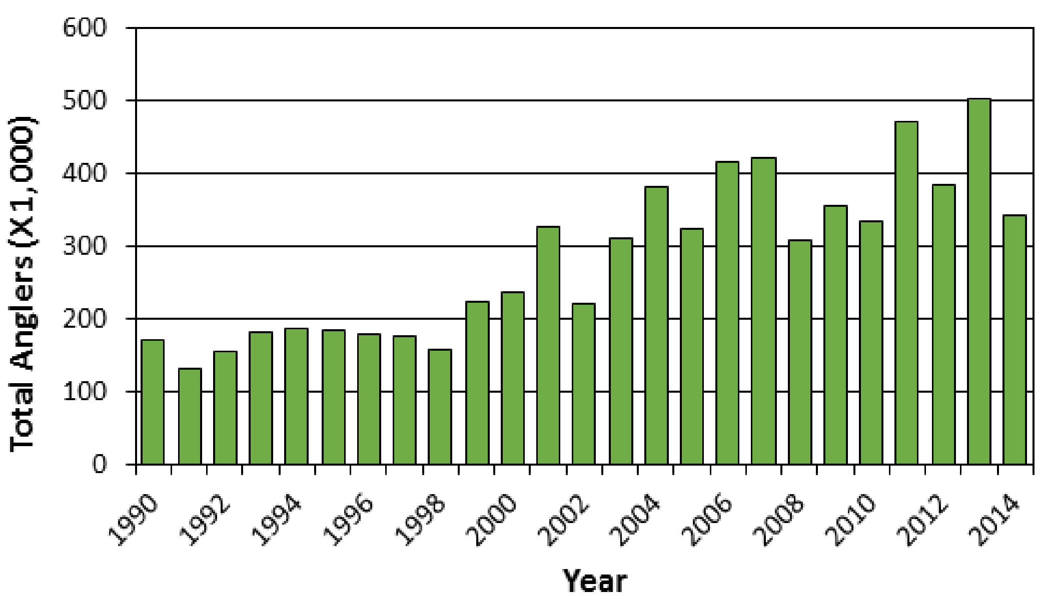


Figure 6.8 Estimate of Alabama residents participating in recreational saltwater fishing from 1990-2014 (NOAA unpublished data).

through the island passes; these materials are retained in the Sound and give tripletail an abundance of surface structure to hold to. Two large shipping channels lined with markers provide permanent structures as well. Unlike other regions, tripletail are not found as often in Mississippi's coastal bays (Bay St. Louis and Biloxi Bay). The Mississippi Sound, from the coastline to the barrier islands, seems to be the primary summer and early fall holding area where tripletail are present.

Recreational fishing for tripletail in Mississippi waters has become increasingly popular in recent years, although the number of Mississippi residents has not increased much over the last 25 years (Figure 6.9). Creel surveys within the state have shown an increasing trend of trips specifically targeting this species though the landings remain relatively small (Figure 6.5). Anglers begin targeting tripletail in late April and continue their effort until waters start to cool, usually in October. The highest landings usually occur in late July and August and seem to coincide with the highest water temperatures in the area (Figure 6.6). The large blue crab fishery in the region provides an abundance of crab trap floats (markers) that attract tripletail in these nearshore waters, which makes these crab trap floats an attractive target for anglers.

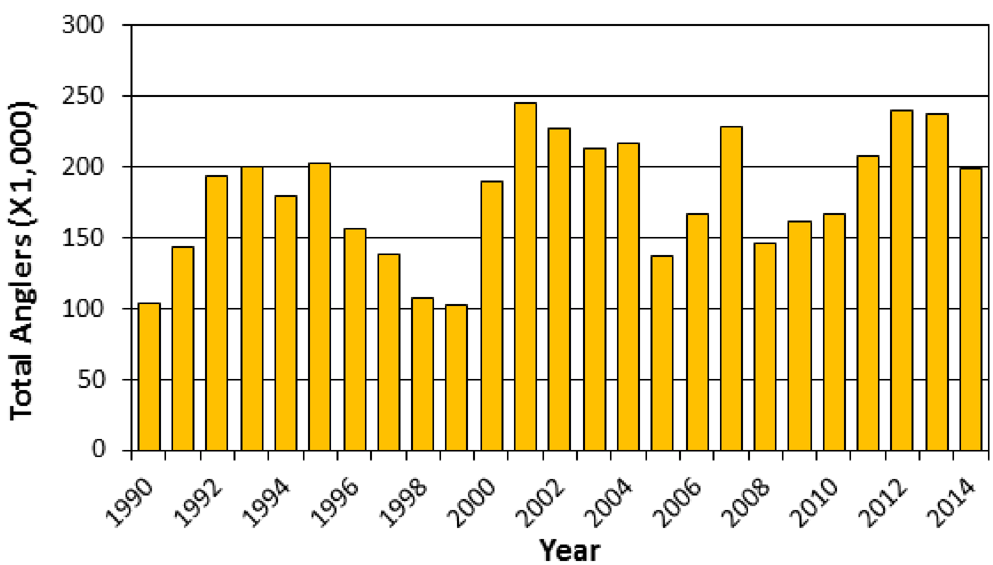


Figure 6.9 Estimate of Mississippi residents participating in recreational saltwater fishing from 1990-2014 (NOAA unpublished data).

It is not uncommon for anglers to travel from the Louisiana state line, through Mississippi waters all the way to the Alabama state line targeting tripletail holding on crab trap floats. Techniques for targeting tripletail in Mississippi are similar to other regions with sight fishing live baits, with live tackle, or fly-fishing with shrimp fly patterns. Only in the past 10 years have for-hire and charter captains specifically offered trips targeting tripletail in the Mississippi Sound. Increased interest and participation will most likely continue as the knowledge of the species becomes more prevalent.

LOUISIANA

Recreationally landed tripletail in Louisiana are primarily caught during July-October but in very low numbers. Tripletail landings in Louisiana have ranged from no reported catches to around 120,000 lbs, but since 2000 have averaged around 32,000 lbs annually (Figure 6.5). Anglers encountered their highest numbers of tripletail in 1990, 1994, and 2009, the only years the landings exceeded 100,000 lbs. Again, landings reported by NOAA have high levels of uncertainty as seen in the PSEs, which have averaged 76% since reporting began in 1981. P. Cooper (personal communication) reports that, in addition to natural

Sargassum, a wide variety of flotsam in Louisiana waters, including materials like buckets, hard hats, and wooden pallets, provide great habitat for tripletail. The most common bait Cooper found effective for tripletail were small swimming crabs and red shrimp, as well as slow sinking artificial flies (P. Cooper personal communication).

While tripletail can occur statewide in Louisiana, encounters are highly variable and localized from year to year. Areas of the state that seem to produce consistent recreational landings are along the West Delta region near Plaquemines Parish, the Lake Borgne and Mississippi Sound, and the Sabine and Calcasieu Lake areas. P. Cooper (personal communication) reported that most of the anglers he has spoken with find the fish west of the Mississippi River and east of Grand Isle and Golden Meadow, up into Little Lake. According to the NOAA landings by wave (Figure 6.6), the majority of the tripletail recreational landings in Louisiana occur from July-October, although a small number of fish are landed as early as March.

Like the other Gulf states, recreational saltwater angling in Louisiana has increased over time with angler participation nearly doubling to an annual average of approximately 800,000 anglers since the 1990s (NOAA unpublished data; Figure 6.10). Again, it is likely that not many anglers target tripletail specifically but do fish them when they are encountered.

Texas

Tripletail are an infrequent visitor to Texas waters but there are occasional catches along much of the coast. Texas collects its recreational landings based on numbers of fish and the comparison with other Gulf states is in Figure 6.11. The highest landings inshore originate from the Matagorda region (TPWD unpublished data). Conversely, Sabine and Galveston report the most offshore landings with a general decline moving further south. Inshore areas produce the most tripletail in the majority of years with a few exceptions (Figure 6.12). Matagorda Bay is one of the few places along the Texas coast where anglers actively target tripletail and look forward to their migration each summer. In a Houston Chronicle article that interviewed TPWD biologists and several recreational fishermen, M. Talasek, a fishing guide in Matagorda Bay, indicated that as many as 15-20 boats fish the buoys in the bay on a daily basis during the summer looking for tripletail and regularly return with fish in their coolers (Tompkins 2005). That was not

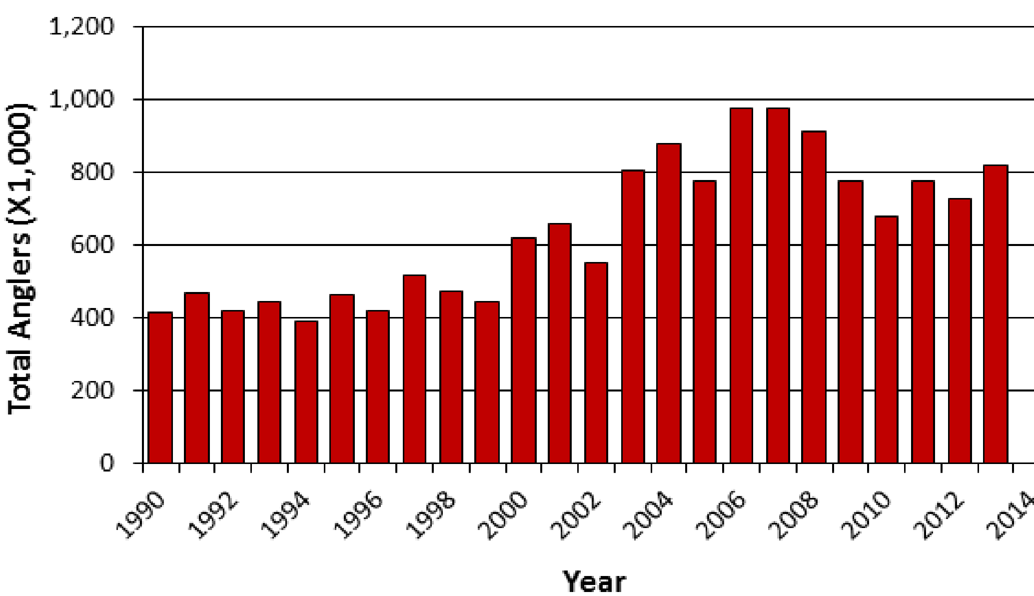


Figure 6.10 Estimate of Louisiana residents participating in recreational saltwater fishing from 1990-2013 (NOAA unpublished data). **Note:** Data for 2014 was collected through the LA Creel and are not available.

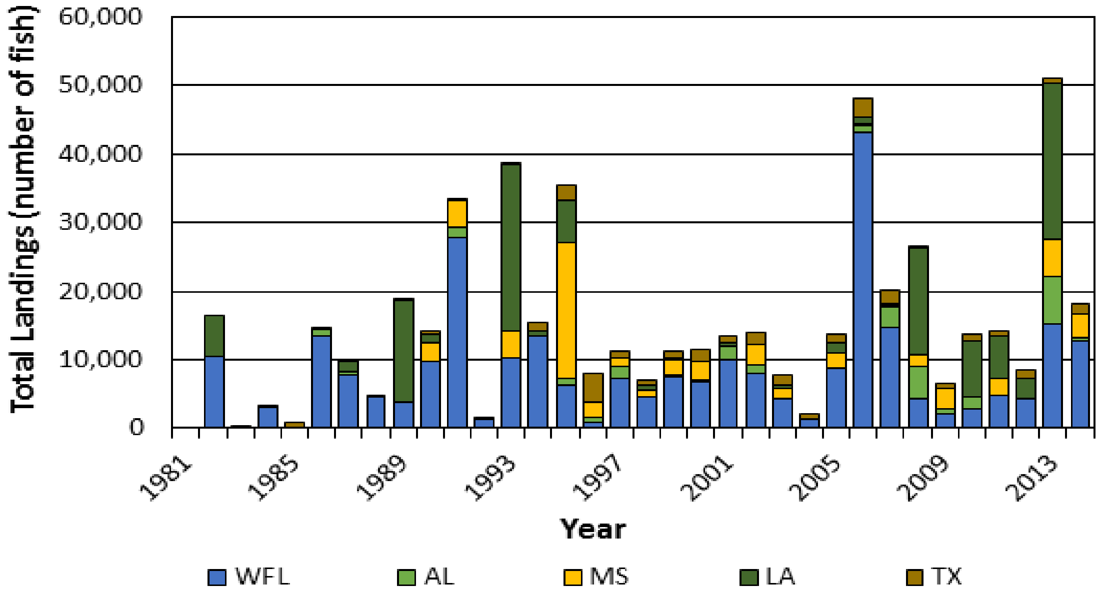


Figure 6.11 Recreational landings of tripletail (by number) from West Florida to Texas from 1981-2014 (NOAA unpublished data and TPWD unpublished data). **Note:** 2014 Louisiana data collected through LA Creel, not MRIP, and is not included.

the case 20 years ago. The second highest tripletail landings originate from the Gulf of Mexico waters off Sabine Pass. Overall, Texas has produced less than 20% of the total Gulf of Mexico landings (by number) of tripletail since 2000 and around 9% of the total production for the Gulf of Mexico and southern Atlantic combined (NOAA unpublished data, TPWD unpublished data; Figure 6.11).

The estimated number of saltwater anglers in Texas ranged from a low of 816,728 in 1978 to a high of 1.1M in 1983. Since 2000, the number of saltwater anglers has averaged just under 1.0M (Table 6.2). As in the other Gulf states, very few Texas anglers likely actively target tripletail. The overall sport boat fishing pressure (in man-hours) generally increased throughout the 1980s and 1990s to a high of about 8.1M man-hours in 2000, but has averaged around 6.3M man-hours since (Figure 6.13).

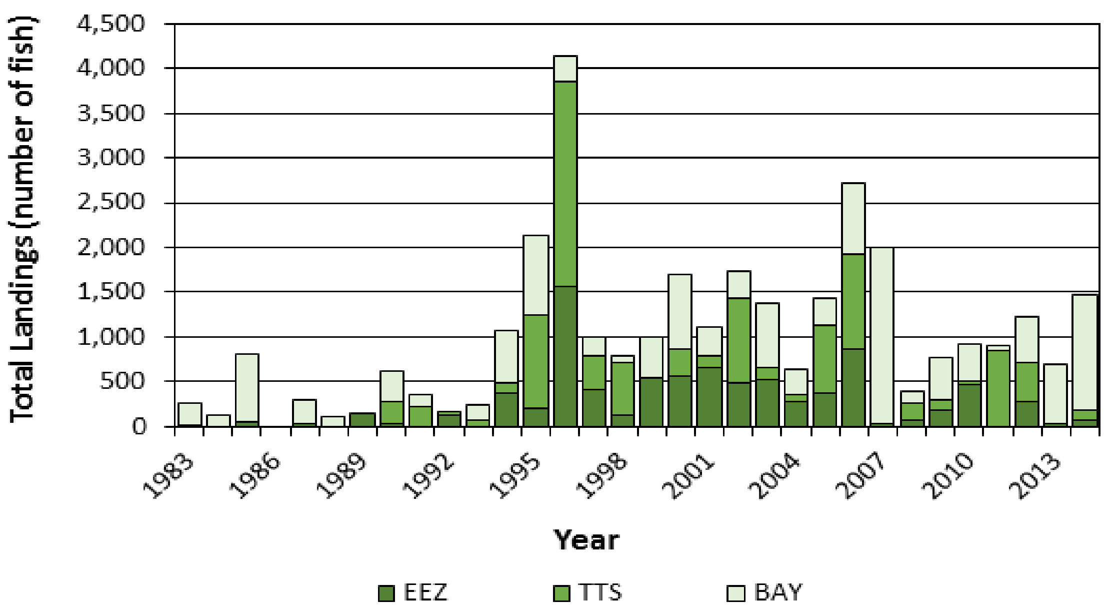


Figure 6.12 Estimated number of tripletail landed recreationally in bays, Texas territorial seas (TTS), and the EEZ from 1983-2014 (TPWD unpublished data).

Table 6.2 Total estimated number of recreational saltwater anglers in Texas from 1977-1978 to 2013-2014 (Green and Campbell 2010 for 1977-1978 through 2007-2008 and TPWD unpublished data for 2008-2009 through 2013-2014). Fiscal year is Sept-August.

Fiscal Year	Estimated number of Saltwater Anglers[1]	Fiscal Year	Estimated number of Saltwater Anglers[1]
1977-1978	816,728	1996-1997	914,927
1978-1979	972,772	1997-1998	929,768
1979-1980	989,967	1998-1999	951,818
1980-1981	1,019,736	1999-2000	943,490
1981-1982	1,092,419	2000-2001	957,045
1982-1983	1,133,226	2001-2002	945,614
1983-1984	1,029,843	2002-2003	940,763
1984-1985	1,037,203	2003-2004	923,808
1985-1986	1,053,828	2004-2005	913,834
1986-1987	1,037,414	2005-2006	895,963
1987-1988	1,072,518	2006-2007	917,238
1988-1989	1,044,619	2007-2008	1,002,793
1989-1990	1,070,922	2008-2009	1,006,601
1990-1991	1,080,071	2009-2010	981,925
1991-1992	989,645	2010-2011	1,019,885
1992-1993	1,007,227	2011-2012	780,000
1993-1994	1,029,095	2012-2013	816,000
1994-1995	983,715	2013-2014	841,000
1995-1996	952,397		

[1] Estimated number of saltwater anglers = fishing license total / 0.67 x 0.38; where 0.67 adjusts for anglers that fish without a license and 0.38 adjusts for anglers that fish in saltwater; based on Green et al. (1982).

Georgia

Considering that the epicenter of tripletail fishing in the U.S. occurs from about Fort Pierce, Florida to Georgia's Jekyll Island, it is appropriate to include Georgia in the general discussion regarding tripletail. Tripletail fishing in Georgia begins in March and continues through about mid-November with May through mid-June marking the peak for occurrence of fish (Figure 6.14). The migration of fish into coastal Georgia during the summer months is believed to be tied to spawning (Merriner and Foster 1974, Ditty and Shaw 1994, Cooper 2002, Strelcheck et al. 2004). As a result, recreational anglers have learned to target the fish during this period but, as with the other states, the NOAA landings are very suspect with extremely high PSEs, around 76% on average, suggesting that very few intercepts result in a wide range of expanded landings (GADNR personal communication).

According to NOAA, there is an estimated average of 220,000 residents who participate in saltwater fishing in Georgia waters (Figure 6.15). It is unknown how many of those anglers actively target tripletail, but the GADNR has an extensive finfish tagging program which added tripletail in 2001. GADNR indicates that while there are about a dozen anglers who contribute to the tripletail tagging effort in Georgia's Cooperative Angler Tagging Project, about half of those tag the majority of the fish (McDowell personal communication).

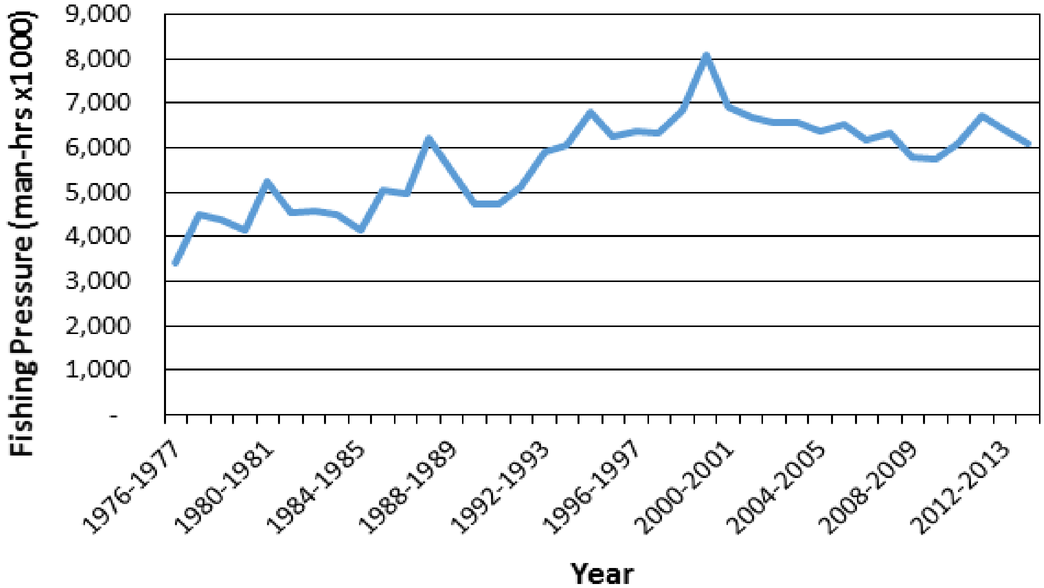


Figure 6.13 Sportboat fishing pressure in Texas marine waters from May 1976 to May 2014. Sport boats = private boats and party boats combined. Texas marine waters = bays/passes (1976-1977 through 2013-2014), TTS (1983-1984 through 2013-2014), and EEZ (1983-1984 through 2013-2014). [Green and Campbell 2010 (1976-1977 through 2007-2008) and TPWD unpublished data (2008-2009 through 2013-2014)]. Survey year = May 15 of one year to May 14 of next year.

There are two distinctly different recreational fisheries that target Georgia tripletail, a nearshore sight-casting, open water fishery and an inshore structure-based fishery (Woodward personal communication). The sight-cast anglers operate from April-June, especially around Jekyll Island, when water quality is good. Anglers drift through the area and look for fish migrating through to the inshore areas. Brown (2013) indicated that fishing guides around Jekyll Island idle along the beaches and continuously search until they locate a fish for customers to target. Woodward (personal communication) reports that this

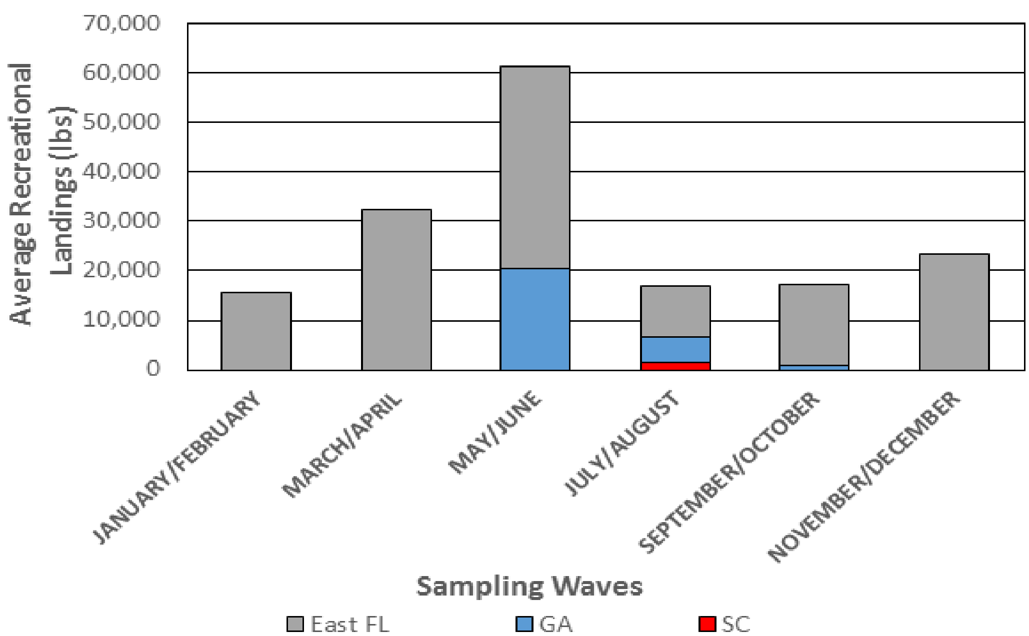


Figure 6.14 Average recreational landings from 2000-2014 by MRFSS/MRIP sampling wave (two-month) along the Southern Atlantic; East Florida, Georgia, and South Carolina (NOAA unpublished data).

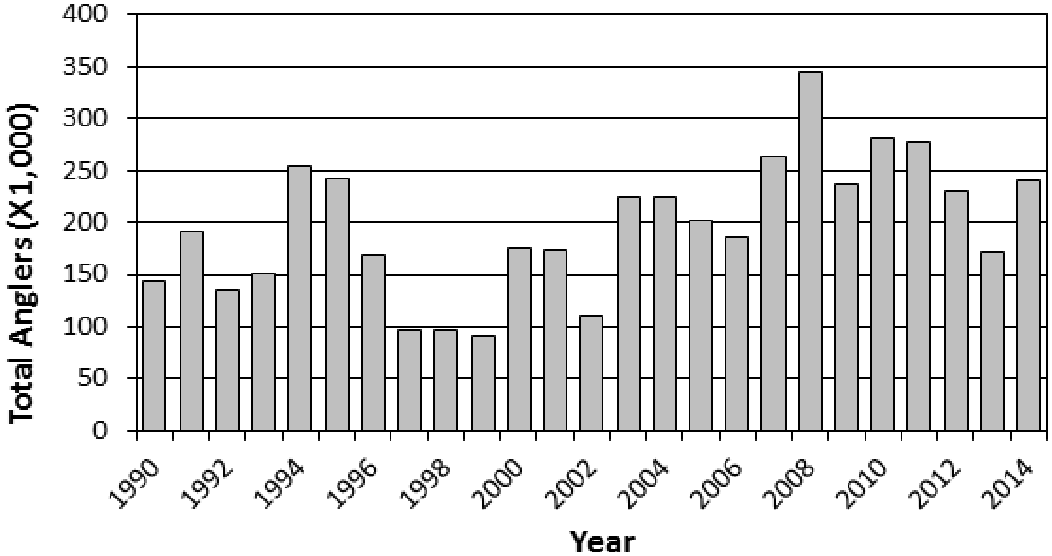


Figure 6.15 Estimate of Georgia residents participating in recreational saltwater fishing from 1990-2014 (NOAA unpublished data).

makes up a very small portion of the Georgia anglers' tripletail effort however. In contrast, the larger and more productive component of the recreational fishery is the group that cruises fixed structures inshore, similar to the other states where tripletail occur (Woodward personal communication). These structures include navigational markers, buoys, and bridge pilings. Woodward (personal communication) reports that there is no way to estimate the number of anglers who participate but that more people have taken an interest over the last decade; but again, the NOAA participation estimates are probably not accurate.

Caribbean (U.S.)

Landings in the Caribbean are reported exclusively from Puerto Rico. The MRFSS and MRIP programs started collecting landings data in Puerto Rico in 2000; despite the number of intercepts being fairly low, the error associated with recreational landings of tripletail averages just under 50% since 2000.

According to the landings collected since 2000, tripletail are taken both inshore (<10 miles) and offshore (>10 miles) of Puerto Rico, but there is not a consistent pattern. This may be an artifact of the annual abundance and spatial distribution of *Sargassum* along the coast. For example, in 2013, all the tripletail were harvested from nearshore Puerto Rican waters, but in 2014 all were caught offshore (Figure 6.16). It should be noted that both 2013 and 2014 were relatively low years for harvest. The highest harvests of tripletail were in 2003 and 2005 (71,309 and 65,755 lbs respectively; Figure 6.17).

Landings for tripletail are predominantly from hook-and-line anglers but a number of fish are taken by spearfishing as well. In Puerto Rico, a professional spearfishing guide indicated that most tripletail are found off the coast while fishing for dolphin (*Coryphaena hippurus*) because of the similar association with S*argassum* and debris (Reyes personal communication). He reported dolphin have two runs in Puerto Rico, a large run along the north coast in November and December and a smaller run along the southern coast February through May. According to NOAA (unpublished data), the majority of tripletail are harvested in Puerto Rico in November and December (Figure 6.18), which coincides with the more abundant dolphin run.

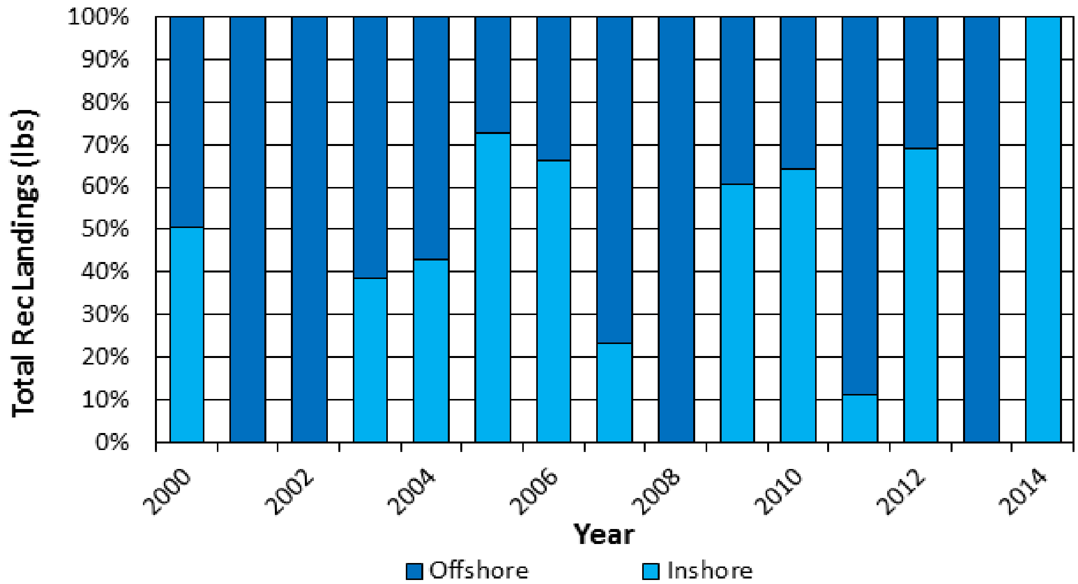


Figure 6.16 Percent of total recreational landings (lbs) of tripletail from Offshore (>10 miles) and Inshore (≤10 miles) off the coast of Puerto Rico from 2000-2014 (NOAA unpublished data).

World Fisheries

There are only a few countries outside the eastern Atlantic basin that report any commercial landings of tripletail. These include Australia, Malaysia, and Mozambique (Pauly and Zeller 2015). The majority of the world production of tripletail is derived from the region referred to as the North Brazil Shelf Large Marine Ecosystem (Phillips 2007). It extends from the boundary with the Caribbean Sea, just off Venezuela, to the Parnaíba River estuary (Brazil) to the southeast (Lara 2003; Figure 6.19). This area of the South American coast is characterized by a wide shelf and is entrained by waters from the South Equatorial Current. The region is heavily influenced by the equatorial climate which drives the heavy rainfall and seasonality associated with the Amazonian region (Ton et al. 2016). The majority of the world's tripletail landings are attributed to the five countries which make up this region: Venezuela, Guyana, Suriname,

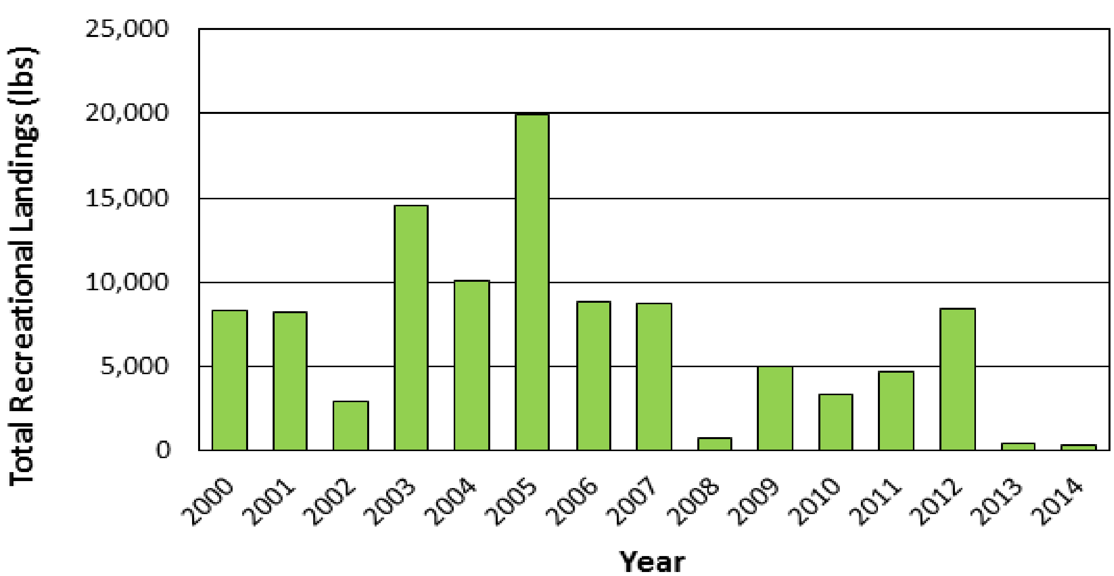


Figure 6.17 Recreational landings of tripletail in the waters of Puerto Rico from 2000-2014 (NOAA unpublished data). The MRIP survey has only been conducted in Puerto Rico since 2000.

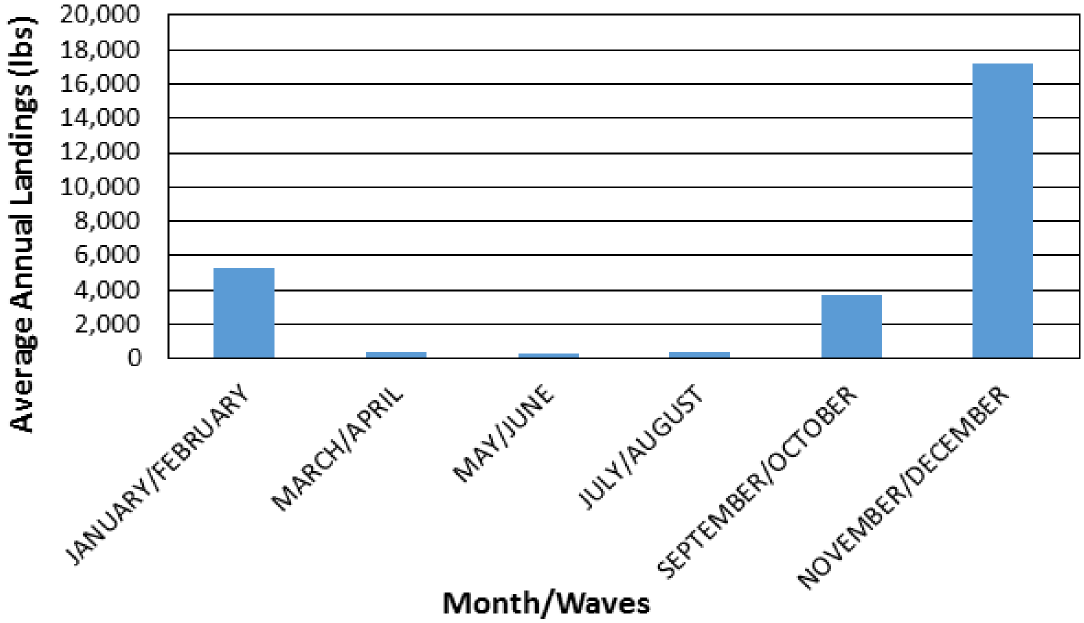


Figure 6.18 Average recreational tripletail landings from Puerto Rico from 2000-2014 by two-month wave (NOAA unpublished data).

French Guiana, and Brazil. Since 2000, around 70% of the world's commercial tripletail landings, around 2.2M lbs annually, originated from Guyana (Figure 6.20, Table 6.3). In addition to reported landings, there are large quantities of fishery products which are underreported or unreported in the artisanal and subsistence fisheries throughout the region (MacDonald et al. 2015, Hornby et al. 2015, Harper et al. 2015). Additional harvest likely occurs throughout the Caribbean islands, but there is little to no data available for these areas; hence understanding the dynamics of a commercial fishery in these areas is difficult due to a lack of robust management and data reporting. For example, St. Lucia and Trinidad and Tabago, combined, report just under 1,000 lbs of tripletail annually from 2000-2010 (Pauly and Zeller 2015). Although minimal tripletail landings occur elsewhere, this section will provide an overview of the five primary tripletail producing counties that make up the North Brazil Shelf Large Marine Ecosystem (Figure 6.20).

Suriname appears to be the primary exporter of tripletail to the U.S. based on observations made during the development of this biological profile (Franks personal observation). The extent of importation into the U.S. is variable but common, with many boxes of whole fish and fillets passing through broker houses in Miami that arrive from Suriname and Panama. The Panamanian fish are labeled as *Lobotes pacificus* and likely do not originate from Gulf of Mexico waters. In 2005, a shift in fishing effort, or at least in reporting, seems to have occurred from Suriname to French Guiana. Contacts in French Guiana indicate that unreported or illegal landings from the region may be twice as much as the reported landings (Franks personal communication). The IICA (1997) report on Suriname confirmed this stating, "the prevalence of illegal fisheries and the generally unreliability of landing statistics for the industry is [due to a] lack of regulation."

Venezuela

Fishing for tripletail in Venezuela is primarily conducted by the artisanal fishery that has landed around 250,000 lbs annually since 2006 (Table 6.3). However, in the prior 15 years (1991-2005), landings were only around 40,000 lbs and no tripletail landings were recorded at all before 1989 (Pauly and Zeller 2015). Fisheries data are collected by the Instituto Socialista de la Pesca y Acuicultura (INSOPESCA)

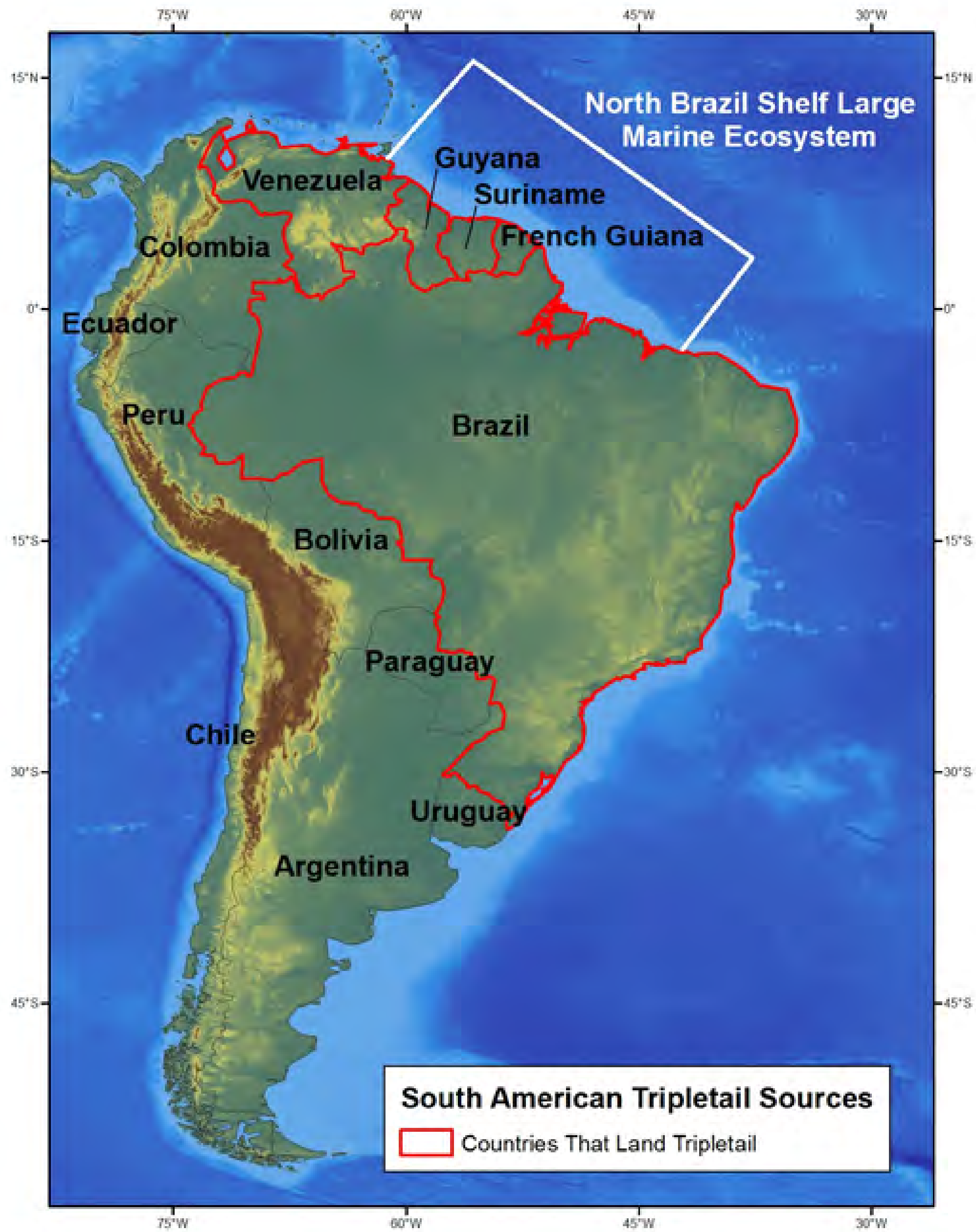


Figure 6.19 South America and the area of the North Brazil Shelf Large Marine Ecosystem (NBSLME). Tripletail landings in the Caribbean are only reported from those countries along the NBSLME. Additional landings occur along the east and southeast Brazilian coast to Uruguay.

in the 11 coastal states (Mendoza 2015). INSOPESCA tracks the foreign port landings by Venezuelan vessels, which operate in Suriname and French Guiana in return for agreements regarding fuel supplies to those countries. INSOPESCA notes, however, that there is a large amount of fishery products which are under-reported or never reported in Venezuela. In addition, there are a number of landing sites for the coastal fishery that are not associated with major processing plants where the fisheries data are collected (Mendoza 2015).

Overall, the small-scale fisheries (artisanal, subsistence, and recreational) provided the majority of Venezuela's entire marine production (79%) since 1950 (Mendoza 2015). The largest component of the artisanal fishery in Venezuela is the coastal fishermen who target sardines, the bivalve turkey wing (*Arca ventricosa*), and a variety of drum. There are around 14,000 wooden vessels in the artisanal fishery which

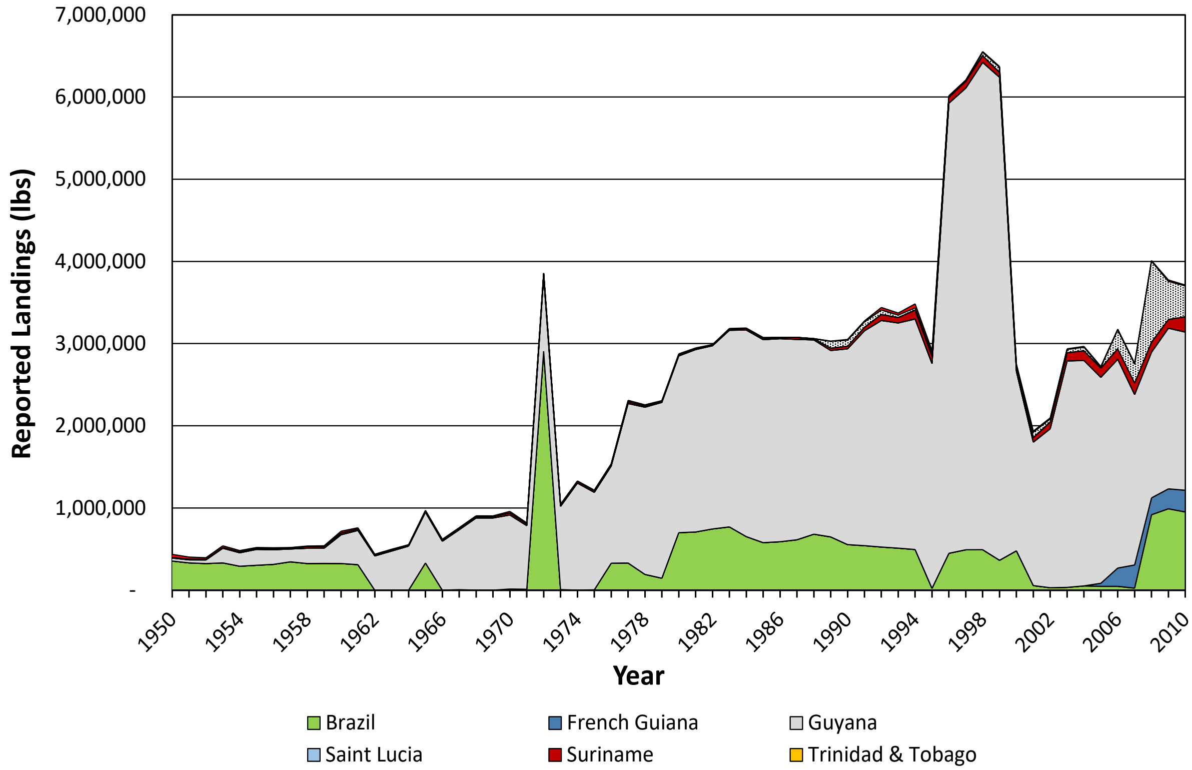


Figure 6.20 Reconstructed fisheries data for the South American countries that make up the North Brazil Shelf Large Marine Ecosystem and the U.S. from 1950 to 2010 derived by Pauly and Zeller (2015) which combines official reported data extracted from the Food and Agriculture Organization of the United Nations (FAO) FishStat database.

range in size from 20-30 feet with one or two outboard motors. Mendoza (2015) notes that when these vessels are fishing, they may work with other boats depending on the gear, each having a crew of three. The most common gears include handlines, longlines, gillnets, and a variety of seines. Additional effort is provided by the medium-range vessels which are more likely to operate in other neighboring countries as well as the Venezuelan EEZ. Mendoza (2015) describes these vessels as more industrial, utilizing diesel power and larger crews (5-7). These vessels are wooden and roughly 30-50ft in length.

Alcalá and Sánchez-Duarte (2011) summarize the flora and fauna around the Orinoco River and mention tripletail (*dormilona*) as both juveniles and adults. They report that juveniles occur in the estuary and river proper, typically associated with vegetative debris, and adults occur less frequently in the delta region of the river during the dry season (November to May) in the Caño Manamo tributary of the Orinoco (Alcalá and Sánchez-Duarte 2011).

While there is a large recreational (sportfish) fishery in Venezuela, this fishery targets offshore pelagics, primarily billfish species (Mendoza 2015), and there are no records of recreational landings for tripletail (Pauly and Zeller 2015). A quick search on the internet yielded no fishing guide or charter vessel opportunities which advertise tripletail, although there were several pages which referred to surf fishing for dormilona (VanderKooy personal observation).

Guyana

The majority of landings of tripletail worldwide come from Guyana, located between Venezuela and Suriname (Table 6.3). MacDonald et al. (2015) provide an overview of the Guyanan fisheries which are dominated by the small-scale, artisanal fishery. The artisanal fishery participants utilize inshore gillnets and some handlines. The primary species are catfish, sharks, and several species of drum (MacDonald

Table 6.3 Tripletail landings (lbs) in the South American countries making up the North Brazil Shelf Large Ecosystem Region from 2001-2010 (Pauly and Zeller 2015).

Year	Venezuela	Guyana	Suriname	French Guiana	Brazil	Grand Total
2001	65,925	1,744,697	55,384		55,931	1,921,938
2002	38,328	1,934,120	80,466		29,873	2,082,787
2003	40,333	2,755,222	99,041		34,105	2,928,701
2004	44,760	2,742,124	118,198		52,117	2,957,199
2005	12,417	2,505,411	112,930	37,479	46,650	2,714,887
2006	229,668	2,540,270	127,121	222,667	46,606	3,166,331
2007	229,599	2,073,196	141,426	282,191	24,626	2,751,039
2008	986,588	1,772,266	122,209	205,030	917,958	4,004,051
2009	463,498	1,954,372	105,883	242,508	990,474	3,756,735
2010	375,855	1,924,211	186,136	264,554	951,406	3,702,163

et al. 2015). There is an industrial fishery which operates larger vessels in deeper waters targeting a variety of shrimp and seabob (*Xiphopenaeus kroyeri*; trawl) and snappers (longlines). Based on the reported landings for tripletail, the artisanal fishery has landed 100% of Guyana's 2.2M lbs average annual production since 2000 (Pauly and Zeller 2015).

The artisanal fleet expanded rapidly after 1971 when the Guyanese government banned imports of foreign fishing products, forcing increased domestic production to meet demand (Dragovich and Villegas 1982). Limited importation into Guyana returned starting in 1993 (MacDonald et al. 2015). The artisanal fleet is currently around 4,500 fishermen with only about 1,000 vessels (MacDonald et al. 2015), yet they land nearly half of the total production since 2000. In addition, MacDonald et al. (2015) estimates that 14% of the total annual landings in Guyana for all species went unreported by the subsistence fishery from 1950-2010. Since about 2000, industrial fishing pressure in Guyana has decreased while both subsistence and artisanal effort have increased, coupled with illegal fishing from foreign vessels (Ton et al. 2016).

The artisanal fleet in Guyana is small with around 1,000-1,200 boats ranging from small, 25-30 ft gillnet boats with outboard motors to large, 40-60 ft gillnet boats with gas or diesel engines (Maison and Haraldsson 2007). The majority are flat-bottomed, dory-type vessels with little draft made of wood locally (Chackalall and Dragovich 1981). Over half the artisanal catch is made with gillnets that range from 1,000-1,600m, are made of polyethylene, and are set and hauled manually from the boats (Chackalall and Dragovich 1981). About 60-70% of the vessel owners belong to fishing cooperatives that aid the fishermen process and sell their catch (FAO 2005). Between 1984 and 1993, the Guyanese government developed eight shore-based facilities to further improve the commercial fishing industry and provide better market opportunities to the various fishing sectors (Maison and Haraldsson 2007). The fishing port complexes are located in the area around Georgetown, Rosignol, Parika, Charity, and two unnamed coastal village (FAO 2000). Six of the facilities have been leased to cooperatives while the other two are operated by private companies (Maison and Haraldsson 2007). These facilities include harborage, workshops, fuel docks, ice, and cold storage; however, several recent online articles indicate that these facilities are generally lacking financial support to properly maintain them, and several have fallen into disrepair. The Canadian International Development Agency (CIDA), who helped develop the facilities, estimates that around 6,500 people are employed in direct fishing and processing in Guyana while another 6,000 are employed indirectly in service jobs for the fishery such as boat building, gear supply, and repair (CIDA unknown date).

Available data indicate that tripletail are harvested by recreational anglers in Guyana (Pauly and Zeller 2015). There are likely some catches, but there is very little information on recreational saltwater-fishing in Guyana. There are numerous accounts and websites dedicated to rod-and-reel and fly fishing in the rivers of Guyana but very little information on a coastal or offshore recreational fishery.

Suriname

Like Guyana, tripletail in Suriname are landed exclusively by the inshore artisanal fishery (Pauly and Zeller 2015). While the artisanal fishery is considered small-scale, it can be broken down into two distinct groups; an inshore fleet which utilizes canoes and a variety of seines, and a coastal fleet which fishes with drifting gillnets (Hornby et al. 2015). The coastal vessels, called "Guyana boats," are owned by Surinamese fishermen but crewed by Guyanese (Hornby et al. 2015). Landings of tripletail in Suriname have averaged around 100,000 lbs annually since 2000, though the underreported artisanal and unreported landings from subsistence fishing could possibly double the total harvest (Pauly and Zeller 2015). In addition, there have been recent accusations of landings by vessels from Guyana taking catches outside Surinamese waters (Hornby et al. 2015) which is a problem in a number of the South American countries.

The Fisheries Department of Suriname collects catch data from most of their fleets. To assist in this effort, all fish landed in Suriname are required to be landed at designated sites. One of the sites is CEVIHAS, a government landing and storage facility in the Port of Paramaribo (IICA 1997). In 2013, the Suriname Ministry of Agriculture, Livestock and Fisheries assisted in building a modern ice factory at the port which increased the ability of commercial fishermen to access ice and maintain better quality control over their fishery products (Republiek Suriname 2013).

The Port of Paramaribo is home to over 100 fishery vessels, most of which are trawlers that participate in the shrimp fishery and, to a lesser degree, finfish trawls, seabob trawls, and an offshore snapper fishery (van Ravenswaay and Chin-A-Lin 2005). In addition to the Surinamese snapper hook-and-line fleet, there are a large number of Venezuelan handliners moored at CEVIHAS. An agreement was signed in 1985 which allowed up to 100 vessels from Venezuela annually to fish in Surinamese waters; the number has been maxed out since 1997 (FAO 1985, van Ravenswaay and Chin-A-Lin 2005). The deal was part of a larger negotiation to acquire more favorable fuel supplies and prices to the fishing fleet and requires that the foreign fishing vessels must land part of their catch in Suriname (Starbroek News 2007). Global exportation of products from Suriname is much more cost-effective than from neighboring countries like French Guiana because the Suriname's Port of Paramaribo is a deep-water port, boasting 500-600 transoceanic ships annually; three times the number departing from French Guiana (AFD 2014).

Similar to Guyana, there are no records of recreationally landed tripletail in Suriname (Pauly and Zeller 2015). Little to no information on recreational saltwater fishing can be found on the internet, although there are a number of websites dedicated to freshwater fishing in the rivers of Suriname.

French Guiana

The artisanal fishery in French Guiana lands the majority of their tripletail locally, and annual landings average around 210,000 lbs. There are no reported landing of tripletail prior to 2005 (Pauly and Zeller 2015). The artisanal fishery primarily lands catfish, sharks, and a number of drum species (Ton et al. 2016; Table 6.4). Blanchard et al. (2011) characterized the artisanal fishery as small wooden vessels known as "Creole canoes" and larger "Guyana boats," locally called "Tapouille," which all participate in the gillnet fishery. The coastal fishery currently includes about 200 vessels (Cisse et al. 2014).

French Guiana is dominated by the mining industry with production and export of aluminum in support of aerospace driving the country's economy (AFD 2014). Only about 2% of the population of French Guiana is tied to natural resources (excluding mining), compared to about 12% of Suriname's workers who are involved with agriculture, fisheries, and forestry (AFD 2014). French Guiana employs only 600 people in the commercial fishing industry and exports around $16.7M (U.S.) in shrimp and other products. For comparison, the commercial fishing industry in Suriname employees approximately 5,000 people and exports around $99.2M (U.S.) in seafood annually (shrimp, red snapper, and whitefish).

French Guiana has an agreement with Venezuela regarding Venezuelan commercial fishing vessels (hand-lines and bottom longlines for snapper and grouper) similar to the agreement with Suriname. Under the agreement, the Venezuelan fleet may fish in their waters but must land 75% of the catch in French Guiana ports. The remainder of the catch may be landed in ports in Venezuela (Charuau and Die 2000). It is unknown how many tripletail landed in Venezuela originate from foreign waters such as French Guiana or Suriname (Mendoza et al. 2003).

Brazil

Brazil is the largest country in South America and has almost 8,500 km of coastline. Approximately 70% of the total population of Brazil lives along these coastal areas (Nascimento et al. 2013; Table 6.5). Historically, the greatest production of tripletail commercially came from the north and northeast regions of Brazil, which includes eleven coastal states, with the majority from the states of Pará and Maranhão (Freire et al. 2015; Table 6.5). These two regions produced the majority (52.2%) of the country's entire marine landings (Isaac et al. 2010, Santos et al. 2011). Three states in the southeast and south are the highest producers of commercial tripletail landings in Brazil in recent years: Rio de Janeiro, São Paulo, and, to a lesser extent, Santa Catarina (MPA 2008, Martins et al. 2014, Mendonça and Pereira 2014, Freire et al. 2015; Table 6.6). However, inconsistancies in the reporting programs in each state and changes to sampling regimes around 1994 and 1995 may have contributed to a lack of reported tripletail in the north and northeast regions since the mid-1990s (Freire et al. 2015). Additional literature indicates tripletail

Table 6.4. Main species of fish landed by the inshore (artisanal) fishery vessels in French Guiana (Table 1 *from* Ton et al. 2016).

Scientific Name	Local Name
Aspistor quadriscutis	Tit'gueule
Bagre bagre	Machoiran coco
Caranx hippos	Carangue
Carcharhinus falciformis	Requin soyeux
Carcharhinus limbatus	Requin à pointes noires
Centropomus undecimalis	Loubine noire
Chaetodipterus faber	Portugaise
Cynoscion acoupa	Acoupa rouge
Cynoscion steindachneri	Acoupa blanc
Cynoscion virescens	Acoupa aiguille
Genyatremus luteus	Croupia roche
Lobotes surinamensis	Croupia grande-mer
Megalops atlanticus	Palika
Mugil cephalus	Mulet
Rhinoptera bonasus	Raie mourina
Sciades proops	Machoiran blanc
Scomberomorus brasiliensis	Thazard
Sphyrna lewini	Requin Marteau halicorne
Sphyrna tudes	Requin Marteau à petits yeux

still occur in relatively high numbers in the commercial catch in the northeast state of Maranhão (Almeida 2008). Brazilian tripletail are mainly called by their Portuguese name, 'prejereba', but are also known as 'dorminhoco', 'croaçu', and 'chancarona'.

Northeast and North

Approximately half of Brazil's total fisheries production occurs along the north and northeast coast (Pinto et al. 2013). While tripletail are reported in the literature from these states, they do not appear in the official records of the Ministry of Fisheries and Aquaculture (Ministério da Pesca e Aquicultura or MPA) landings since 1994/1995 (Table 6.5). Those that are harvested probably stay in the domestic market and are not reported, unlike tripletail landed in the neighboring countries to the west (Fabio Hazin personal communication). According to the published literature, there are essentially three states which land tripletail along the North Brazil Shelf: Maranhão, Pará, and Amapá (Isaac et al. 2010, Santos et al. 2011, Freire et al. 2015).

In the state of Maranhão, which is southeast of the mouth of the Amazon River, the majority of the coastal population participates in artisanal fishing, primarily using a variety of entangling nets (Santos et al. 2011). The total commercial production for all species in Maranhão is around 10.1M lbs with the primary targets being Serra Spanish mackerel (*Scomberomorus brasiliensis*), corvina (*Macrodon ancylodon*), and catfish (Ariidae family). According to Santos et al. (2011), in Maranhão there are as many as 200 individual fishing communities that house up to 47,000 fishermen who live exclusively on artisanal fishing. In a summary of the fishing industry in Maranhão, Almeida (2008) reports artisanal harvest of tripletail from 2002-2007 averaged 142 tonnes (248,328 lbs) annually, although the landings data does not list tripletail for any of the northeast states.

East of Maranhão, along the north Brazilian coast, is the state of Pará which contributes about 20% of the country's fishery production (Isaac et al. 2010). Several ports exist along the estuarine waters surrounding the Amazon River. The waters around Pará are highly productive, in part due to the high nutrient load from the expansive mangroves forests. Isaac et al. (2010) reported that in 2000, just over 1,000 vessels operated in the ports of Pará. These vessels were dominated by an artisanal fleet of row boats and sailing skiffs (≈70%) that operated almost exclusively in estuarine or coastal waters of the Bragantine ports, with about half the total landings originating from the Rio Caeté estuary during the wet season (August to November). The most common gear for small scale fishing is gillnets, although there are also hand-lines, long-lines, pound nets, and traps (Figure 6.21). Larger offshore boats fish weakfish, snapper, catfish, and some lobster. The inshore fishery targets a wide variety of finfish as well as shrimp, crab, and some mussels (Isaac et al. 2010). Tripletail were not landed in high numbers during the survey period (2000-2001) reported by Isaac et al. (2010) but were the 26th most important out of 62 total species observed. Total production of tripletail was just over 35,000 lbs, comprising <1% of the total catch from the Bragantine region of Pará. Fishing along the state of Amapá occurs primarily during the wet season (December to July) when fish and fishermen are moved away from the mouths of the rivers (Isaac et al. 2010).

Southeast and South

Mendonça and Pereira (2014) report that fairly extensive artisanal fisheries that encounter tripletail using gillnet types of gear occur along the southern coast of Brazil. The report focuses on fishing activities near São Paulo, about 200 km south of the city of Rio de Janeiro. Mendonça and Pereira (2014) note that the estuarine component of the fishery encounters tripletail regularly; however, they are not clear on the magnitude of the landings. According to the official landings data from the MPA (2008), there is a large-scale 'industrial' fishery that fishes offshore in São Paulo, which lands about half of the region's commercial landings, and a small-scale, inshore, 'artisanal' fleet in Rio de Janeiro, which lands the other half (MPA 2008; Table 6.6).

Table 6.5 Landings of tripletail (prejereba) in coastal Brazil from 1950-2007 based on reconstructed commercial landings from Freire et al. (2015) and 2008-2014 landings estimates from the Instituto de Pesca, São Paulo (personal communication).

Year	Northern Region	Northeast Region	Southeast Region	Southern Region	Total
1971		2,205			2,205
1972	2,894,666				2,894,666
1973		6,614			6,614
1975		4,409			4,409
1976		15,432	282,191	50,706	348,330
1977		103,617	187,393	70,548	361,558
1978			33,069	68,343	101,413
1979			8,818	90,389	99,208
1980	191,802	469,584	15,432	30,865	707,683
1981	85,980	537,927	6,614	77,162	707,683
1982	59,525	619,498	30,865	59,525	769,412
1983	30,865	692,251	17,637	41,888	782,640
1984	28,660	588,634	17,637	28,660	663,591
1985	22,046	522,495	11,023	28,660	584,224
1986	35,274	518,086	2,205	35,274	590,838
1987	33,069	542,337	6,614	33,069	615,089
1988	59,525	593,043	17,637	19,842	690,046
1989	48,502	570,997	11,023	15,432	645,954
1990	41,888	540,132	9,921	26,455	618,396
1991	41,888	540,132	9,921	26,455	618,396
1992	41,888	540,132	9,921	26,455	618,396
1993	41,888	540,132	9,921	26,455	618,396
1994	41,888	540,132	9,921	26,455	618,396
1995	41,888		9,921	15,432	67,241
1996			7,716	12,125	19,842
1997			9,921	6,614	16,535
1998			16,535	3,307	19,842
1999			18,739	1,102	19,842
2000			46,297	2,205	48,502
2001			54,013		54,013
2002		248,328 [1]	29,762		278,090
2003		248,328 [1]	34,172		282,500
2004		248,328 [1]	51,809		300,137
2005		248,328 [1]	46,297		294,625
2006		248,328 [1]	46,297		294,625
2007		248,328 [1]	29,762		278,090
2008					39,683 [2]
2009					44,092 [2]
2010					26,429
2011					22,312
2012					30,812
2013					28,289
2014					38,692

[1] Additional average annual landings data reported by Almeida (2008) for the State of Maranhão.
[2] FAO derived estimates from FAO-FISHSTAT

Table 6.6 Commercial tripletail (prejereba) landings (converted to lbs) and values (converted to US$) in Brazil for 2006 (MPA 2008).

State	Average Price (US$/lb)	Industrial		Artisanal		Total	
		Landings lbs	Value US$	Landings lbs	Value US$	Landings lbs	Value US$
Rio de Janeiro	0.17	0	-	24,251	$ 4,211.10	24,251	$ 4,211.10
São Paulo	0.17	22,046	$ 3,828.27	22,046	$ 3,828.27	0	-
Total		**22,046**	**$ 3,828.27**	**46,297**	**$ 8,039.37**	**24,251**	**$ 4,211.10**

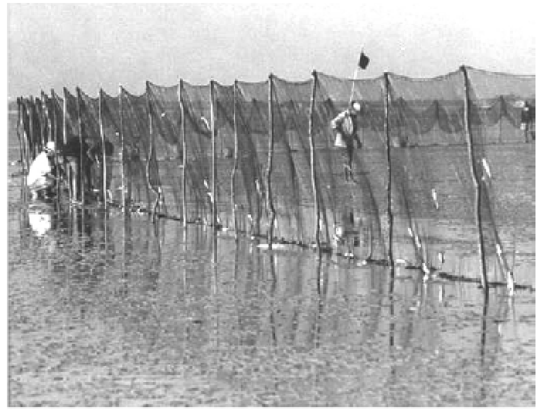
The artisanal fleet is characterized by small aluminum boats and fiberglass or wooden canoes (Mendonça and Pereira 2014). They estimated that around 1,700 vessels (bateiras) operated in 2010. In the State of São Paulo, the majority of artisanal fishermen focus on broadband anchovy from October to April and fish a wide variety of species, including tripletail, the remainder of the year. Mendonça and Pereira (2014) highlight that, despite having a relatively low fishing power, the fleet is very large with a large number of participants because of accessibility, and contributes around 97% of the landings for the region (Mendonça and Pereira 2014). The offshore industrial fleet numbered around 40 vessels in 2010. They are generally wooden boats averaging 40+ feet in length with engines ranging from 45-366 horsepower. These vessels (baleeiras) fish deeper water but also utilize gillnets (bottom and surface).

Additional tripletail have been reported in the region around Tajucas Bay in the State of Santa Catarina, approximately 50 km south of São Paulo (Martins et al. 2014), although no estimate of the total landings exists. Martins et al. (2014) points out that the communities in this region have a very high dependence on fishing as their principle source of income. The fishermen reported that tripletail occurred frequently, utilizing the bay as both nursery ground and foraging area.

In an effort to make improvements to the fishing communities, the MPA in Brazil began the development of state run fishing terminals (Terminais Pesqueiros Públicos or TPPs). Since 2004, the MPA has invested about $34.7M (U.S.) in the facilities that provide support equipment, cold storage, and ice factory to supply the fishing fleet. The terminals can operate 24 hours a day and have the capacity to process many tons of fishery products daily (ITAIPU 2014). They include floating piers which can moor many of the industrial vessels. The fish are taken from the piers to a production facility which is monitored for quality control by the Ministry of Agriculture, Livestock and Supply (MAPA) and marketed by seafood traders who share space in the building. In addition, most of the TPPs include fuel docks which provide subsidized diesel fuel. As of the date of this publication, there are 19 TPPs running, under construction or being built: Angra dos Reis, Aracaju, Belém, Beberibe, Cabedelo, Camocim, Campos dos Goytacazes, Canaanite, Salvador, Ilheus, Laguna, Manaus, Natal, Niterói, Puerto old, Recife, Santana, Santos, and Vitoria (Conepe 2015).

There are no data on the recreational fishery in Brazil but it is recognized to be very large, contributing considerably to the overall economy of the country (Freire et al. 2015). It is estimated that there may be over 250,000 recreational anglers in Brazil (Freire et al. 2016). However, not all of those licensed anglers fish marine waters and there is no data collection system in place for compiling recreational catch estimates (Freire et al. 2015). Freire et al. (2014) provided an overview of anglers participating in 20 years of fishing tournaments sponsored by fishing clubs in the State of Sergipe in the Northeast (1993-2013). Tripletail was reported as one of the three heaviest fishes caught in some of the fishing tournaments promoted in Sergipe. Freire (personal communication) provided a few of the 'record' fish submitted during these tournaments in Table 6.7.

Stationary pound net

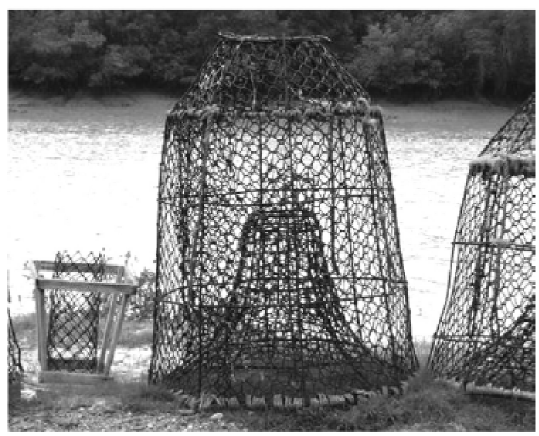


"Zangaria"- Fixed beach net

Gillnet

Long line

"Fuzarca"-Trap with net



Lobster trap

Figure 6.21 Principal fishing gear used by the Bragantine fishing fleet (Fig. 15.5 *from* Isaac et al. 2010).

Conducting an online search of sportfishing websites throughout Brazil, every coastal state lists tripletail as a common species for recreational anglers to target (VanderKooy personal observation). Their distribution is noted in somewhat generic terms but indicate that large fish are found offshore in association with floating objects while younger, smaller fish occur around the mouths of rivers and are associated with mangroves and other complex structures. The consensus is that tripletail season along the Brazilian coast is from October to February (summer) during either day or night. Similar to fish in the U.S., an assortment of baits will work from natural baits, such as sardines, to surface plugs and jigs. One webpage notes that "the meat is tasty, but is rarely found in the markets" (Pesca Amadora website). Nunes et al. (2012) note that at least one tripletail was harvested by a recreational spearfisher off the State of Bahia. Considering the behavior of tripletail, it would not be surprising if additional spearfishing effort was directed toward this species in the future. Freire et al. (2016) reports that spearfishing in Brazil has been practiced since at least 1970 and that a magazine promoting the sport was launched about that time.

Bycatch

Bycatch in a fishery can be classified into two different types: incidental catch and discarded catch. Incidental catch refers to retained or marketable catch of non-targeted species. Discarded catch is the portion of the catch returned to the sea because of regulatory, economic, or personal considerations. When possible, these terms will be used in this section; otherwise, the overall catch of non-targeted species will be described as bycatch.

The idea of bycatch, discarded catch specifically, is one of the most significant issues in fisheries management throughout the world. The concept of discarding undersized or non-target species that may not survive is generally considered a waste and many fisheries have attempted to deal with reducing waste through gear changes and modification, changes to fishing patterns, or the addition of specially developed devices. For fishermen in the U.S., the appearance of 'wanton discarding' often results in public outcry, environmental action, and user conflicts (Hall et al. 2000). The incidental mortality on non-target species may contribute to reductions in biodiversity and may have long-term ecosystem impacts by shifting the predator-prey balance (Harrington et al. 2005).

In the United Nation's Food and Agriculture Organization Code of Conduct for Responsible Fisheries (FAO 1995), it is stated that best management practices for fisheries should "minimize waste, catch of non-target species, both fish and non-fish species, and impacts on associated or dependent species." Currently, the Gulf states are struggling with that very issue. For most fisheries to gain designations of 'sustainable' in the marketplace, the management agencies must address how bycatch of non-target species is being minimized. In some cases, bycatch can include threatened and endangered species such as marine mammals, birds, and inshore and offshore populations of sea turtles. However, the bycatch issue is a problem generally found in more advanced fisheries that operate under well-developed management systems.

In a review on bycatch, Alverson and Hughes (1996) note that starting in the late 1980s the term 'bycatch' became synonymous with 'waste.' In addition, this was when many scientists began discussing

Table 6.7 Maximum size of tripletail (prejereba) reported by coastal recreational anglers in competitive rod and reel fishing events in the state of Sergipe, Brazil (Freire personal communication).

Tournament Tripletail (prejereba) (lbs)
10.7
17.9
26.7
13.0
17.3

that non-selective fishing degrades an ecosystem. Many of the less developed countries utilize fishing gear that is non-selective as a matter of economics. Most of the basic nets and traps used by small-scale, artisanal, or subsistence fishermen may not be intended to target any specific species, having relatively low selectivity; however, they are often set or deployed in conjunction with the temporal or spatial occurrence of highly desired and marketable finfish, making them much more selective at certain times. The gear used is often homemade, inexpensive, and basically disposable. Examples include flume and fyke nets built with sticks and reeds, fish traps built with locally available or recycled materials, or stone traps set as weirs to direct catch into a trap. More commercially available gear such as a variety of entangling nets are used for multiple species in multiple seasons and used nets can be turned into beach and haul seines, cast nets, or serve as components in other designs such as flumes and fykes. The total catch in these small-scale fisheries can be separated into the valuable marketable catch, the less valuable yet marketable catch, and the non-marketable catch which is frequently retained for personal consumption; thus, there are virtually no discards in many of these fisheries and likewise, very little is wasted as discards. The concept of bycatch being 'waste' is more applicable to advanced fishery management systems like those in the U.S. that don't rely on incidental catch as food. Countries which rely on subsistence fisheries make up much of the range of tripletail worldwide.

Commercial

In the U.S., tripletail is probably best characterized as an 'opportunity' species, meaning tripletail are not typically captured accidentally as bycatch, but may be targeted when encountered. Because of their close association with flotsam and fixed structures, tripletail are generally not caught in traditional commercial fisheries in the Gulf of Mexico and southern Atlantic. In nearshore areas, there has been a relatively high incidence of tripletail occurring in entangling type nets (Figure 6.1). These landings were likely associated with fishing for drum, mullet, and mackerel. Some shrimp trawlers report landings of tripletail, mostly from nearshore regions and typically in shallow water areas.

Recreational

The opportunistic nature of anglers encountering tripletail while fishing for other species would not classify tripletail as bycatch. As noted previously, this species generally has to be targeted with very specific fishing techniques, centered on sight casting, in order to achieve success. Anglers using techniques like jigging, bottom fishing, or trolling would not likely encounter tripletail or may not be aware of their presence. Anglers are more likely to encounter tripletail when passing navigational markers or other buoys, floats, or debris.

Chapter 7
ECONOMIC CHARACTERISTICS OF THE COMMERCIAL AND RECREATIONAL FISHERIES

Tripletail is a species that is targeted by both commercial harvesters and recreational anglers. Available data suggest that tripletail is of modest economic importance in terms of the overall Gulf of Mexico region, with landings and associated commercial sales concentrated within specific locales. Commercial economic value is derived from the economic activity and sales associated with the harvesting of tripletail for eventual sale to buyers within the regional seafood market, such as processors, retailers, restaurants, and consumers. Recreational economic value would be partly generated by the economic activities associated with tripletail anglers. In addition, economic value associated with the willingness of consumers and anglers to accept or pay a price different from what they encounter in the market (e.g., nonmarket valuation) further contributes to the economic values associated with tripletail. This report, however, will focus exclusively upon the economic values generated by market transactions associated with commercial harvest and sale of tripletail.

For the purposes of the economic discussion, the following nomenclature will apply: dockside value refers to the total amount paid to the harvester by the first handler during the initial off-loading of fish; ex-vessel price refers to the per unit price paid to the harvester by the first handler. Markups that might occur in the subsequent market levels, from the first handler to the consumer, are not included. Expenditures by recreational anglers are not available. Additionally, the non-market-related values of both commercial and recreational sectors are not available.

Annual and monthly nominal (not adjusted for inflationary changes) dockside values will be discussed for each state and the Gulf and southern Atlantic region in general. Annual and monthly nominal dockside prices (i.e., the price per pound received by the harvester for the whole fish) will be discussed for the Gulf region, southern Atlantic region, by state, and by harvest gear type, as allowed by confidentiality concerns. Information on dockside prices and dockside value provides basic insight into the economic importance of the commercial tripletail harvest sector. Information on trends in Gulf landings (lbs) is found in Chapter 6 (Table 6.1 and Figure 6.4).

The discussion will also focus on commercial landings, dockside value, and prices within the Gulf of Mexico region. However, additional data are available that provide insight into commercial landings and sale of tripletail in the southern Atlantic region, including North Carolina, South Carolina, Georgia, and the Florida east coast. This information was included to provide a more complete picture of the commercial market for tripletail in the southeastern U.S. region and to provide preliminary insight into the role that tripletail landings within the southern Atlantic region may play in sales and prices for tripletail originating from the Gulf of Mexico.

Commercial Sector

Annual Dockside Value

Annual Dockside Value by Region

The dockside value of tripletail landed in the Gulf of Mexico has been relatively low since 1950, with values only exceeding $1,000 in seven years between 1950 and 1988 and the highest dockside value recorded in 2013 (Figure 7.1). During the 1950-1987 period, annual dockside value was somewhat erratic and averaged approximately $600. Nominal dockside value increased during the 1988-1998 period with annual average dockside value being approximately $2,300. However, during the 1999-2012 period dockside values continued to increase with an annual average dockside value of approximately $3,900. Dockside value reached an all-time high of $13,742 during 2013, far exceeding the previous high of $8,430 during 2009. In comparison with other finfish fisheries in the Gulf of Mexico region, these values are almost negligible.

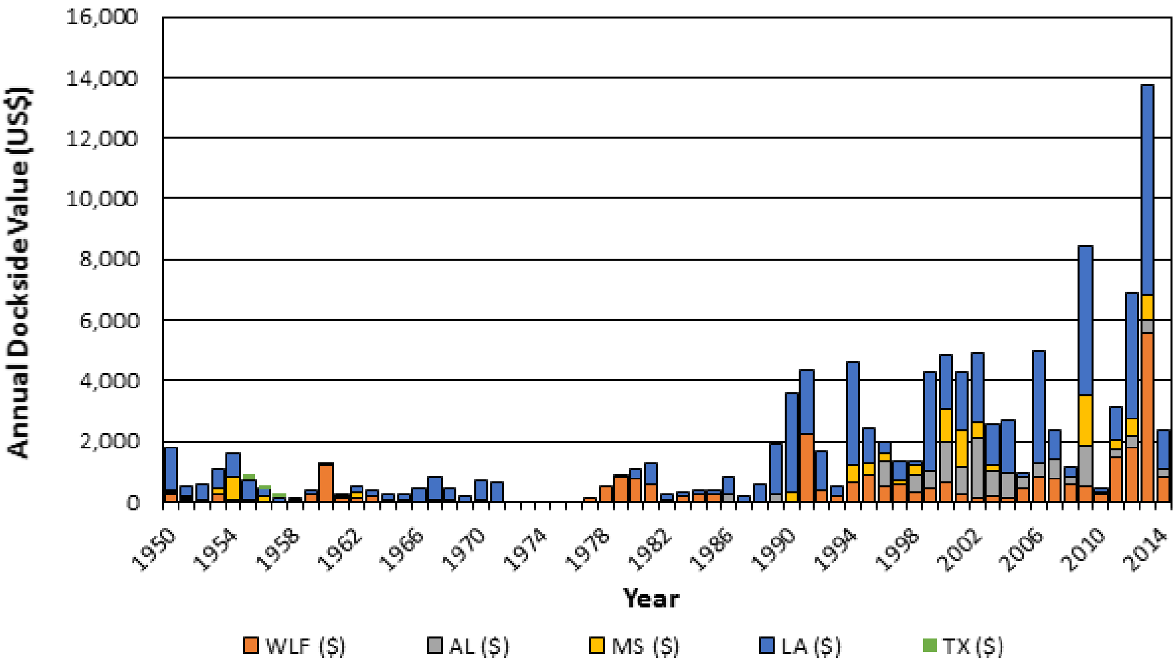


Figure 7.1. Annual tripletail dockside value by Gulf state (NOAA unpublished data). **Note**: 1972-1976 data are confidential.

Dockside values for tripletail in the southern Atlantic region were often higher and more erratic than in the Gulf of Mexico during the same 1950-2014 period (Figure 7.2). Dockside values were approximately $1,600 for 1950 and 1951, but declined significantly during the 25-year period between 1952 and 1976, with the reported average annual dockside value being approximately $270. However, during the 1977-1985 period, average annual dockside value increased to approximately $1,700, before briefly declining again to about $300 during the 1986-1990 period. Average annual dockside value then increased to $5,000 during 1991, reaching all-time highs during the 1992-1995 period, with the highest dockside value of $53,000 to that date being recorded during 1994. Dockside values declined again during the 1996-2006 period, with the average annual value being $12,346 during that 11-year period. However, dockside values in the southern Atlantic region trended up again during the 2007-2014 period, with the average annual dockside value being $34,544. The total dockside value of tripletail landings in the southern Atlantic region during 2014 was $83,448, significantly more than the previous high reported during 1994 ($52,954).

Annual Dockside Values by State

During the overall period from 1950-2014, the majority of the dockside value generated by tripletail landings occurred in the southern Atlantic region rather than the Gulf of Mexico (Figures 7.1 and 7.2). This was due to higher landing and relatively higher ex-vessel prices in the southern Atlantic region. In fact, since 1990, the total dockside value of tripletail landed in the Gulf of Mexico totaled $91,044, while the total dockside value of tripletail landed in the southern Atlantic region was $570,300.

Discussion of dockside value by state is complicated by the paucity of data and associated confidentiality concerns (particularly data collected during the 1972-1976 period for both the Gulf of Mexico and

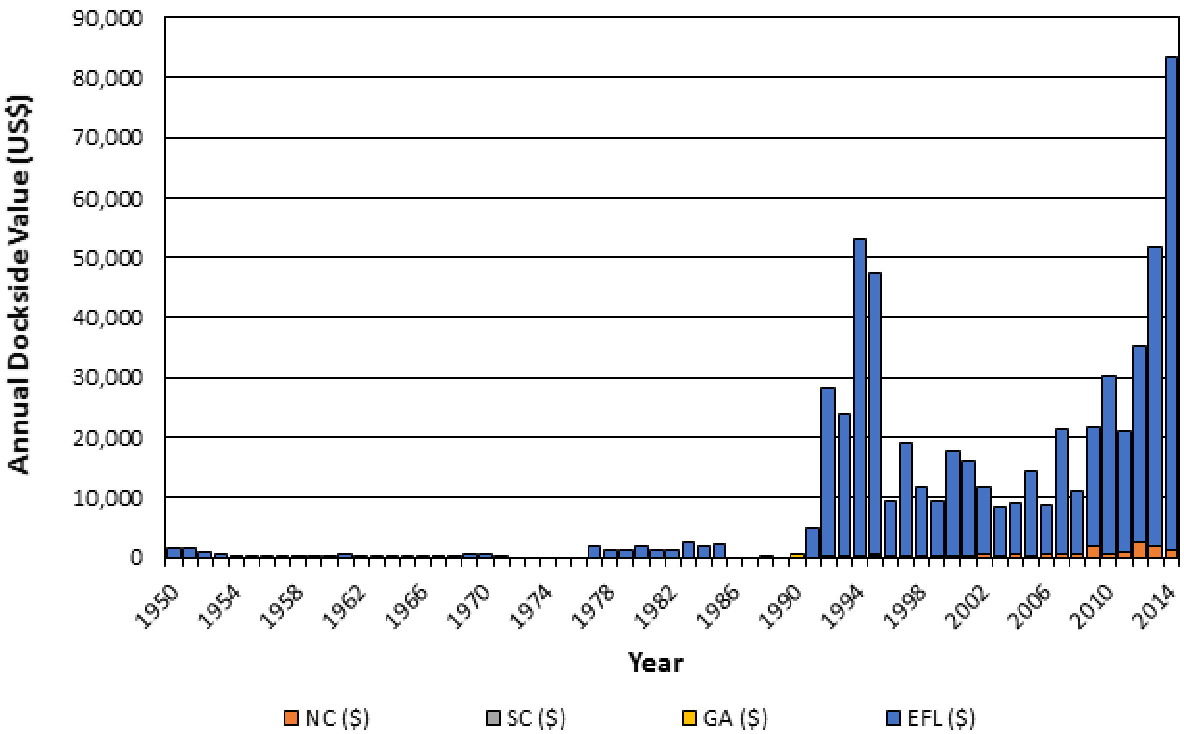


Figure 7.2 Annual tripletail dockside values for the southern Atlantic states (NOAA unpublished data). **Note**: 1972-1976 data are confidential.

southern Atlantic). However, existing data do provide insight into the key states that contributed to commercial tripletail sales within the southeastern U.S. region.

Florida (East and West Coasts)

Within the aggregate southeastern U.S. region, Florida is the most important source of commercial tripletail landings and dockside value. In particular, the east coast of Florida generates the greatest share of tripletail dockside value within the region and the whole U.S. Of the cumulative dockside value generated by commercial tripletail sales during the 1980 to 2014 period, the east coast of Florida accounted for 96% of the total for Florida, 97% of the total for the southern Atlantic, and 83% of the total for the Gulf of Mexico and southern Atlantic combined. The average annual dockside value for tripletail on the west coast of Florida during the 1980-2014 period was $640, while the average value for the east coast of Florida was $16,180. Although relatively larger, the values for the east coast of Florida were somewhat more erratic that those for the west coast, with Florida east coast values increasing from $1,147 in 1981 to $52,626 in 1994, then declining to $8,342 in 2006. Dockside values then increased to $82,117 in 2014. The dockside value for the west coast of Florida only exceeded $1,000 in four years between 1980 and 2014, with an all-time high of $5,560 reported for 2013.

Louisiana, Alabama, Mississippi, and Texas

Though overall landings and dockside value are relatively modest, Louisiana is the most important state within the Gulf of Mexico with respect to dockside value for tripletail. Prior to 1989, the average annual dockside value of tripletail landed in Louisiana was approximately $350. However, Louisiana dockside value increased to $1,688 in 1989, then began an erratic increase to $4,930 in 2009 and $6,899 in 2013, declining again to $1,284 in 2014. Again, the value of this fishery is nearly negligible when compared to other fisheries in the region, such as reef fish (snapper/grouper) and highly migratory pelagics such as tuna.

Both Alabama and Mississippi were minor contributors to the dockside value of tripletail in the Gulf of Mexico region during the 1950-2014 period. Since 2000, the average annual dockside value of commercial tripletail sales in Alabama and Mississippi were $690 and $419 (including years with zero landings), respectively. Texas has not reported any commercial sales of tripletail since 1957.

North Carolina, South Carolina, and Georgia

Reported commercial sales of tripletail in South Carolina and Georgia were very modest and inconsistent during the 1950-2014 period, with the majority of reported sales being confidential and never exceeding $1,000 in any given year. In contrast, North Carolina has consistently recorded commercial dockside values for tripletail harvest since 1992, with dockside value increasing from approximately $200 in 1992 to a peak of $2,373 in 2012.

Average Monthly Dockside Value

Average monthly dockside value for tripletail in the Gulf of Mexico and southern Atlantic regions was computed for two periods: 2000-2006 and 2007-2014 (Table 7.1). These time periods were chosen due to a pattern of very inconsistent monthly reporting of commercial sales prior to 2000, which created issues of data paucity and confidentiality. Due to these concerns, monthly dockside values are not discussed on a state level, but rather only on a regional basis.

During the 2000-2006 period, Gulf of Mexico monthly dockside value for tripletail exhibited increases during the summer and fall months, with peaks during the fall (September – November). In contrast, the monthly values during the same period for the southern Atlantic region (dominated by the Florida east coast) exhibited peak dockside value during the spring (April – June). For the 2007-2014 period, monthly dockside value for the Gulf of Mexico region continued to peak during the fall months, while monthly dockside values for the southern Atlantic exhibited increases earlier in the winter, with peaks in late winter and spring. In addition, the more recent monthly dockside values for the southern Atlantic region increased significantly as compared to the values reported during the 2000-2006 period.

Table 7.1 Average monthly dockside value and ex-vessel price by Gulf of Mexico and southern Atlantic regions (2000-2006 and 2007-2014; NOAA unpublished data). **Note:** Dashes (-) indicate data are not available or confidential.

Region and Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dockside Value ($)												
G 00-06	100	17	82	101	374	452	294	303	630	546	841	75
SA 00-06	644	470	911	1,453	3,035	2,031	651	544	520	736	937	599
G 07-14	-	-	-	84	164	294	425	584	963	2,342	491	-
SA 07-14	3,833	3,196	4,681	4,793	5,274	2,739	1,084	1,268	2,203	3,032	1,467	3,028
Ex-vessel Price ($)												
G 00-06	1.64	1.06	0.99	1.12	1.04	1.01	1.04	0.94	0.83	0.72	0.84	0.80
SA 00-06	1.85	2.09	2.26	2.21	2.29	2.16	1.92	1.82	1.53	1.65	1.93	1.97
G 07-14	-	-	-	1.51	2.36	1.58	0.91	1.69	1.15	1.71	1.72	-
SA 07-14	2.94	3.34	3.37	3.26	3.31	3.03	2.62	2.79	2.57	2.73	3.03	3.23

G 00-06 represents the Gulf of Mexico region during the 2000-2006 time period.
G 07-14 represents the Gulf of Mexico region during the 2007-2014 time period.
SA 00-06 represents the southern Atlantic region during the 2000-2006 time period.
SA 07-14 represents the southern Atlantic region during the 2007-2014 time period.

Annual Ex-vessel Prices

Annual ex-vessel prices are defined as those that are received by the harvester upon the sale of tripletail to the first buyer. Such prices are often recorded when the required trip ticket is completed by the first buyer, who most often is a licensed wholesale seafood dealer. However, the ex-vessel prices utilized in this analysis are generated as the quotient of dockside value ($) and landings volume (lbs). Thus, the prices generated are the average dollars per pound ($/lb) for the region or time period of interest. In addition, the ex-vessel prices for this discussion represent dockside sale of whole fish, not otherwise processed or altered (gutted, head-off, filets, etc.).

Regional Ex-vessel Prices

The nominal ex-vessel price (per pound whole weight) for tripletail has shown a steady increase over the period from 1950-2014 (Figure 7.3). The Gulf-wide ex-vessel price remained approximately $0.10 per pound until about 1980, when a steady increase in ex-vessel price for tripletail was initiated. Ex-vessel price in the Gulf of Mexico region continued to increase, with prices approaching $1.00 per pound being reported in the late 1990s. Prices remained somewhat steady until 2005 when ex-vessel prices reached $1.25. Though somewhat erratic, prices continued a general increase, with $2.43 being observed for 2013. The Gulf of Mexico price then declined to $1.52 in 2014.

Similar patterns were observed for ex-vessel prices in the southern Atlantic region (Figure 7.4). However, by 1990 prices in the southern Atlantic region began increasing at a more rapid pace than for prices representing the Gulf of Mexico region. Ex-vessel prices in the southern Atlantic region exceeded the $1.00 per pound benchmark by 1994 and continued to increase in an erratic manner through 2014, when a regional ex-vessel price of $3.65 was reported. Thus, prices in the southern Atlantic region increased at a faster pace and achieved higher levels than seen in the Gulf of Mexico region.

Ex-vessel Prices by State

Discussion of ex-vessel prices on the state level is constrained by missing data and confidentiality

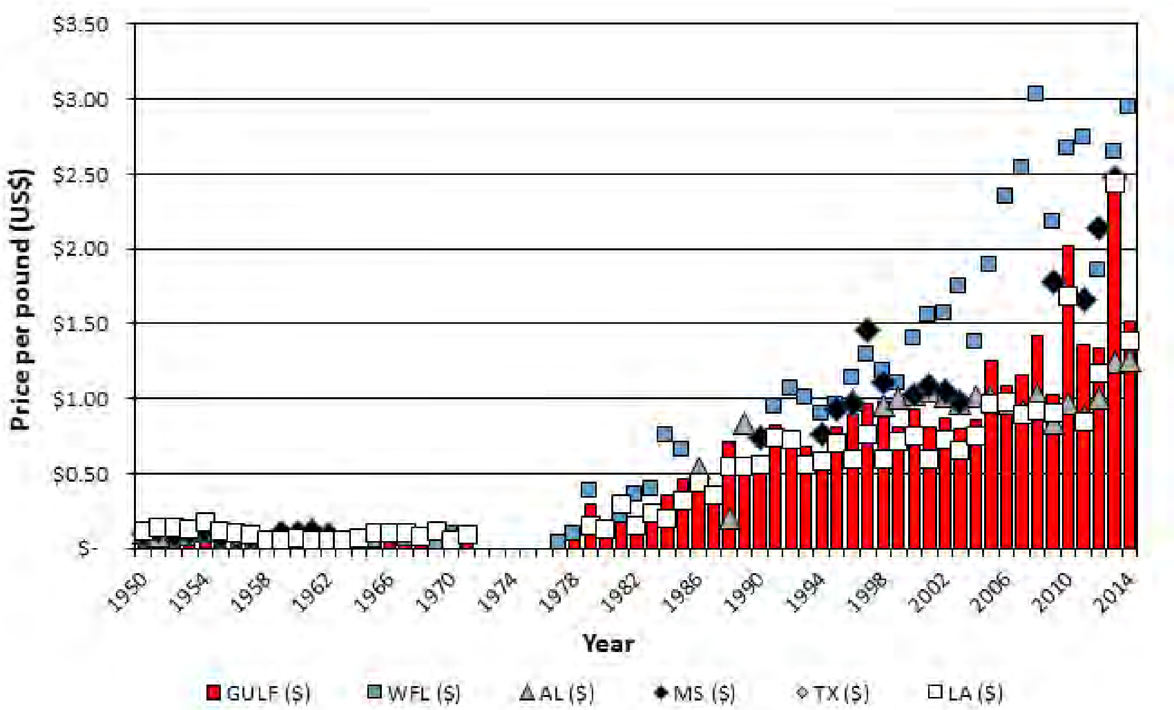


Figure 7.3 Annual average tripletail ex-vessel price/lb by Gulf state state (NOAA unpublished data). **Note**: 1972-1976 data are confidential.

concerns. However, sufficient data do exist to describe the basic trends in prices within each of the two major regions of harvest. In general, ex-vessel prices for tripletail exhibit an increasing trend across all states over the 1950-2014 period. However, some dissimilarities exist. Within the Gulf of Mexico region, annual ex-vessel prices were relatively higher for tripletail landed on the west coast of Florida, while ex-vessel prices for tripletail landed in Louisiana were relatively lower (Figure 7.3). Ex-vessel prices for Alabama and Mississippi were more consistently available only during the 1990-2014 period and were only slightly higher than those prices recorded for Louisiana. No price data exists for Texas because there are no commercial landings of tripletail in Texas waters since 1957.

Ex-vessel price data in the southern Atlantic region were only available for the east coast of Florida and North Carolina, with the latter only having consistent price information during the 1990-2014 period (Figure 7.4). Prices for North Carolina were substantially lower than those for the east coast of Florida. Prices for the east coast of Florida were similar to those reported for the west coast of Florida until about 1995, when the prices for the east coast of Florida began increasing at a more rapid pace. Prices for the east coast of Florida exceeded $2.00 in 2000, and increased steadily to $3.73 in 2014, exceeding ex-vessel prices for tripletail found in any other state in the Gulf of Mexico and southern Atlantic region.

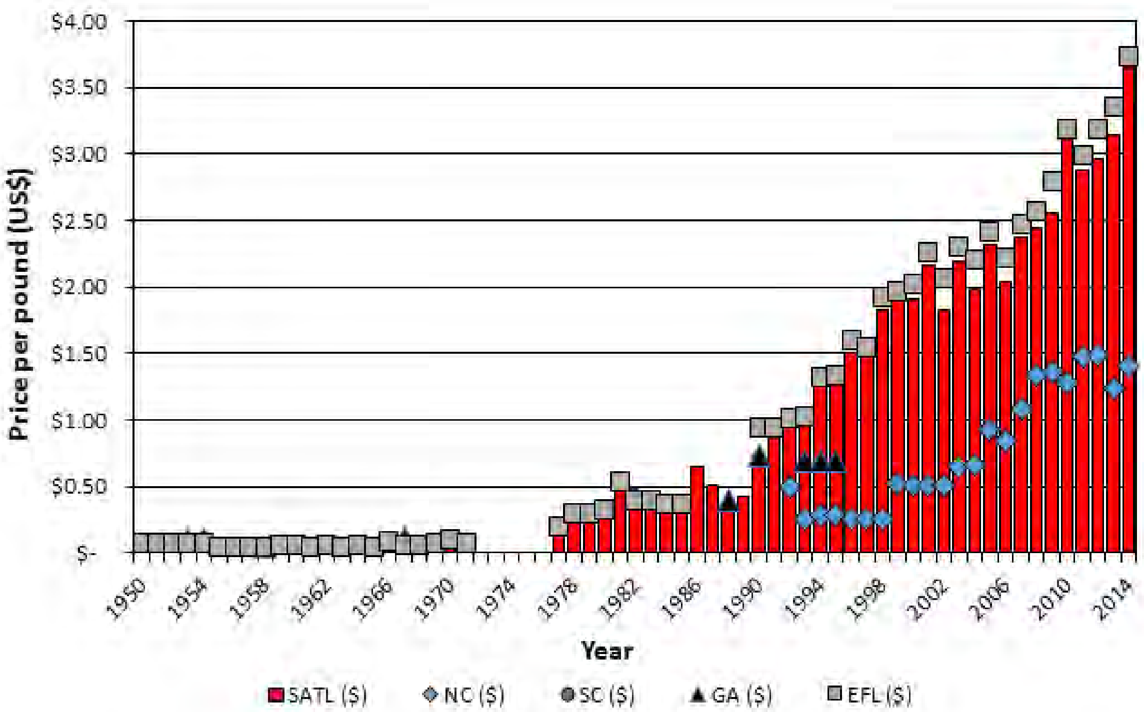


Figure 7.4 Average annual tripletail ex-vessel prices for the southern Atlantic states (NOAA unpublished data). **Note**: 1972-1976 data are confidential.

Average Monthly Ex-vessel Prices

Average monthly prices for tripletail in the Gulf of Mexico and southern Atlantic regions were computed for two periods; 2000-2006 and 2007-2014 (Table 7.1). As with monthly dockside values, these time periods were chosen due to a pattern of very inconsistent monthly reporting of commercial sales prior to 2000, which created issues of data paucity and confidentiality. Due to these concerns, monthly ex-vessel prices are not discussed on a state level, but rather on a regional basis.

During the 2000-2006 period, average monthly ex-vessel prices for the Gulf of Mexico region were higher during the winter and spring, with a similar pattern observed for prices in the southern Atlantic region. However, the prices in the southern Atlantic region were almost double those reported for the Gulf of Mexico region. In contrast, during the 2007-2014 period, prices in the Gulf of Mexico region were higher during the fall months, while prices for the southern Atlantic region continued to be highest during the late winter and spring months. Again, prices for the southern Atlantic region were almost twice those found for the Gulf of Mexico.

Ex-vessel Prices by Type of Harvesting Gear

Factors such as seasonal shifts in landings and demand, supply of closely substitutable species, and region of harvest may affect the per pound ex-vessel price for tripletail. In addition, the harvest gear used may have some influence on the ex-vessel price received. For example, a gear which allows the individually harvested fish to be handled more gently (less damage through crushing, tearing, etc.) may result in a perceived higher quality product. In addition, a fish brought to shore more quickly, such as those harvested on relatively short 'day' trips, may be less subject to thermal abuse. If buyers recognize these quality attributes and a market for those attributes exists, a higher per unit price may result. Thus, a fish caught in an entangling net that may be bruised and missing scales, caught in a trawl and subjected to crushing in the cod-end of the trawl, and a fish kept on ice through a long-duration trip may bring a lower price than a fish caught on a brief hook-and-line trip.

Nominal ex-vessel prices were computed for landings of tripletail by gear type (Table 7.2). These were computed for both the Gulf of Mexico and southern Atlantic regions and represent aggregate ex-vessel prices of tripletail landed across both regions during the 2000-2014 period. The prices were calculated by dividing the total nominal ex-vessel value for each gear type category by the respective landings for each gear type category. The gear types selected for comparison were those that accounted for the majority of the landings on a gear type basis, including 1) Gill, Trammel, and other Entangling Nets, 2) Lines, Hand and Rod/Reel, 3) Haul Seines, Trawls (Otter, Skimmers, and Butterfly), and Cast Nets 4) Spear, Gig, and Diving, and 5) Other Combined Gears. The data reported by gear type represent only a portion of the total landings for the commercial tripletail fishery in the two regions, as some landings do not have a gear category assigned. Landings by gear type available for this discussion represent 31% and 49% of the total landings of tripletail for the Gulf of Mexico and southern Atlantic regions, respectively.

The prices by gear type are shown as the average annual price across the 2000-2014 period. For the Gulf of Mexico region, the majority of the landings reported by gear type are harvested with lines or rod-and-reel but were not the highest by price. In both regions, the prices were highest in other combined gears ($2.00/lb Gulf and $3.35/lb southern Atlantic) which included primarily pots and traps. In both regions, spear, gig, and dive gear comprised the lowest landings but had substantially higher prices than the remaining specified gears; spear, gig, and dive gear only made up 4% of the total landings by gear however. All prices by comparable gear were higher in the southern Atlantic region. The disparate prices

Table 7.2 Average ex-vessel prices by gear type for the Gulf of Mexico and southern Atlantic Regions. The prices represent an annual average price for landings and dockside value by gear type for the 2000-2014 time period (NOAA unpublished data).

Gear Type	Gulf ($)	SATL ($)
Gill, Trammel, Entangling Nets	1.11	1.93
Lines, Rod and Reel	1.37	2.58
Seines, Trawl, Haul, Cast Nets	1.20	1.78
Spear, Gig, Diving Gear	2.00	2.58
Combined Gear/Uncoded	2.00	3.36

across regions (by gear type) are likely an artifact of differing regional markets (e.g., consumer familiarity, demand, market placement, etc.), rather than factors related to gear.

Processing and Marketing

Market Channels

No previous studies have been conducted to describe the commercial processing and marketing of tripletail in the Gulf of Mexico. In particular, no studies exist that describe the marketing channels associated with tripletail in the region. Although tripletail is known to enter commercial trade within the seafood market in the Gulf of Mexico region, the path taken by tripletail products from the harvester to the final buyer has not been described. Such information will help managers better understand the market forces that can influence commercial effort and value within the region.

To develop a preliminary overview of the market system for tripletail in the Gulf of Mexico region, a brief market survey was designed and conducted by the Tripletail Technical Task Force in the fall of 2015. The survey attempted to describe the buying and selling of tripletail by fish houses, seafood dealers, and wholesalers. This survey solicited information on sources of tripletail supply, product forms, and disposition of tripletail products in and out of the Gulf states. The relative importance of various product forms demanded by wholesalers, retailers, restaurants, and retail consumers was also solicited. This survey solicited information for the 2014 calendar year. The survey was conducted via the phone by the respective state agency and GSMFC staff. A copy of the most recent survey instrument is located in Figure 7.5 and, given the relative importance of the tripletail landings from the southern Atlantic region, firms on the east coast of Florida were included. Note that the survey was administered to firms that were known to have handled tripletail during 2014, as determined by trip ticket data, of which not all responded. The findings suggest no statistical relevance, and the representative nature of the data is unknown across the entire industry sector.

Of the 1,898 seafood wholesale dealers in the Gulf region (including the east and west coasts of Florida) who bought any form of seafood directly from domestic harvesters during 2014, 47 firms reportedly handled tripletail during 2014. Of those 47 firms, 34 were located in Florida, with six, two, and five firms being located in Louisiana, Mississippi, and Alabama, respectively. A total of 36 completed surveys were obtained. Of the total number of survey instruments completed, 18 were associated with Florida east coast firms, nine with Florida Gulf coast firms, three with Louisiana firms, two with Mississippi firms, and four with Alabama firms. Texas was not surveyed due to no reported commercial tripletail landings in the survey year. The findings of the tripletail market survey are aggregated across all states and discussed below.

Respondents were asked about the source of their tripletail supply during 2014. Approximately 73% of the tripletail purchased by wholesalers in the Gulf was obtained directly from local (in-state) harvesters, with none being obtained from out-of-state harvesters. Another 17% was obtained from other in-state wholesalers (e.g., distributors and processors), with none being obtained from out-of-state wholesalers (Table 7.3). Although the survey focused on dealers who handled domestically harvested tripletail, it was discovered that some of these dealers also imported tripletail, which accounted for around 10% of the overall tripletail volume handled by the 47 dealers that completed the market survey. Based on personal communication with several anonymous U.S. seafood brokers and importers in the region, major sources of imported tripletail are the countries of Suriname and Panama. The survey findings provide little information on dealers who may handle only imported tripletail (and were therefore not encountered through the survey). In addition, there is minimal information on imported tripletail but what is available is discussed below in *Imports*.

Tripletail Market Survey

******* PLEASE RESPOND TO THE FOLLOWING QUESTIONS WITH YOUR "BEST GUESS" ESTIMATES *******
(The following questions to tripletail, 'blackfish', or 'soapfish')

1. FROM WHOM AND WHERE DID YOUR SUPPLY ***COME*** *FROM?*

Of the total volume of whole tripletail you handled last year (2014), what percent (*estimate*) were obtained directly from each of the following sources?

1. In-state fishermen ________ %
2. Out-of-State fishermen ________ %
3. In-State Wholesale Distributor/Processor ________ %
4. Out-of-State Wholesale Distributor/Processor ________ %
5. Other In-State Source (please describe________________________________) ________ %
6. Other Out-of-State Source (please describe____________________________) ________ %
7. Foreign Supplier (country of origin_________________________________) ________ %

Total → 100 %

2. DID YOU CUT IT, LEAVE IT WHOLE, FREEZE IT, OR WHAT?

A. Of the total volume of tripletail you processed last year, what percent (*estimate*) was processed into the following product forms prior to final sale by your firm?

1. Whole form (gutted, headed, and/or eviscerated) ________ %
2. Fillets ________ %
3. Other (please describe_________________________________) ________ %

Total → 100 %

B. What percent (*estimate*) of the tripletail you handled last year was sold by your firm as fresh or frozen?

1. Fresh ________ %
2. Frozen ________ %

Total → 100 %

3. ***WHO*** *DID YOU SELL IT TO AND* ***HOW*** *DID THEY WANT IT?*

A. Of the total volume of tripletail you handled last year, what percent (*estimate*) was sold to each of the following types of buyers?

1. In-state Wholesale Distributor/Processor ________ %
2. Out-of-state Wholesale Distributor/Processor ________ %
3. In-state Retailer (grocery, seafood market, etc) ________ %
4. Out-of-state Retailer ________ %
5. In-state Restaurant ________ %
6. Out-of-state Restaurant ________ %
7. Retail Consumer ________ %

Total → 100 %

Figure 7.5 Market survey instrument for dealers that handled tripletail in 2014 from the Gulf of Mexico region (also including the Florida east coast).

B. For each of the following types of buyers to whom you sell tripletail, please indicate the percentage (*estimate*) of each product form purchased by each in a typical year. Also, for each type of buyer, show the percentage of fresh versus frozen purchased. Both sets of %'s should total to 100%.

TRIPLETAIL PRODUCT FORM

Buyers	**Whole**	**Fillets**	**Other**	**Total**	**Fresh**	**Frozen**	**Total**
Example: Restaurants	*(50%)*	*(50%)*	*(0%)*	*100%*	*(75%)*	*(25%)*	*100%*
Wholesale Distributor/Processor	( )	( )	( )		( )	( )	
Retailers	( )	( )	( )		( )	( )	
Restaurants	( )	( )	( )		( )	( )	
Retail Consumers	( )	( )	( )		( )	( )	
Other (please describe____________)	( )	( )	( )		( )	( )	

4. WHERE ARE YOU LOCATED?

In what states do you operate fish houses where tripletail are handled? Indicate the number in each of the states listed.

Texas __________
Louisiana __________
Mississippi __________
Alabama __________
Florida (Gulf region) __________

5. CAN WE CONTACT YOU DIRECTLY TO FOLLOW-UP WITH ADDITIONAL QUESTIONS RELATED TO YOUR TRIPLETAIL PURCHASES AND SALES?

Yes__________ **Contact Person and Local Phone**________________________________

THANK YOU FOR PARTICIPATING!!

Figure 7.5 Market survey instrument (con't).

Respondents were then asked to describe the product forms into which the initial supplies of tripletail were converted. Overall, of the total amount of tripletail obtained from harvesters and other wholesalers, respondents indicated that most was left as round/whole form (58%) for final sale while 42% was processed into fillets for final sale. Approximately 99% of the total sales were as fresh product, while the remaining volume was sold as frozen product.

Respondents were asked to describe how their tripletail sales were distributed across buyers and what product forms were purchased by these buyers (Table 7.4).

Wholesale Buyers - Sales to wholesale buyers accounted for 22% of tripletail sales, with 14% and 8% of those sales going to in-state and out-of-state wholesale buyers, respectively. The majority (90%) of tripletail product sold to wholesaler distributors/processors remained in whole form while 10% of sales to wholesalers was sold as fillets. Of the total amount of tripletail sold to wholesalers, 91% was sold fresh with the remaining 9% sold frozen.

Retail Buyers - Sales to retail buyers accounted for 18% of tripletail sales, with the full amount being sold to in-state retail buyers. Of the tripletail product sold to retail buyers, 68% was sold as whole product,

Table 7.3 Sources of tripletail supply for wholesalers in the Gulf of Mexico region (also including the Florida east coast), in 2014 (GSMFC unpublished data).

Supply Source		Percent of Total Volume
Fishermen	In-State (n=31) Out-of-State	73% 0%
Other Wholesalers	In-State (n=9) Out-of-State	17% 0%
Other Domestic Sources	In-State Out-of-State	0% 0%
Imports (n=4)		10%
Total (n=36)[1]		100%

[1] Note: n is the number of respondents who indicated obtaining supply volume from the respective source. The n's do not add to 36 due to some respondents selecting more than one source.

while 23% of sales to retail buyers was sold as fillets. An additional 9% was sold as some "other" form of product. Of the total amount sold to retail buyers, 100% was fresh.

Restaurants - Sales to restaurants accounted for 23% of tripletail sales, with the full amount being sold to in-state restaurant buyers. Of the tripletail product sold to restaurants, 14% was sold as whole product, while the remaining 86% was sold as fillets. Of the total amount sold to restaurants, 100% was sold fresh.

Retail Consumers - Sales to retail consumer buyers accounted for 37% of tripletail sales. The majority (74%) of tripletail product was sold to retail consumers as fillets, while 26% of sales to retail consumers was sold in whole form. Of the total amount sold to retail consumers, 100% was fresh.

Whole tripletail represented the most important product form for wholesale and retail buyers. However, fillets were of most importance for sales to restaurants and retail consumers. In addition,

Table 7.4 Sales volume (% by buyer type and product form) for tripletail wholesalers in the Gulf of Mexico region (also including the Florida east coast), in 2014 (GSMFC unpublished data).

Sales Volume by Sector (Buyer) and Product Forms[1]								
Market Sector (Buyer)	Destination of Sales (%)			Product Form Sold (%)[2]				
	In-State	Out-of-State	Total	Whole	Fillets	Other	Fresh	Frozen
Wholesalers	14 (n=9)	8 (n=4)	22	90 (n=11)	10 (n=2)	0	91 (n=10)	9 (n=1)
Retailers	18 (n=11)	0	18	68 (n=9)	23 (n=3)	9	100 (n=10)	0
Restaurants	23 (n=13)	0	23	14 (n=2)	86 (n=11)	0	100 (n=10)	0
Retail Consumers	37 (n=15)[3]		37	26 (n=6)	74 (n=10)	0	100 (n=13)	0
Other	-	-	-	0	100 (n=1)	0	100 (n=1)	0
Total (*average %*)	-	-	100	-	-	-	-	-

[1] Note: n is the number of respondents who provided a response greater than zero.

[2] These percentages represent indices of importance relative to each product form for the respective market sector. Percentages given by respondents (see survey instrument in Figure 7.5) are summed and divided by the total number of responses, including zero (0) responses. Missing values are excluded. Percentages are computed only for those market channels utilized by respondents.

[3] Responses for Retail Consumers was not disaggregated into In-State and Out-of-State sectors.

all types of buyers apparently preferred fresh product although a small volume of frozen product was associated with wholesale buyers. Finally, in-state sales were the most important component of the regional market.

Imports

During the completion of the previously discussed market survey conducted by each state agency and GSMFC staff (Figure 7.5), a number of dealers reported that imports of tripletail were utilized to supplement the domestic supply derived from Southeastern U.S. sources. Imported tripletail was necessary to fulfill the demand by restaurants consistently due to insufficient volume and the seasonal availability of domestically caught tripletail. In subsequent interviews, the domestic dealers indicated that a large portion of the imported tripletail being sold domestically originated from Panama and other sources from both the Atlantic and Pacific coasts of Central and South America.

VanderKooy (personal communication) contacted a few of the wholesale seafood importers that local dealers indicated were their source of imported tripletail. Wholesalers in Miami, New Orleans, and New York all indicated that the amount of tripletail received in any shipment varied but that they sold all that they received. One importer received around 40,000 lbs of tripletail annually as a frozen export, principally from Suriname and Brazil. Another importer reported receiving consistent supplies from Panama, Ecuador, and Costa Rica of approximately 2,000 lbs per month.

Several dealers described the tripletail market as a 'southern fish' market, very popular as a catch-of-the-day in restaurants throughout the Gulf of Mexico and southern Atlantic region. However, the wholesalers also suggested some product was being sold to restaurants in New York, but in relatively limited amounts. VanderKooy and Franks (personal communications) contacted several seafood exporters in the countries identified by the domestic wholesale dealers, but were able to generate few useful responses.

Fishery products entering the U.S. market from outside the U.S. are typically tracked through the 10-digit Harmonized Tariff Schedule (HTS) code that is implemented by the United States International Trade Commission. Utilizing the HTS code, the volume and value of imported seafood products can be inferred. Unfortunately, according to the NOAA Office for International Affairs and Seafood Inspection, there is no 10-digit HTS code unique to *Lobotes surinamensis* so imported tripletail is filed under a generic code (personal communication). Without a unique code, the tripletail import volume and value cannot be separated from the combined generic grouping in which such data are contained and therefore cannot be quantified at this time.

Recreational Sector

While anecdotal information suggests that recreational anglers continue to become more interested in tripletail as a targeted species, there are currently no data with which to evaluate the amount of effort or expenditures incurred targeting tripletail. Although most states have seen increases in anglers participating in saltwater fishing (Chapter 6 State Recreational Fisheries), those who target tripletail are likely a small component of the overall participation in saltwater angling. As an incidental catch, this fish typically must be targeted and is not generally encountered 'by accident,' making it even more difficult to use a proxy species to describe those who fish for tripletail. Because of these limitations, the economic value of the recreational sector for tripletail cannot be discussed, estimated, or evaluated.

Commercial Mariculture

During the completion of the market survey, one wholesaler conveyed that there have been discussions of developing a tripletail aquaculture supply in the U.S. The wholesaler indicated there is already research being conducted by a few entrepreneurs (VanderKooy personal communication). At first glance, tripletail would appear to be a very good candidate for mariculture; they are fast growing, solitary, and appear to display relatively low activity. Franks (personal communication) had good success keeping juvenile tripletail alive in captivity and reported that they were docile and acclimate well to being held in tanks (see Chapter 3 Age and Growth, Life Span, and Mariculture).

One of the surveyed wholesalers indicated that mariculture would be a great source for product domestically and recommended further investigation, while another indicated that tripletail have a relatively 'low yield' and raised concern over the time and cost to get a market-sized fish. It was suggested that yields were only around 34% and that anything less than a 3lb fish would not be commercially viable at the current market price/lb. Franks (personal communication) found yields to have great potential in captivity and one dealer indicated that tripletail could not be handled using typical filleting techniques which would result in a 10% loss. Hand filleting rather than using machine could increase yield to around 40% or more (anonymous).

Civil Restitution Values and Replacement Costs

Values exist by which a state can assess damages for events in which negligence or illegal activities result in loss of fish. These values are determined in a variety of ways for both recreationally and commercially important species. Cost of replacement may be assessed based on the costs associated with hatchery production, willingness to pay by users and nonusers, and recreational user travel cost estimation. The individual states may utilize additional methods for estimating the value associated with an individual fish for the purpose of damage assessment, such as utilizing existing market prices for commercially important species and estimated recreational valuations associated with marine recreational anglers. The American Fisheries Society (1982, 1992) has estimated replacement values for certain species (primarily freshwater) and provides the methods for determining these values. State civil restitution values may be linked directly with these published estimates and methods.

Restitution values vary considerably by state and may change annually. Florida assigns a replacement value of $10.10 per fish for tripletail, regardless of size, in the Florida Administrative Code (Chapter 62-11.001). Louisiana provides a 'monetary value' for tripletail at $0.57 per fish (Louisiana Administrative Code Title 76, Chapter 3, Section 315). Texas has a civil restitution value for tripletail that increases in inch-wise increments from $0.12, for fish 1-2 inches in length, to $253.93 for fish 30 inches in length (Table 7.5; TPWD unpublished data). Mississippi, Alabama, and Georgia do not currently have restitution values for tripletail.

Table 7.5 Civil restitution values for tripletail in Texas waters (TPWD unpublished data).

Length (inches)	Recreational Value Adjusted ($)	AFS Value Adjusted ($)	Special Unit Value ($)	Value Per Individual ($)
1	0.000	0.119	0.000	0.12
2	0.000	0.119	0.000	0.12
3	0.000	0.239	0.000	0.24
4	0.000	0.372	0.000	0.37
5	0.000	0.836	0.000	0.84
6	0.760	1.300	0.000	2.06
7	1.521	1.658	0.000	3.18
8	2.281	3.287	0.000	5.57
9	3.041	4.809	0.000	7.85
10	3.801	6.758	0.000	10.56
11	4.562	9.194	0.000	13.76
12	5.322	12.178	0.000	17.50
13	6.082	15.771	0.000	21.85
14	6.842	20.036	0.000	26.88
15	7.603	25.038	0.000	32.64
16	8.363	30.841	0.000	39.20
17	9.123	37.513	0.000	46.64
18	9.883	45.119	0.000	55.00
19	10.643	53 728	0.000	64.37
20	11.404	63.409	0.000	74.81
21	12.164	74.233	0.000	86.40
22	12.924	86.268	0.000	99.19
23	13.684	99.588	0.000	113.27
24	14.445	114.264	0.000	128.71
25	15.205	130.368	0.000	145.57
26	15.965	147.976	0.000	163.94
27	16.725	167.160	0.000	183.88
28	17.486	187.995	0.000	205.48
29	18.246	210.558	0.000	228.80
30	19.006	234.924	0.000	253.93

Chapter 8
RESEARCH NEEDS

Goals and Objectives for the Fishery

As demonstrated throughout this profile, there is a need for directed research on this species throughout its range to better inform management. However, without a better understanding of the basic biology, reproduction, and migration of tripletail, 'regional' management may be difficult to define on such a widely distributed species.

Data Gaps and Considerations for Management

At this time, any 'management' of tripletail based on population abundance is impossible since there is very little understood regarding the stock structure, the reproductive capacity, and the existence of any sub-populations. There is also little reliable information regarding recreational fishing mortality since so few fish are encountered in the MRIP estimates. The items below highlight how little we understand about this species and some will need to be examined before any sort of realistic stock assessment can be conducted. They are separated into 'critical needs,' which are those data needs considered necessary to complete a stock assessment, and 'secondary needs,' which are items that would help our general understanding but may not be necessary for management.

Critical Needs

Distribution

- *Migration Patterns* – As discussed in Chapter 3 Seasonal Movement, an acoustic tagging study conducted by GADNR has revealed that tripletail migrate seasonally from Georgia waters in the summer months to the area around Cape Canaveral, Florida during the winter months. Further acoustic and/or satellite tag studies are needed to determine whether tripletail exhibit this behavior in other parts of their range.
- *Site Fidelity/Residency* – Tagging studies conducted by GADNR and GCRL have shown potential evidence of some level of site fidelity or residency (Chapter 3 *Tagging Studies*). In Georgia, dart and acoustic tagging studies have found that tripletail are frequently recaptured near the same site in different years, lending to a thought that tripletail may exhibit either site fidelity or some residency. This is also true in the northern Gulf based on the work by GCRL. Further acoustic or satellite tag studies would shed light on which, if either, behavior tripletail exhibit and possibly whether these behaviors are exhibited differently in different areas (such as the fish that travel from Georgia to Florida vs fish in the Gulf of Mexico).

Reproduction

- *Spawning Location* – As indicated throughout Chapter 3, there is no information, published or unpublished, regarding the location of spawning tripletail anywhere in the western central Atlantic or the world. There are records of 'spawning capable' fish throughout the region but no documentation of where spawning occurs (*Spawning and Season* and *Location*). In addition, early juvenile fish have been collected in offshore waters as well as in nearshore brackish areas. It is believed that isotopic investigations into otolith microchemistry may shed light on the natal waters and potential nursery areas of tripletail larvae which could contribute to a better understanding of the reproductive nature of this fish.

- *Recruitment* – Since very little is known about spawning and reproduction in general (Chapter 3 *Spawning and Season* and *Location*), it is not clear what environmental conditions contribute to tripletail spawning success, larval survival, and recruitment.
- *Larval Transport* – As noted throughout Chapter 3, without an understanding of where spawning occurs (*Spawning and Season* and *Location*), the mechanisms for transport of larvae cannot be determined. In addition, the presence of juvenile tripletail throughout marine and brackish environments (Chapter 4) provides little help in determining how larvae can occur throughout the western central Atlantic from seawalls inshore to Sargassum offshore. Directed sampling targeting adult spawning fish will need to be conducted to better determine the habitat use and preferences of young tripletail.
- *Fat Bodies* – In Chapter 3 (*Spawning and Season*), 'fat bodies' associated with gonadal development were identified and discussed; However, the purpose and function of the deposits are poorly understood. Research should be directed to determine if the deposits are critical in ovary and teste development or serve as an energy reserve in support of general biological function in tripletail.
- *Courtship* – As indicated in Chapter 3 (*Reproduction*), there is no published information on the courtship behaviors of tripletail anywhere in the world. While numerous spawning capable females have been captured throughout the southern Atlantic and Gulf regions, no fish have been recovered that were in 'imminent spawning condition.' Most of the fish used in culture were strip spawned and the one occurrence of natural reproduction in tanks at GCRL was not actually witnessed (Chapter 3 Mariculture). There are anecdotal reports suggesting that along the Atlantic coast of southern Florida tripletail may school in deeper water to spawn. These reports have not been confirmed but it was suggested that one female with four or five males were captured by hook-and-line from the same offshore structure, apparently having formed a spawning aggregation (VanderKooy personal communication). It is believed that acoustic and/or satellite tagging could be used to identify spawning groups of tripletail in the future.

Genetics

- *Speciation* – While this profile focuses on *Lobotes surinamensis* in the Western Central Atlantic, the genetic resolution of the two species in the Lobotes genus is debated today (Chapter 3 Lobotes Differences). The descriptions for *L. pacificus* have been questioned in the literature for many years and there is little genetic work done to determine the species description. Extensive genetic work needs to be done throughout the global range of both species to confirm Lobotes as a single- or multi-species genus.
- *Management Unit/Stock(s)* – As noted in Chapter 3 (Geographic Distribution), tripletail occur in tropical and temperate waters worldwide and are found throughout the Western Central Atlantic Ocean. While we are considering the western Atlantic Ocean, Gulf of Mexico, and Caribbean populations of tripletail to be a single stock, there is considerable evidence of sub-populations throughout the region (Chapter 3 Migration) which would potentially impact how we manage the species throughout its Western Central Atlantic range. Additional genetics work will need to be conducted to examine local populations within the Gulf of Mexico and throughout the Western Central Atlantic region.

Habitat

- *Sargassum* – Tripletail are consistently found in association with floating *Sargassum*. It can be in large, expansive mats, broken up clumps, or gathered in windrows in the offshore and nearshore environments (Chapters 3, 4, and 6). The amount of *Sargassum* that moves into an area is often wind and storm driven, collected on currents and widely dispersed throughout the Caribbean and Gulf of Mexico. However, there is no known correlation between relative abundance of *Sargassum* and tripletail, despite every life history stage having been collected in and around *Sargassum*; clearly it is a primary habitat. Additional research needs to be conducted to determine if *Sargassum* is tied directly to tripletail reproduction, growth, and survival or if it is simply another habitat of opportunity.

Fishery-Related

- *Hooking/Release Mortality* – While a small number of tripletail are recaptured in tagging studies (Chapter 3 *Tagging Studies*), there is no information on short term and long term effects of capture and release from recreational and commercial hook-and-line fishermen. Franks and Gibson (unpublished data) reports a 10% tag recapture rate but recaptures don't explain the other 90% of tag releases or their ultimate fate. Similarly, there is no information on final disposition of non-tagged released tripletail.
- *Recreational Effort* - Recreational fishing estimates of tripletail harvest and effort are probably not reliable due to infrequent intercept data since few recreational anglers 'target' tripletail (Chapter 6 Recreational Fishery). While an increased number of anglers are taking an interest in this species over the last decade, as noted in Chapter 4 (*Media Awareness*), the opportunity to routinely sample tripletail in state fishery-dependent surveys are infrequent due to the low encounter rates. In addition, there are anecdotal reports of specialty trips targeting tripletail by fishing guides and other for-hire vessels but no information quantifying level of participation in these trips is known.

Secondary Needs

Behavior

- *Migration* – Fishery-independent data suggests that tripletail movement coincides with water temperature as documented through tagging studies (Chapter 3 Migration) along the southern Atlantic from Georgia to Florida. Other areas of the world where tripletail occur report anecdotally, that the fish move according to prevailing water temperatures and are not found below 20°C. It is unclear what physiochemical requirements may drive the migration patterns observed in tripletail. Research is required to determine the role of temperature in the life cycle of tripletail, including seasonal migrations, reproductive strategies, feeding ecology, and survival.
- *Mimicry and Camouflage* - In Chapter 3 (*Cryptic Behavior, Coloration, and Camouflage)* adult tripletail are described as being olive to reddish brown to dark brown with darker spots or blotches, while juveniles can have a wider range of colors included a yellow color mottled with brown and black. It is generally accepted that the coloration serves as a protective mechanism, helping the fish to blend in with or appear as drifting flotsam or leaves, especially when in close proximity to *Sargassum*. Inshore, juvenile tripletail can adapt their coloration to match their surroundings such as when associated with leaf litter in and around mangroves. What is not clear is the mechanisms involved that enable tripletail to change color and anecdotal reports (Franks personal communication) suggest that juvenile and adult tripletail can flash color changes in a matter of seconds.
- *Lateral Surface Swimming* – Tripletail are most recognized by their tendency to float on their sides close to the surface. At times they have been found swimming rapidly at the surface essentially 'listing to one side' assuming a 45 angle to the surface of the water so only their dorsal ridge is near the air-water interface (Chapter 3 General Behavior). The recreational fishery off of Jekyll Island, Georgia is dominated by tripletail exhibiting this behavior, failing to associate with structure but remaining free swimming (Chapter 6 State Recreational Fisheries, Georgia). It is unclear what

advantages tripletail gain from their surface association and lateral floating behavior. It has been suggested by numerous authors that it could be an observational stance above and below the water surface in search of prey, a predator avoidance behavior, or a combination.

- *Free Jumping* – Aerial locomotion or 'flight' is not well understood in fishes with the exception of those that have morphologically evolved to capture air under enlarged pectoral and pelvic fins, like the flying fishes (family Exocoetidae). Tripletail are known to display an apparently random jumping behavior but, like the mullets (genus *Mugil*), it is not known why. Fish jumping is speculated to be a response to external parasite load, reproductive display, or predator avoidance, yet none of these potential causes have been examined in regards to tripletail.
- *Predator/Prey Interactions* – Very little is known regarding the predator/prey relationships of this species (Chapter 3 Feeding, Prey, and Predators) and information on the role of tripletail in trophic dynamics in the northern Gulf of Mexico and the southern Atlantic is lacking. Additional study is needed to elucidate their position relative to the habitats that they occupy through their various life history stages.

Age and Growth

- *Age-at-Maturity* – Although age and growth studies can provide useful information on tripletail age and reproductive seasonality, detailed information on age at maturity necessary to develop a better understanding of age-at-maturity schedules is lacking.
- *Age Determination and Annuli Validation* - As noted in Chapter 3 (Age and Growth), while considerable effort has been given to successfully ageing tripletail, there are still a number of issues with the techniques used to date. A number of studies have aged tripletail using spines, scales, and otoliths but each has its own difficulties. In addition, there has been no validation of annual ring formation to date. Part of the difficulty in ageing tripletail may be related to their narrow temperature preferences and propensity to remain at or near the surface. These factors combined could lead to reasonably consistent growth throughout the year reducing the clearly defined slow and fast growth periods used to age structures in other species.

Habitat

- *Northern Boundaries* – On the Atlantic coast of the U.S., tripletail are most commonly targeted by anglers and commercial fishermen in Florida and Georgia; however, they can be found at least through parts of North Carolina, if not further north. Although it appears that tripletail range may be at least somewhat influenced by temperature (they are not generally found in waters cooler than 20°C), the extent of their range on the Atlantic U.S. coast may not be fully known.
- *Range Expansion* – As discussed in several places in Chapter 3 (Physiologic Requirements and Migration), one of the factors that likely effects where tripletail are found is water temperature. Considering the long-term potential for oceanic warming due to climate change, it is possible that tripletail may be able to inhabit waters that were previously too cold. However, more study of their various physiological needs, such as salinity or pH, may allow scientists to better understand the ability of tripletail to expand their current range. In addition, waters that were traditional habitats for tripletail may become hyperthermic, forcing them into new regions in search of their preferred temperature regime. Increases in prevailing water temperatures could have negative physiologic impacts on growth, reproduction, and ultimately survival.
- *Larval/Juvenile Habitats* – As indicated throughout Chapter 4, there is very little information on habitat preferences for tripletail during their early life history stages. Larvae have been collected offshore in the Gulf of Mexico but there is no information on where the fish were spawned. No collections of tripletail larvae have been made inshore but spawning capable females have been encountered routinely in inshore waters. Juvenile tripletail have been captured in all marine and brackish environments throughout the Western Central Atlantic. Specimens <20mm have

been collected along seawalls as well as in *Sargassum* offshore. Directed sampling will need to be conducted targeting adult spawning fish to better determine the habitat use and preferences of young tripletail.

- *Winter Adult Habitats* – Tagging studies described in Chapter 3 (Conventional and Acoustic) have provided considerable information regarding the movement of tripletail along the southern Atlantic coast from Georgia to Florida on an annual basis. Within the Gulf of Mexico, however, conventional tagging only provides summer returns of adult tripletail when they return to nearshore waters. There is no information regarding where these fish go during the winter months. Improved tagging (acoustic and satellite) may be required to determine seasonal patterns and habitat usage outside the nearshore Gulf waters.

Fishery-Related

- *Fish Aggregating Devices (FADs)* – As discussed briefly in Chapter 4 (*Fish Aggregating Devices (FADs)/Debris*), because of their association with floating material, tripletail may be especially susceptible to harvest related to FADs. However, there is little known about how commonly FADs are used throughout the region, who is placing them in the water, or if anglers are using FADs specifically to target tripletail or to target other species and possibly attracting tripletail in the process. Research is needed into the prevalence of FADs as well as their potential to effect harvest pressure for species like tripletail. Additionally, further information on the materials that anglers are using to construct FADs may give a fuller picture of the fishery.
- *Bow and Spearfishing* – The commercial and recreational tripletail landings data suggest that harvest by use of spears may be on the increase. A number of anecdotal reports on various angling and spearfishing websites note the ease of capture when tripletail are encountered. Other reports suggest that bow-fishermen (archery) are taking fish in increasing numbers as well. As the fish has a strong affinity for surface waters, it make them potentially vulnerable to these types of gears. In addition, there is no 'catch-and-release' in these non-traditional fishing gears, ensuring mortality. Research is needed in the prevalence and impact of these non-traditional fishing gears and activities related to local tripletail populations.

Economics

- *Tracking Imported Product* - During the development of this profile, a market survey was conducted to examine the market channels for domestic product. Through that process, it was determined that tripletail were being imported from Central and South America to fulfill market demand throughout the Gulf and southern Atlantic regions. Unfortunately, tripletail is not a targeted species by NOAA and therefore does not have a Harmonized Tariff Schedule (HTS) code that allows tracking. The imports may be significant compared to the domestic production but more work is needed to understand the volume of fish being brought into the U.S. The demand for imports suggests that a larger domestic contribution could occur in the future.
- *Domestic Commercial Markets and Recreational Use* – Tripletail is a species that plays a relatively small role in the overall scope of the regional seafood market. However, local awareness and demand by seafood consumers has contributed to growing, localized markets in the Gulf region. In addition, increases in tripletail-related effort by private boaters and the for-hire sector will result in more economic activity associated with the resource. Better understanding the seasonality, volume of harvest, pricing, expenditure, and product form attributes of the commercial and recreational sectors will allow managers to better match the capacity of the resource with a growing demand for access by all users.
- *Mariculture* – As noted in Chapter 7 (Commercial Mariculture), there is a lot of interest in developing an aquacultured tripletail product to meet domestic demand. Franks et al. (2001) and Saillant et al. (2014) had relatively good success raising tripletail in captivity and noted fast

growth rates once they passed the early juvenile stages (Chapter 3 Age and Growth, Life Span, and Mariculture). However, their work noted difficulty in getting larvae to eat once they passed through the yolk stage. In addition, the absence of information on tripletail spawning behavior and spawning location further compounds the issue of locating suitable broodstock and initiating captive spawning. Finally, there is some question regarding the meat yield from tripletail and the impact that yield might have on time and investment requirements to market cultured tripletail as a reliable seafood product. More research is needed before mariculture of tripletail becomes economically viable.

Chapter 9
REFERENCES

AFS (American Fisheries Society). 1982. Monetary values of freshwater fish and fish-kill counting guidelines. Special Report Number 13. Bethesda, Maryland.

AFS (American Fisheries Society). 1992. Investigation and valuation of fish kills. Special Report Number 24. Bethesda, Maryland.

AFD (Agence Française de Développement). 2014. French Guiana and Suriname: Better mutual economics knowledge for better cooperation. 60p.

Alcalá, C.A.L. and P. Sánchez-Duarte. 2011. Los peces del delta del Orinoco: Diversidad, bioecología, uso y conservación. Fundación La Salle de Ciencias Naturales y Chevron C. A. Venezuela. Caracas 500 pp.

Almeida, Z.D.S.D. 2008. Os recursos pesqueiros marinhos e estuarinos do Maranhão: biologia, tecnologia, socioeconomia, estado da arte e manejo. Dissertation. Universidade Federal do Pará, Museu Paraense Emílio Goeldi, Programa de Pós-Graduação Em Zoologia. 286p.

Alvera-Azcarate, A., A. Barth, and R.H. Weisberg. 2009. The Surface Circulation of the Caribbean Sea and the Gulf of Mexico as Inferred from Satellite Altimetry. Journal of Physical Oceanography 39:640-657.

Alverson, D.L., and S. Hughes. 1996. Bycatch: from emotion to effective natural resource management. Reviews in Fish Biology and Fisheries 6(4):443-462.

AMRD (Alabama Marine Resources Division). Personal Communication. Alabama Department of Conservation and Natural Resources, Marine Resources Division. Gulf Shores, Alabama.

AMRD (Alabama Marine Resources Division). Unpublished Data. Alabama Department of Conservation and Natural Resources, Marine Resources Division. Gulf Shores, Alabama.

Arguedas- Soto, R. Personal Communication. Costa Rica Dreams Sportfishing, Herradura, Costa Rica.

Armstrong, M., R. Crabtree, M. Murphy, and R. Muller. 1996. A stock assessment of Tripletail, *Lobotes surinamensis*. Florida waters. Florida Department of Environmental Protection, Marine Research Institute, IHR 1.

Artigas, L.F., P. Vendeville, M. Leopold, D. Guiral, and J.F. Ternon. 2003. Marine biodiversity in French Guiana: estuarine, coastal, and shelf ecosystems under the influence of Amazonian waters la biodiversidad marina en Guyana Francesa: los ecosistemas de estuarios, las costas y plataformas bajo la influencia de las aguas amazonicas. Gayana 67(2):302-326.

Balboa, B. Personal Communication. Texas Sea Grant, Matagorda County. Bay City, Texas.

Baughman, J. 1941. On the occurrence in the Gulf Coast waters of the United States of the Triple Tail, *Lobotes surinamensis*, with notes on its natural history. American Naturalist:569-579.

Baughman, J. 1943. Additional notes on the occurrence and natural history of the triple tail, *Lobotes surinamensis*. American Midland Naturalist:365-370.

Bean, T.F. 1906. A Catalog of the fishes of Bermuda with notes on a collection made in 1905 for the Field Museum. Field Columbian Museum Zoological Series 7(2). 95p.

Beckert, H. and J. Brashier. 1981. Final environmental impact statement, proposed OCS oil and gas sales 67 and 69. Department of the Interior, Bureau of Land Management, New Orleans, Louisiana, USA.

Benton, R. 2010. Robert Benton oral history interview by Terry Howard, August 5, 2010. Digital Collection - Florida Studies Center Oral Histories. Paper 202. 37pp.

Ben-Tuvia, A. 1978. Immigration of fishes through the Suez Canal. Fishery Bulletin, 76(1), 249-255.

Berg, C. 1895. Enumeración sistemática y sinonímica de los peces de las costas Argentina y Uruguay. Anales del Museo Nacional de Buenos Aires 4:1-120.

Bischof, B., E. Rowe, A.J. Mariano, and E.H. Ryan. 2004. "The North Equatorial Current." Ocean Surface Currents. http://oceancurrents.rsmas.miami.edu/atlantic/north-equatorial.html.

Blanchard, F., A. Cissé, O. Guyader, S. Gourguet, L. Doyen, and P. Rosele-Chim. 2011. GECO: Gestion durable des pêcheries côtières en Guyane. Département des Ressources Biologiques et Environnement, Unité de Recherche Biodiversite Halieutique de Guyane. Ifremer. Rapport interne RBE/BIODIVHAL 2011-03. 47p.

Blaylock, R.B., S.A. Bullard, and C.M. Whipps. 2004. *Kudoo hypoepicardialis* N. Sp. (Myxozoa: Kudoidae) and associated lesions from the heart of seven perciform fishes in the northern Gulf of Mexico. Journal of Parasitology 90(3):584-593.

Branson, E.J., and T. Turnbull. 2008. Welfare and deformities in fish. Chapter 13 *In*: Branson, E.J (ed). Fish welfare. Blackwell, Oxford, pp.202-216.

Breder, C. 1949. On the behavior of young *Lobotes surinamensis*. Copeia 1949(4):237-242.

Brown, D.A. 2013. Take on the tricky tripletail. Boat US Angler, July 2013.

Brown-Peterson, N.J., and J.S. Franks. 2001. Aspects of the reproductive biology of tripletail, *Lobotes surinamensis*, in the northern Gulf of Mexico. Pages 586-597 *In*: Proceedings of the Gulf and Caribbean Fisheries Institute Vol52.

Buff, V. and S. Turner. 1987. The Gulf Initiative. Pages 784-792 In: Magoon et al. (Editors) Coastal Zone 1987, Proceedings of the Fifth Symposium on Coastal and Oceans Management. May 26-29, 1987. Volume 1.

Bullard, S.A., R.J. Goldstein, R. Hocking, and J. Jewell. 2003. A New Geographic Locality and Three New Host Records for *Neobenedenia melleni* (MacCallum) (Monogenea: Capsalidae). Gulf and Caribbean Research 15(1):1-4.

Butler, C.M., J.M. Logan, J.M. Provaznik, E.R. Hoffmayer, M.D. Staudinger, J.M. Quattro, M.A. Roberts, G.W. Ingram Jr., A.G. Pollack, and M.E. Lutcavages. 2015. Atlantic Bluefin tuna *Thunnus thynnus* feeding ecology in the northern Gulf of Mexico: a preliminary description of diet from the western Atlantic spawning grounds. Journal of Fish Biology 86:365-374.

Calder, D. R. 1995. Hydroid assemblages on holopelagic *Sargassum* from the Sargasso Sea at Bermuda. Bulletin of Marine Science. Vol. 56:537-546.

Caldwell, D.K. 1955. Offshore records of the Tripletail, *Lobotes surinamensis*, in the Gulf of Mexico. Copeia:152-153.

Casazza, T.L. and S.W. Ross. 2010. Sargassum: A Complex 'Island' Community at Sea. NOAA Ocean Explorer http://oceanexplorer.noaa.gov/explorations/03edge/background/sargassum/sargassum.html

Centurioni, L.R., and P.P. Niiler. 2003. On the surface currents of the Caribbean Sea. Geophysical Research Letters 30(6).

Cervigón, F. 1985. The ichthyofauna of the Orinoco estuarine water delta in the west Atlantic coast, Caribbean. Pages 57-78 *In*: Fish Community Ecology in Estuaries and Coastal Lagoons: Towards an Ecosystem Integration. UNAM Press, México.

Chackalall, B., and A. Dragovich. 1981. Artisanal fishery of Guyana. Proceedings of the Gulf and Caribbean Fisheries Institute (USA). 13p.

Chanrachkij, I., and A. Loog-On. 2004. Preliminary report on the ghost fishing phenomena by drifting payao for tuna purse seine fishing in the Eastern Indian Ocean. Research Division, SEAFDEC/TD, Thailand. 9p.

Charuau, A. and D. Die. 2000. Red Snapper (*Lutjanus purpureus*) fishery in French Guiana, pp. 72-86. In: Report of the third workshop on the assessment of shrimp and groundfish fisheries on the Brazil-Guianas shelf. FAO Fisheries Report No. 628. Food and Agricultural Organization of the United Nations (FAO), Rome.

CIDA (Canadian International Development Agency). Unknown Date. An Evaluation of the Competitiveness of the Productive and Non–Productive Sectors of the Guyanese Economy in the context of the CARICOM Single Market and Economy (CSME). Prepared for the Private Sector Commission Ltd. Georgetown, Guyana. 142p.

Cissé, A., L. Doyen, F. Blanchard, C. Béné, and J.-C. Péreau. 2015. Ecoviability for small-scale fisheries in the context of food security constraints. Ecological Economics 119:39-52.

Cochrane, J.E. 1965. The Yucatan Current. Pages 20-27 *In*: Annual Report, Project 286, Texas A&M University, Ref. 65-17T, College Station, USA.

Comyns, B.H., N.M. Crochet, J.S. Franks, J.R. Hendon, and R.S. Waller. 2002. Preliminary assessment of the association of larval fishes with pelagic *Sargassum* habitat and convergence zones in the northcentral Gulf of Mexico. Pages 636-645 *In*: Creswell, R.L. (ed). Proceedings of the 53rd Gulf and Caribbean Fisheries Institute. November 2000. Biloxi, Mississippi.

Conepe (Conselho Nacional de Pesca e Aquicultura). 2015. MPA invests 130 million in Public Fishery Terminals. http://www.conepe.org.br/index.php/noticias/340-mpa-investe-130-milhoes-nos-terminais-pesqueiros-publicos. 22 April 2015

Cooper, D.C. 2002. Spawning patterns of tripletail, *Lobotes Surinamensis*, on the Atlantic coast of Florida. Florida Institute of Technology.

Cooper, P., Jr. Personal Communication. Outdoor Sportswriter. Broussard, Louisiana.

Corsini-Foka, M. and P.S. Economidis. 2007. Allochthonous and vagrant ichthyofauna in Hellenic marine waters. Mediterranean Marine Science 8(1):67-89.

Coston-Clements, L., L.R. Settle, D.E. Hoss, and F.A. Cross. 1991. Utilization of the *Sargassum* habitat by marine invertebrates and vertebrates - a review. NOAA Technical Memorandum NMFS-SEFSC-296, 32 p.

Dahlberg, M. D. 1970. Frequencies of abnormalities in Georgia estuarine fishes. Transactions of the American Fisheries Society 99(1):95-97.

De Angelo, J.A., P.W. Stevens, D.A. Blewett, and T.S. Switzer. 2014. Fish assemblages of shoal- and shoreline-associated seagrass beds in eastern Gulf of Mexico estuaries. Transactions of the American Fisheries Society 143(4):1037-1048

Deidun, A., P. Vella, A. Sciberras, and R. Sammut. 2010. New records of *Lobotes surinamensis* (Bloch, 1790) in Maltese coastal waters. Aquatic Invasions 5, Supplement 1: S113-S116.

Ditty, J.G., and R.F. Shaw. 1994. Larval development of tripletail, *Lobotes surinamensis* (Pisces: Lobotidae), and their spatial and temporal distribution in the northern Gulf of Mexico. Fisheries Bulletin U.S. 92:33-45.

Dooley, J. K. 1972. Fishes associated with the pelagic *Sargassum* complex, with a discussion of the *Sargassum* community. Contributions to Marine Science 16:1-32.

D-PAF Website (Database of Parasites in Fish and Shellfish). http://fishparasite.fs.a.u-tokyo.ac.jp/index-eng.html. Grant-in-Aid for Scientific Research from Japan Society for the Promotion of Science (No. 198079).

Dragovich, A., and L. Villegas. 1982. Small-scale (artisanal) fisheries of northeastern Brazil (Para), French Guyana, Suriname and Guyana. FAO Fisheries Report (FAO), no. 278(suppl.): 192-212 p.

Drummond, K.H. and G.B. Austin, Jr. 1958. Some aspects of the physical oceanography of the Gulf of Mexico, in U.S. Fish and Wildlife Service, Gulf of Mexico physical and chemical data from Alaska cruises: U.S. Fish and Wildlife Service Special Scientific Report-Fisheries 249:5-13.

Dufour, V. 1996. Population dynamics of coral reef fishes and the relative abundance of their early life history stage—an example from French Polynesia. Proceedings of the Workshop on Aquaculture of Coral Reef Fishes and Sustainable Reef Fisheries, Kota Kinabalu, Sabah, Malaysia:198-204.

Dulcic, J., and B. Dragicevic. 2011. Short communication First record of the Atlantic tripletail, *Lobotes surinamensis* (Bloch, 1790), in the Adriatic Sea. Journal of Applied Ichthyology 27:1385-1386.

FAO (Food and Agriculture Organization). 1985. FAOLEX Legislative database of FAO legal office. Fishing agreement between the government of the Republic of Suriname and the government of the Republic of Venezuela. FAOLEX No: LEX-FAOC002161. http://faolex.fao.org/

FAO (Food and Agriculture Organization). 1995. United Nation's Food and Agriculture Organization Code of Conduct for Responsible Fisheries. Rome, FAO. 1995. 41 p.

FAO (Food and Agriculture Organization). 2000. FAO Summary: information on fisheries management in the Republic of Guyana. http://www.fao.org/fi/oldsite/FCP/en/GUY/body.htm

FAO (Food and Agriculture Organization). 2005. The Republic of Guyana. FAO Fishery Country Profile, General Economic Data - November 2005. http://www.fao.org/fi/oldsite/FCP/en/GUY/profile.htm

FAO- FISHSTAT (Food and Agriculture Organization Statistics Division). Food and Agriculture Organization of the United Nations - Statistics Division. http://faostat3.fao.org/home/E

Fowler, H. W. 1931. The fishes of the families Pseudochromidae, Lobotidae, Pempheridae, Priacanthidae, Lutjanidae, Pomadasyidae, and Teraponidae, collected by the United States Bureau of fisheries steamer "Albatross," chiefly in Philippine seas and adjacent waters. Contributions to the biology of the Philippine Archipelago and adjacent regions. Smithsonian Institution. Unites States National Museum. Bulletin 100, Vol 11.

Franks, J., J. Warren, D. Wilson, N. Garber, and K. Larsen. 1998. Potential of spines and fin rays for estimating the age of Tripletail, *Lobotes surinamensis*, from the northern Gulf of Mexico. Pages 1022-1037 in Proceedings of the Gulf and Caribbean Fisheries Institute, Vol 50.

Franks, J.S. Personal Communication. Gulf Coast Research Laboratory, University of Southern Mississippi. Ocean Springs, Mississippi.

Franks, J.S., and D. Gibson. Unpublished Data. Tripletail Tagging Program. Gulf Coast Research Laboratory, University of Southern Mississippi. Ocean Springs, Mississippi.

Franks J.S., D.R. Johnson, and D.S. Ko. Unpublished Data. Gulf Coast Research Laboratory, University of Southern Mississippi. Ocean Springs, Mississippi.

Franks, J.S., J.T. Ogle, J.R. Hendon, D.N. Barnes, and L.C. Nicholson. 2001. Growth of captive juvenile tripletail, *Lobotes surinamensis*. Gulf and Caribbean Research 13:75-78.

Franks, J.S., K.E. VanderKooy, and N.M. Garber. 2003. Diet of tripletail, *Lobotes surinamensis*, from Mississippi coastal waters. Gulf and Caribbean Research 15:27-32.

Freire K.M.F. Personal Communication. Professor of Fisheries Engineering, Federal University of Sergipe. Sergipe, Brazil.

Freire K.M.F., R.A. Tubino, C. Monteiro-Neto, M.F. Andrade-Tubino, C.G. Belruss, A.R. Tomás, S.L. Tutui, P.M. Castro, L.S. Maruyama, A.C. Catella, and D.V. Crepaldi. 2016. Brazilian recreational fisheries: current status, challenges and future direction. Fisheries Management and Ecology. 23(3-4):276-290.

Freire, K.M.F., M.C.S. Bispo, and R.M.C.A. Luz. 2014. Competitive marine fishery in the state of Sergipe. Actapesca 2(1):59-72.

Freire, K.M.F., J.A.N. Aragão, A.R.R. Araújo, A.O. Ávila-da-Silva, M.C.S. Bispo, G. Velasco, M.H. Carneiro, F.D.S. Gonçalves, K.A. Keunecke, J.T. Mendonça, P.S. Moro, F.S. Motta, G. Olavo, P.R. Pezzuto, R.F. Santana, R.A. Santos, I. Trindade-Santos, J.A. Vasconcelos, M. Vianna, and E. Divovich. 2015. Reconstruction of catch statistics for Brazilian marine waters (1950-2010). Pages 3-30. In: Freire, K.M.F. and D. Pauly (eds). Fisheries catch reconstructions for Brazil's mainland and oceanic islands. Fisheries Centre Research Reports vol. 23(4). Fisheries Centre, University of British Columbia, Vancouver.

Froese, R. and D. Pauly (eds). 2016. FishBase. World Wide Web electronic publication. www.fishbase.org, version (05/2016).

Fujii, R. 1993. Cytophysiology of Fish Chromatophores. Pages 191-255 *In*: M.F. Kwang W. Jeon, and J. Jonathan (eds). International Review of Cytology, Volume 143. Academic Press.

FWC (Florida Fish and Wildlife Conservation Commission). Personal Communication. Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida.

FWC (Florida Fish and Wildlife Conservation Commission). Unpublished Data. Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida.

GADNR (Georgia Department of Natural Resources). Personal Communication. Georgia Department of Natural Resources, Coastal Resources Division. Brunswick, Georgia.

GADNR (Georgia Department of Natural Resources). Unpublished Data. Georgia Department of Natural Resources, Coastal Resources Division. Savannah, Georgia.

GADNR 2015 (3-28)

Galstoff, P. (ed). 1954. Gulf of Mexico, its origin, waters, and marine life. Fishery Bulletin 55(89):1-604.

GCRL (Gulf Coast Research Laboratory). Unpublished Data. Gulf Coast Research Laboratory, University of Southern Mississippi. Ocean Springs, Mississippi.

Geijskes, D.C. 1968. Review of marine biological studies on the Guyana shelf. Studies on the Fauna of Suriname and other Guyanas 10(1):137-152.

Gilhen, J., and D.E. McAllister. 1985. The tripletail, *Lobotes surinamensis*, new to the fish fauna of the Atlantic Coast of Nova-Scotia and Canada. Pages 116-118 *In*: Ottawa Field-Naturalists Club, Canada. 116-118 pp.

Gill, T. 1856. On the fishes of New York. Pages 253-269 *In*: Annual report of the Board of Regents of the Smithsonian Institution, showing the operations, expenditures, and condition of the institution, for the year 1856. Mis. Doc. No. 54.

GMFMC (Gulf of Mexico Fishery Management Council). 1998. Generic amendment for addressing essential fish habitat requirements in fishery management plans of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, Florida. 507 p.

Gower, J.F.R., and S.A. King. 2011. Distribution of floating *Sargassum* in the Gulf of Mexico and the Atlantic Ocean mapped using MERIS. International Journal of Remote Sensing 32(7):1917-1929.

Graham, G.C. Personal communication. International Game Fish Association (IGFA) Representative Baja, Mexico.

Gray, C.A., S.J. Kennelly, and K.E. Hodgson. 2003. Low levels of bycatch from estuarine seining in New South Wales, Australia. Fisheries Research 64:37-54.

Green, A.W., L.Z. Barrington, and G.C. Matlock. 1982. An estimation of the total number of Texas fishermen, 1 September 1978 - 31 August 1979. Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies 36:241-251.

Green, L.M., and R.P. Campbell. 2010. Trends in finfish landings of sport-boat anglers in Texas marine waters, May 1974-May 2008. Texas Parks and Wildlife Department, Texas Parks and Wildlife Department Management Data Series No. 257. 645 pp.

GSMFC (Gulf States Marine Fisheries Commission). 2004. Guidelines for Marine Artificial Reef Materials, Second Edition. A Joint Publication of the Gulf and Atlantic States Marine Fisheries Commissions. Lukens, R.R. and C. Selberg, Project Coordinators. Gulf States Marine Fisheries Commission, Ocean Springs, Mississippi. Publication Number 121, 205 p.

GSMFC (Gulf States Marine Fisheries Commission). Unpublished Data. Market Survey for Tripletail in the Gulf of Mexico. Gulf States Marine Fisheries Commission, Ocean Springs, Mississippi.

Gudger, E.W. 1929. An adult pug-headed brown trout, *Salmo fario*, with notes on other pug-headed salmonids. Bulletin of the American Museum of Natural History LVIII(X):531-559.

Gudger, E.W. 1930. Pug headedness in the striped seabass, *Roccus lineatus*, and in other related fishes. Bulletin of the American Museum of Natural History LXI (I):1-19.

Gudger, E.W. 1931. The triple-tail, *Lobotes surinamensis*, its name, occurrences on our coasts and its natural history. The American Naturalist 65-696:49-69.

Gunter, G. 1935. Records of fishes rarely caught in shrimp trawls in Louisiana. Copeia 1935(1):39-40.

Gunter, G. 1941. Relative numbers of shallow water fishes of the northern Gulf of Mexico, with some records of rare fishes from the Texas coast. American Midland Naturalist 26(1):194-200.

Gunter, G. 1957. Predominance of the young among marine fishes found in fresh water. Copeia 1957(1):13-16.

Hall, M.A., D.L. Alverson, and K.I. Metuzals. 2000. By-catch: problems and solutions. Marine Pollution Bulletin Vol. 41(1-6):204-219

Hardy, J.D.J. 1978. Development of fishes of the mid-Atlantic bight: an atlas of the egg, larval, and juvenile stages - Volume III Aphredoderidae through Rachycentridae. U.S. Fish and Wildlife Service, Biological Services Program Report FWS/OBS-78/12, Washington, D.C. 394 pp.

Hargis, W.J., JR. 1955. A new species of *Benedenia* (Trematoda: Monogenea) from *Girella nigricans*, the opaleye. Journal of Parasitology. 41:48-50.

Harper, J. Personal Communication. Texas Parks and Wildlife Department. Palacios, Texas.

Harper, S., L. Frotté, S. Booth, L. Veitch, and D. Zeller. 2015. Reconstruction of marine fisheries catches for French Guiana from 1950-2010. Fisheries Centre Working Paper #2015-07, University of British Columbia, Vancouver, 11 p.

Harrington, J.M., R.A. Myers, and A.A. Rosenberg. 2005. Wasted fishery resources: discarded by-catch in the USA. Fish and Fisheries 2005(6):350-361

Hazin, F.H.V. Personal Communication. National Secretary for Fisheries. Brazilian Ministry of Fisheries and Aquaculture. Pernambuco, Brazil.

Heemstra, P.C. 1995. Lobotidae. Dormilonas. p. 1226. In W. Fischer, F. Krupp, W. Schneider, C. Sommer, K.E. Carpenter and V. Niem (eds.) Guia FAO para Identification de Especies para lo Fines de la Pesca. Pacifico Centro-Oriental. 3 Vols. FAO, Rome.

Hernandez, F. 2011. Sargassum in the northern Gulf of Mexico. Dauphin Island Sea Lab. Powerpoint presentation. October 25, 2011.

Hickey, C.R., Jr. 1972. Common abnormalities in fishes, their causes and effects. Technical Reports of the New York Ocean Sciences Laboratory 0013, 20pp.

Hilton, E.J., and W.E. Bemis. 2005. Grouped tooth replacement in the oral jaws of the tripletail, *Lobotes surinamensis* (Perciformes: Lobotidae), with a discussion of its proposed relationship to Datnioides. Journal Information 2005(3).

Hoffmayer, E.R., J.S. Franks, B.H. Comyns, J.R. Hendon, and R.S. Waller. 2005. Larval and juvenile fishes associated with pelagic Sargassum in the northcentral Gulf of Mexico. Proceedings of the Gulf and Caribbean Fisheries Institute 56:259-265.

Holt, J., M. Bartz, and J. Lehman. 1982. Regional environmental impact statement, Gulf of Mexico. Department of the Interior, Minerals Management Service, 735 pp.

Hornby, C. S. Harper, J MacDonald, and D. Zeller. 2015 Reconstruction of Suriname's marine fisheries catches from 1950-2010. Fisheries Centre, The University of British Columbia. Working Paper #2015-49. 15p.

Hughes, K. 1937. Notes on the habits of the Triple-Tail, *Lobotes surinamensis*. American Naturalist 71(735):431-432.

Hunnewell, M. C. 2013. The culturability of marine fishes in Georgia: Preferred habitat characteristics and behavioral responses of Atlantic tripletail, *Lobotes surinamensis*, and of spotted seatrout, *Cynoscion nebulosus*, to fixed, changing, and experimentally-manipulated captive environment variables. Savannah State University.

IGFA (International Game Fish Association). 2016. World Recreational Fishing Records. Dania Beach, Florida.

IICA (Inter-American Institute for Cooperation on Agriculture). 1997. Agriculture in Suriname; 1991-1995 & beyond. Working Document, #12 of 13. Socioeconomic Policy, Trade, and Investment Programme. Caribbean Regional Centre Office in Trinidad and Tobago. 23p.

Instituto de Pesca, São Paulo. Personal Communication. Instituto De Pesca: Pesca y Acuicultura, Governo do Estado, São Paulo, Brazil.

Isaac, V., R. Espírito-Santo, and U. Saint-Paul. 2010. Fisheries and Management. Pages 233-248 *In*: Mangrove Dynamics and Management in North Brazil. Springer.

ITAPIPU (Instituto de Previdência de Itajaí Porto de Itajaí). 2014. 1st Brazilian Fishery and Aquaculture Yearbook 2014. www.itajai.sc.gov.br

Jiménez-Prado, P., and P. Béarez. 2004. Peces marinos del Ecuador continental/Marine fishes of continental Ecuador (Vol. 1). SIMBIOE/NAZCA/IFEA.

Johns, W.E., T.L. Townsend, D.M. Fratantoni and W.D. Wilson. 2002. On the Atlantic inflow to the Caribbean Sea. Deep Sea Research 49:211–243.

Jones, J.I., R.E. Ring, M.O. Rinkel, and R.E. Smith (eds). 1973. A summary of knowledge of the eastern Gulf of Mexico, State University System of Florida Institute of Oceanography, St. Petersburg, Florida.

Jordan D.S. and B.W. Evermann. 1898. The fishes of North and Middle America: A descriptive catalogue of the species of fish-like vertebrates found in waters of North America, north of the Isthmus of Panama, Part III. Bulletin of the U.S. National Museum 47(3): 2184-2744.

Jordan, D.S. and W.F. Thompson. 1911. A review of the Fishes of the Families Lobotidae and Lutianidae, found in the Waters of Japan. Proceedings of the U.S. National Museum 39:435-471.

Junor, F.J.R. 1967. Deformities in tilapia species at Lake Kyle, Rhodesia. Piscator (70):66-67.

Kalinowsky, C. Personal Observation. Coastal Resources Division, Georgia Department of Natural Resources. Savannah, Georgia.

Kalinowsky, C. Unpublished Data. Coastal Resources Division, Georgia Department of Natural Resources. Savannah, Georgia.

Katsanevakis, S., Ü. Acar, I. Ammar, B.A. Balci, P. Bekas, M. Belmonte, C.C Chintiroglou, P. Consoli, M. Dimiza, K, Fryganiotis, V. Gerovasileiou, V. Gnisci, N. Gülşahin, R. Hoffman, Y. Issaris, D. Izquierdo-Gomez, A Izquierdo-Muñoz, S. Kavadas, L. Koehler, E. Konstantinidis, G. Mazza, G. Nowell, U. Önal, M.R. Özen, P. Pafilis, M. Pastore, C. Perdikaris, D. Poursanidis, E. Prato, F. Russo, B. Sicuro, A.N. Tarkan, M. Thessalou-Legaki, F. Tiralongo, M. Triantaphyllou, K. Tsiamis, S. Tunçer, C. Turan, A. Türker, and S Yapici. 2014. New Mediterranean biodiversity records (October, 2014). Mediterranean Marine Science 15(3):675-695.

Kharin, V., D. Vyshkvartsev, and O. Maznikova. 2009. About the taxonomic status of rare fish species Surinam tripletail *Lobotes surinamensis* (Lobotidae) and new discovery of this species in Russian waters. Journal of Ichthyology 49(1):32-38.

Konishi, Y. 1988. Lobotidae. *In*: M. Okiyama (ed.). An atlas of the early stage fishes in Japan. Tokai Univ. Press, Tokyo, 1,154 p. (in Japanese.)

Lacerda, L.D., J.E. Conde, C. Alarcon, R. Alvarez-León, P.R. Bacon, L. D'Croz, B. Kjerfve, J. Polaina, and M. Vannucci. 1993. Mangrove Ecosystems of Latin America and the Caribbean: a Summary. Project PD114/90 (F). Smithsonian Institution. Conservation and sustainable utilization of mangrove forest in Latin America and Africa regions. Part I–Latin America. ITTO/ISME, Okinawa, 1-42.

Lara, R.J. 2003. Amazonian mangroves – A multidisciplinary case study in Pará State, North Brazil: Introduction. Wetlands Ecology and Management 11(4):217-221

Lawler, A.R. 1980. Studies on *Amyloodinium ocellatum* (Dinoflagellata) in Mississippi Sound: natural and experimental hosts. Gulf and Caribbean Research 6(4):403-413.

LDWF (Louisiana Department of Wildlife and Fisheries). Unpublished Data. Louisiana Department of Wildlife and Fisheries, Marine Fisheries Division, Baton Rouge, Louisiana.

Lee, S.L., V.C. Chong, K.H. Loh, and T. Yurimoto. 2013. Are intertidal mudflat communities (fish and shrimp) affected by cockle culture? Malaysian Journal of Science 32:107-116.

Letourneur, Y., P. Chabanet, P. Durville, M. Taquet, E. Teissier, M. Parmentier, J.C. Quero, and K. Pothin. 2004. An updated checklist of the marine fish fauna of Reunion Island, South-Western Indian Ocean. Cybium 28(3):199-216.

López, R., J.M. López, J. Morell, J.E. Corredor, and C.E. Del Castillo. 2013. Influence of the Orinoco River on the primary production of eastern Caribbean surface waters. Journal of Geophysical Research: Oceans 118(9):4617-4632.

Lucano-Ramirez, G., S. Ruiz-Ramírez, B. Aguilar-Palomino, J.A. Rojo-Vásquez. 2001. Listado de las especies de peces de la regióncostera de Jalisco y Colima, México. Ciencia y mar. Artículos yensayos:13-20.

Lum, S. Personal Communication. Outcast Sportfishing Charters. Port Canaveral, Florida.

MacDonald, J., Harper, S., Booth, S., and Zeller, D. 2015. Guyana fisheries catch: 1950-2010. Fisheries Centre Working Paper #2015-21, University of British Columbia, Vancouver, 18 p.

Maison, D. M. A., and G. Haraldsson. 2007. Management of inshore artisanal fisheries in Guyana: a co-management approach. United Nations University - Fisheries Training Programme. Final Report. Iceland. 57p.

Martins, I.M, R.P. Medeiros, and N. Hanazaki. 2014. From fish to ecosystems: The perceptions of fishermen neighboring a southern Brazilian marine protected area. Ocean and Coastal Management 91:50-57.

Mather, F. 1881. Fishes which can live in both salt and fresh water. Transactions of the American Fisheries Society 10(1):65-75.

McDowell, D. Personal Communication. Coastal Resources Division, Georgia Department of Natural Resources. Brunswick, Georgia.

McDowell, D. 2015. Cooperative angler tagging project: 1987-2013. Cooperative Angler Tagging Project 1987-2013. A Report to the GSMFC. 6p.

McEachern, J., and J.D. Fechelm. 2005. Fishes of the Gulf of Mexico. Volume 2: Scorpaeniformes to Tetraodontiformes. University of Texas Press, Austin. 1004p.

MDMR (Mississippi Department of Marine Resources). Unpublished Data. Marine Fisheries, Mississippi Department of Marine Resources. Biloxi, Mississippi.

Meeks, S.E., and S.F. Hildebrand. 1925. The marine fishes of Panama. Part II. Field Museum of Natural History, Publication No, 226.

Ménard, F., M. Potier, S. Jaquemet, E. Romanov, R. Sabatié, and Y. Cherel. 2013. Pelagic cephalopods in the western Indian Ocean: New information from diets of top predators. Deep-Sea Research II 95:83-92.

Mendonca, J. T., and A. L. Pereira. 2014. Management of gillnet fisheries in the south coast of the state of São Paulo, Brazil. Anais da Academia Brasileira de Ciências 86(3):1227-1237.

Mendoza, J. 2015. Rise and fall of Venezuelan industrial and artisanal marine fisheries: 1950-2010. Fisheries Centre Working Paper #2015-27, University of British Columbia, Vancouver. 15 p.

Mendoza, J., S. Booth, and D. Zeller. 2003. Venezuelan marine fisheries catches in space and time: 1950-1999. pp. 171-180 *In:* D. Zeller et al. (eds.), From Mexico to Brazil: Central Atlantic fisheries catch trends and ecosystem models. Fisheries Centre Research Reports 11(6), Vancouver.

Merriner, J.V., and W.A. Foster. 1974. Life history aspects of the tripletail, *Lobotes surinamensis*, (Chordata-Pisces-Lobotidae), in North Carolina waters. Journal of the Elisha Mitchell Scientific Society 90-4:121-124.

Mitchill, S.L. 1815. The fishes of New York. Transactions of the Literary and Philosophical Society of New York Vol I: 355-492.

MPA (Ministério da Pesca e Aquicultura Brasil). 2008. Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis Estatística da pesca 2006 Brasil: grandes regiões e unidades da federação /Brasília: Ibama. 174 p.

Munprasit, A. and P. Prajakjitt. 2000. Tuna resource exploration with tuna longline in the South China Sea, Area IV: Vietnamese waters. Proceedings of the SEAFDEC Seminar on Fishery Resources in the South China Sea, Area IV: Vietnamese Waters: 29-40.

Nagpure, N.S., I. Rashid, A.K Pathak, M. Singh, S.P Singh, and U.K. Sarkar. 2012. FBIS: A regional DNA barcode archival & analysis system for Indian fishes. Bioinformation, 8(10):483.

Nascimento, E., L. Santos, F. Santos, S. Sobral, S. Lima, R. da Silva, and H. Andrade. 2013. Análise da pesca dos municípios litorâneos do Estado de Pernambuco. XIII Jornada de Ensino, Pesquisa e Extensão – JEPEX 2013 – UFRPE: Recife, 09 a 13 de dezembro.

NDBC (National Data Buoy Center). Unpublished Data. NOAA National Data Buoy Center - #41113 and Station FPKG1 - 8670870 - Fort Pulaski, GA. Stennis Space Center, Mississippi. http://www.ndbc.noaa.gov/

NOAA (National Oceanic and Atmospheric Administration). Unpublished Data. Fisheries Statistics and Economics Division, Silver Spring, Maryland.

NOAA (National Oceanic and Atmospheric Administration). Personal Communication. NOAA Office of Science and Technology, National Marine Fisheries Service. Annual Commercial and Recreational Landings Data.

NARP (National Artificial Reef Plan). 2007. National Artificial Reef Plan (as Amended): Guidelines for Siting, Construction, Development, and Assessment of Artificial Reefs. United States Department of Commerce, National Oceanic and Atmospheric Administration. 60p.

NMFS (National Marine Fisheries Service). Fisheries of the United States 2011. NOAA - National Marine Fisheries Service. 124 pp.

Nunes, J.A.C.C., D.V. Medeiros, J.A. Reis-Filho, C.L.S. Sampaio, and F. Barros. 2012. Reef fishes captured by recreational spearfishing on reefs of Bahia State, northeast Brazil. Biota Neotrop. 12(1):179-185

Ochoa, J., H. Sheinbaum, A. Badan, J. Candela, and D. Wilson. 2001. Geostrophy via potential vorticity inversion in the Yucatan Channel. Journal of Marine Research 59:725-747.

Ogden, J.C., S.M. Davis, K.J. Jacobs, T. Barnes, and H.E. Fling. 2005. The use of conceptual ecological models to guide ecosystem restoration in South Florida. Wetlands 25(4):795-809.

Page, L.M., H. Espinosa-Pérez, L.T. Findley, C.R. Gilbert, R.N. Lea, N.E. Mandrak, R.L. Mayden, and J.S. Nelson. 2013. Common and scientific names of fishes from the United States, Canada, and Mexico, 7th edition. AFS Special Publication 34. 243p.

Parr, A.E. 1935. Report on the hydrographic observations in the Gulf of Mexico and the adjacent straits made during the Yale Oceanographic Expedition on the Mabel Taylor in 1932. Bull. Bingham Oceanog. Coll. 5(1):1-93.

Parr, R.T. 2011. Age, growth, and reproductive status of tripletail, *Lobotes surinamensis*, in the aggregation nearshore Jekyll Island, GA, USA. B.S. Thesis. University of Georgia. Athens, Georgia.

Pauly, D, and C. Zeller (eds). 2015. Sea Around Us Concepts, Design and Data (www.seaaroundus.org). Fisheries Centre, The University of British Columbia.

Perry, H.M. and VanderKooy, S.J. 2015. The Blue Crab Fishery of the Gulf of Mexico: A Regional Management Plan 2015 Revision. Gulf States Marine Fisheries Commission. Ocean Springs, MS.

Pesca Amador Website. 2016. Peixes de Agua Salgada (Salt Water Fish). http://www.pescamadora.com. br/peixes-de-agua-salgada/

Phillips, T. 2007. Thematic Report for the Guianas – Brazil Sub-region. Prepared for the CLME Project. 70 pp.

Pinto, M.F., J.S. Mourão, and R.R.N. Alves. 2013. Ethnotaxonomical considerations and usage of ichthyofauna in a fishing community in Ceará State, Northeast Brazil. Journal of ethnobiology and ethnomedicine 9(17):1-11.

Poizat, G., and E. Baran. 1997. Fishermen's knowledge as background information in tropical fish ecology: a quantitative comparison with fish sampling results. Environmental Biology of Fishes 50(4):435-449.

Pradervand, P., B. Q. Mann, and B.F. Bellis. 2007. Long-term trends in the competitive shore fishery along the KwaZulu-Natal coast, South Africa. African Zoology 42(2):216-236.

PRDNER (Puerto Rico Department of Natural and Environmental Resources). Personal Communication. Fisheries - Puerto Rico Department of Natural and Environmental Resources. Rio Piedras, Puerto Rico

Prince, E.D., and J. Gonzalez. 1985. Preliminary underwater observations of fish aggregating device off San Juan, Puerto Rico. Page 150 *In*: Mitchell, C.T. (ed). Diving for science-1985: proceedings of Joint International Scientific Diving Symposium, October 31, 1985 to November 3, 1985, La Jolla, California, USA. American Academy of Underwater Sciences.

Randall, J.E. 2005. A review of mimicry in marine fishes. Zoological Studies-Taipei 44(3):299.

Reis-Filho, J.A., and C.F. Cruz. 2009. Ichthyofauna of two beaches in the outlet of the Paraguaçu River – Todos os Santos Bay, Bahia, Brazil. Anais do IX Congresso de Ecologia do Brasil, 13 a 17 de Setembro de 2009, São Louren_co – MG: 1-4.

Republiek Suriname. 2013. NV CEVIHAS is de moderne ijsfabriek. Actueel. http://www.gov.sr/ministerie-van-lvv/actueel/nv-cevihas-is-de-moderne-ijsfabriek.aspx

Rester, J. (ed). In Prep. A profile of the habitats in the U.S. Gulf of Mexico and their threats. Gulf States Marine Fisheries Commission. Ocean Springs, Mississippi.

Reyes, Roberto. Personal Communication. Puerto Rico Freedivers, Inc. Puerto Rico.

Riera, F., A. Grau, A.M. Grau, E. Pastor, A. Quetglas and S. Pou. 1999. Ichtyofauna associated with drifting floating objects in the Balearic Islands (Western Mediterranean). Scientia Marina 63(3-4):239-260.

Rose, C.D. and A.H. Harris. 1968. Pugheadedness in the spotted seatrout. Quarterly Journal of the Florida Academy of Sciences 31(4):268-270.

Rounds, J., and R. Feeney. 1993. 1st record of the tripletail (*Lobotes surinamensis*, family Lobotidae) in California waters. California Fish and Game 79(4):167-168.

Rudershausen, P.J., J.A. Buckel, J. Edwards, D.P. Gannon, C.M. Butler, and T.W. Averett. 2010. Feeding ecology of blue marlins, dolphinfish, yellowfin tuna, and wahoos from the North Atlantic Ocean and comparisons with other oceans. Transactions of the American Fisheries Society 139:1335-1359.

Russell, B.J. and H.M. Dierssen. 2015. Use of Hyperspectral Imagery to Assess Cryptic Color Matching in *Sargassum* Associated Crabs. PLoS ONE 10(9): e0136260. doi:10.1371/journal. pone.0136260

Saad, A. 2005. Check – list of Bony Fish Collected from the Coast of Syria. Turkish Journal of Fisheries and Aquatic Sciences 5: 99-106.

Saillant, E.A., J.S. Franks, J.T. Lemus, and C.S. Lee. Unpublished Data. Gulf Coast Research Laboratory, University of Southern Mississippi. Ocean Springs, Mississippi.

Saillant, E.A., J.T. Lemus and J.S. Franks. 2014. Culture of *Lobotes surinamensis* (Tripletail). Final Report to the Mississippi Department of Marine Resources, Biloxi, MS, 27pp.

SAFMC (South Atlantic Fishery Management Council). 1998. Habitat Plan for the South Atlantic Region: Essential Fish Habitat Requirements for Fishery Management Plans of the South Atlantic Fishery Management Council. South Atlantic Fishery Management Council, Charleston, South Carolina. NOAA Awards NA77FC0002 and NA87FC0004. 457p. + Appendices.

Santos, P., I. Almeida-Funo, F. Piga, V. França, S. Torres, and C. Melo. 2011. Profile of fishermen's socioeconomic Fox City, State Maranhão. Rev. Bras. Eng. Pesca 6(1):1-14.

Sazima, I., L.N. Carvalho, F.P. Mendonça, and J. Zuanon. 2006. Fallen leaves on the water-bed: diurnal camouflage of three night active fish species in an Amazonian streamlet. Neotropical Ichthyology 4(1):119-122.

Sazima, I., A. Grossman, A. Carvalho-Filho, and C. Sazima. 2009. First record of the tripletail or blackfish (*Lobotes surinamensis*) from an oceanic island in the South Atlantic. Marine Biodiversity Records 2:e97.

Schaeffer-Novelli, Y., G. Cintrón-Molero, M.L.G. Soares, and T. De-Rosa. 2000. Brazilian mangroves. Aquatic Ecosystem Health and Management 3(4):561-570.

Schmitt, J.D., and D. J. Orth. 2015. First Record of Pughead Deformity in Blue Catfish. Transactions of the American Fisheries Society, 144(6), 1111-1116.

Schoener, A., and G.T. Rowe. 1970. Pelagic *Sargassum* and its presence among the deep-sea benthos. Deep Sea Research and Oceanographic Abstracts 17(5):923-925.

Schwartz, F.J. 1965. A pugheaded menhaden from Chesapeake Bay. Underwater Naturalist 3(1):22-24.

Sheinbaum, J., J. Candela, A. Badan, and J. Ochoa. 2002. Flow structure and transport in the Yucatan Channel. Geophysical Research Letters 29(3).

Shipp, R. 1999. Dr. Bob Shipp's Guide to Fishes of the Gulf of Mexico. KME Seabooks

Silas, E., P.P. Pillai, A. Jayaprakash, and M.A. Pillai. 1984. Focus on small scale fisheries: drift gillnet fishery off Cochin, 1981 and 1982. Marine Fisheries Information Service, Technical and Extension Series 55:1-12.

Sime, P. 2005. St. Lucie Estuary and Indian River Lagoon conceptual ecological model. Wetlands 25.4: 898-907.

Solis, R.S., and G.L. Powell. 1999. Hydrography, mixing characteristics, and residence times of Gulf of Mexico estuaries. Pages 29-62 *In*: T.S. Bianchi, J.R. Pennock and R.R. Twilley (eds), Biogeochemistry of Gulf of Mexico Estuaries. John Wiley & Sons, Inc., New York.

Staley, T. Personal Communication. Crocodile Bay Resort. Puerto Jiménez, Costa Rica.

Starbroek News. 2007. Suriname, Venezuelan sign fishing pact. March 23, 2007. https://news.google.com/newspapers?nid=2492&dat=20070323&id=8kVaAAAAIBAJ&sjid=CigMAAAAIBAJ&pg=688,3740284&hl=en

Stramma, L. 1991. Geostrophic transport of the South Equatorial Current in the Atlantic. Journal of Marine Research 49:281-294

Streich, M.K., C.A. Kalinowsky, and D.L. Peterson. 2013. Residence, habitat use, and movement patterns of Atlantic tripletail in the Ossabaw Sound Estuary, Georgia. Marine and Coastal Fisheries 5(1):291-302.

Strelcheck, A.J., J.B. Jackson, J. Cowan, and R.L. Shipp. 2004. Age, growth, diet, and reproductive biology of the tripletail, *Lobotes surinamensis*, from the north-central Gulf of Mexico. Gulf of Mexico Science 22(1):45-53.

Sugimoto, M. 2002. Morphological color changes in fish: regulation of pigment cell density and morphology. Microscopy research and technique, 58(6):496-503.

Taquet, M., G. Sancho, L. Dagorn, J. Gaertner, D. Itano, R. Aumeeruddy, B. Wendling, and C. Peignon. 2007. Characterizing fish communities associated with drifting fish aggregating devices (FADs) in the Western Indian Ocean using underwater visual surveys. Aquatic Living Resources 20(4):331-341.

Tenorio, M.C. 2013. 2013 Update to the checklist of fishes of the CNMI. The Commonwealth of the Northern Marianas Islands, Department of Lands and Natural Resources, Division of fish and Wildlife. 47p.

Thayer, G.W. and J.F. Ustach. 1981. Gulf of Mexico wetlands: value, state of knowledge, and research needs. Pages 1-30 *In*: D.K. Atwood (convener). Proceedings of a Symposium on Environmental Research Needs in the Gulf of Mexico (GOMEX) Volume I1B.

Tomkins, S. 2005. Tripletail is there for taking near surface of Gulf's water. August 18, 2005 Houston Chronical. http://www.chron.com/sports/outdoors/article/Tompkins-Tripletail-is-there-for-taking-near-1935774.php

Ton, C., A. Magraoui, F. Blanchard, L. Baulier, H. Andre, F. Grigoletto, and E. Mansuy. 2016. Structure et dynamique de la biodiversité halieutique dans les eaux Guyanaises. Projet STUDY – Rapport Final. Ifremer. Janvier 2016 – R.INT.RBE/BIODIVHAL/2016-1. 83p.

TPWD (Texas Parks and Wildlife Department). Personal Communication. Austin, Texas.

TPWD (Texas Parks and Wildlife Department). Unpublished Data. Texas Creel Survey Data. Austin, Texas.

Turner, R.E. 1999. Inputs and outputs of the Gulf of Mexico, Chapter 4. *In*: H. Kumpf, K. Steidinger and K. Sherman (eds). The Gulf of Mexico Large Marine Ecosystem: Assessment, Sustainability, and Management. Blackwell Science, Malden, Massachusetts.

Uchida, K., S. Imai, S. Mito, S. Fujita, M. Ueno, Y. Shojima, T. Senta, M. Tahuka, and Y. Dotsu. 1958. Studies on the eggs, larvae, and juveniles of Japanese fishes. Series I. Second Laboratory of Fisheries Biology, Fisheries Department, Faculty of Agriculture, Kyushu University. Fukuoka, Japan.

Van Cleave, H. 1918. Acanthocephala of the subfamily Rhadinorhynchinae from American fish. The Journal of Parasitology 5(1):17-24.

VanderKooy, S.J. Personal Communication. Gulf States Marine Fisheries Commission. Ocean Springs, Mississippi.

VanderKooy, S.J. Personal Observation. Gulf States Marine Fisheries Commission. Ocean Springs, Mississippi.

VanderKooy, S.J. 2009. A Practical Handbook for Determining the Age of Gulf of Mexico Fishes Second Edition. Gulf States Marine Fisheries Commission. Ocean Springs, Mississippi. GSMFC No. 167.

van Ravenswaay, R.O., and R.S. Chin-A-Lin. 2005. Assessment of Agricultural Information Needs in African, Caribbean & Pacific (ACP) states for CTA'S Products and Services. Phase 1: Caribbean. Country Study: Suriname. Technical Centre for Agricultural and Rural Cooperation (CTA) Final Report. Project: 4-7-41-204-4/e. 72p.

Vera, J.M., and P. Sánchez. 1997. Patterns in marine fish communities as shown by artisanal fisheries data on the shelf off the Nexpa River, Michoacán, México. Fisheries Research 33(1):149-158.

Walker, B.K. and D.S. Gilliam. 2013. Determining the extent and characterizing coral reef habitats of the northern latitudes of the Florida Reef Tract (Martin County). PloS one 8.11: e80439.

Watson, J.K. 2005. Avian conservation implementation plan Canaveral National Seashore – *Final Draft*. National Park Service Southeast Region, U.S. Fish and Wildlife Service. 47p.

Wells, R.J. and J.R. Rooker. 2004. Spatial and temporal patterns of habitat use by fishes associated with Sargassum mats in the northwestern Gulf of Mexico. Bulletin of Marine Science 74(1):81-99.

White, R. Personal Communication. Tropic Star Lodge. Panama City, Panama.

White, D.B., and R.R. Stickney. 1973. A manual of flatfish rearing. Skidaway Institute of Oceanography, Technical Report Series Number 73-7, Savannah, Georgia. 36 pp.

Wiegert, R.G., and B.J. Freeman. 1990. Tidal Salt Marshes of the Southeast Atlantic Coast: A Community Profile. United States: N. p. Web. doi:10.2172/5032823.

Williams Jr, E.H., L. Bunkley-Williams, and T.G. Rand. 1994. Some copepod and isopod parasites of Bermuda marine fishes. Journal of Aquatic Animal Health 6(3):279-280.

Wirtz, P., R. Fricke, and M.J. Biscoito. 2008. The coastal fishes of Madeira Island—new records and an annotated check-list. Zootaxa 1715: 1–26.

Wiseman, W.J. Jr., and J. Sturges. 1999. Physical oceanography of the Gulf of Mexico: processes that regulate its biology. *In*: H. Kumpf, K. Steidinger and K. Sherman (eds). The Gulf of Mexico Large Marine Ecosystem: Assessment, Sustainability, and Management. Blackwell Science, Malden, Massachusetts.

Woods, L.P. 1942. Rare fishes from the coast of Texas. Copeia 1942(3):191-192.

Woodward, A.G. "Spud". Personal Communication. Coastal Resources Division. Georgia Department of Natural Resources. Brunswick, Georgia.

Yarbro, L.A. and P.R. Carlson Jr. 2011. Seagrass integrated mapping and monitoring for the state of Florida. Mapping and Monitoring Report No. 1.

Yerger, R.W. 1961. Additional records of marine fishes from Alligator Harbor, Florida, and vicinity. Quarterly Journal of the Florida Academy of Sciences 24:111.

Zemnukhov, V.V., and S.V. Turanov. 2011. First catch in Russian waters of a spinulated specimen of *Lobotes surinamensis* (Bloch, 1790) (Percoidei: Lobotidae) with notes on taxonomy of this species. Journal of Ichthyology 51(1):84-89.

About the Artist

Connie Sherman Lovell

A native of St. Simons Island, Georgia, Connie Sherman Lovell has perfected her own unique combination of direct and indirect techniques of Gyotaku designs. "This art form," Lovell explains, "is used by the Japanese angler to document the actual size and species of his catch. It is the technique of printing from the inked body of a fish or other sea life." After the fish is prepared and positioned, ink is applied to its body, then handmade rice paper is placed over the fish and rubbed with finger tips. "When pulled off, a mirror image of the fish is created," she adds. Several prints can be made from the same fish because each has its own uniqueness and is considered an original.

A favorite among sport fishermen, her work features trophy fish designed especially for the home or office. Schools of snapper or shrimp come to life through vivid patterns, interweaving her love of the sea. Most recently her creations can be enjoyed on T-shirts.

Lovell studied under renowned Georgia artist Mary T. Griffith of Jekyll Island and Yoshinko Takahashi, a master fish printer. Takahashi teaches at Shizuaka and Tokai Universities in Japan where he specializes in the indirect method of printing.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