A Comparative Dietary Analysis of Tomtate (*Haemulon aurolineatum*) and White Grunt (*H. plumieri*)

An essay submitted in partial fulfillment of

the requirements for graduation from the

Honors College at the College of Charleston

with a Bachelor of Arts degree in

Biology and Spanish

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May 2015

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Abstract

A diet analysis can provide insight on competition for resources, food web dynamics, feeding behavior, and transfer of energy throughout the ecosystem. Species population management is most effective when focusing on ecosystem-based fisheries management. Studying groups of fishes rather than a single species can be useful when completing a dietary analysis of the community. This study compared the diet of two species from the genus *Haemulon*: White grunt, *Haemulon plumieri*, and Tomtate, *Haemulon aurolineatum.* Both species had a widespread diet that included amphipods, bivalves, bony fishes, bryozoans, crabs, decapods, echinoderms, gastropods, isopods, ostracods, plants, shrimp, sponges, stomatopods, tunicates and worms. White grunt had a more diverse diet, feeding on a total of 52 varied prey items, while tomtate fed on 21 different prey items. Many of the prey items found in each species were benthic or bentho-pelagic species, confirming that tomtate and white grunt are bottom dwellers. Competition between the fishes is only likely among bony fish prey items.

Introduction

White grunt, *Haemulon plumieri*, and tomtate, *Haemulon aurolineatum*, are two abundant fish species from the Haemulidae family found from Cape Cod, Massachusetts to Brazil including the Gulf of Mexico (Darcy 1983). Tomtate are distributed based on varying temperature, salinity, water clarity, habitat, and food availability among these geographical locations (Darcy 1983). Tomtate prefer warmer water; they are uncommon north of the Chesapeake Bay, and Manooch & Barans 1982 have never found tomtate in water less than 10.3°C. Tomtate favor high salinity and clear water, which supports the fact that they are not found in estuarine areas (Darcy 1983). Tomtate are more abundant on artificial reefs than fringing reefs, which is likely due to food availability (Randall 1963, Darcy 1983). Tomtate are found in depths from 9-55m along a wide variety of habitats including sponge-coral habitats, sandy bottoms, grass beds, and artificial reefs (Manooch & Barans 1982, Darcy 1983). Tomtate are most frequently caught over a sponge coral live bottom but there have also been large sporadic catches over sandy bottoms (Manooch &Barans 1982, Sedberry 1985). Factors affecting white grunt distribution are not well known (Darcy 1983). Cold temperatures limit white grunt distribution north of the Chesapeake Bay (Beebe and Tee-Van 1933). White grunt are found in depths varying from 0 to 185m depending on the season (Darcy 1983). White grunt distribution is also dependent on food availability. White grunt are found on hard substrate but have also been found to exhibit a diurnal-nocturnal forage migration pattern (Davis 1967, Randall 1967).

Tomtate and white grunt are largely benthic feeders, but the larval and early juvenile stages may have different feeding patterns and feed higher in the water column (Darcy 1983). Tomtate have been found to forage on sandy or grassy benthic areas near reefs at night (Randall 1963, Davis 1967). The varying catch locations between reefs and sandy areas suggest daily movements of the fish between the two habitats, which could be vital in transporting energy between these communities (Manooch & Barans 1982, Darcy 1983, Mikell 2014). White grunt are also nocturnal feeders, and similarly migrate off reefs to forage in sandy areas or sea grass beds (Darcy 1983).

The management of fish populations is important because it can strongly affect the ecological communities surrounding the fishes. While focusing on the population of a single species is beneficial, it is also difficult to catch just a single species (Link 2011). Therefore, it would be more effective to focus on ecosystem-based fisheries management and manage a community of fishes that share a similar habitat and resources (Link 2002, 2011). Studying groups of fishes rather than a single species can be useful when completing a dietary analysis of the community (Link 2002, 2011). A diet composition analysis can provide plentiful information when working with ecosystem-based fisheries management (Link 2013). For example, a diet analysis can provide insight on competition for resources, food web dynamics, feeding behavior, and transfer of energy through the ecosystem. This information can then be combined with other studies, such as age and growth, reproductive, and physiological characteristics to compare a species' diet with its various life stages. The goal of this study is to provide a diet analysis of tomtate and white grunt collected in the South Atlantic Bight and use the information discovered to determine the impact they have on the structure of their surrounding community and ecosystem.

Materials and Methods

White grunt and tomtate were caught in chevron traps and hook and line between May and October 2014 aboard the *RV Palmetto.* Half of the tomtate were caught in traps and the other half were caught on hook and line. All white grunts were caught on hook and line. Chevron trap survey locations were randomly selected from 2,600 stations in the South Atlantic Bight between 27°N and 34°N (Figure 1). Sampling occurred at stations with an approximate depth of 300 feet during daylight hours. Chevron traps were constructed from plastic-coasted galvanized 12.5 ga. wire with a 3.4 cm^2 mesh size. The traps were arrowhead-shaped with 1.7 m × 1.5 m × 0.6 m dimensions and a total volume of 0.91 $m^{3.}$ Traps were baited with menhaden (*Brevoortia tyrannus)*, and were soaked for 90 minutes. The traps were deployed in sets of six, with each trap having a single vertical line and a buoy attached. A conductivity, temperature, and depth assessment was made before or after each trap set (SCDNR 2014). Hook and line catches aboard the *RV Palmetto* were performed with rods with hand reels or 6/0 Penn Senator reels with Electramate motors. Lines were comprised of 80-pound test monofilament line with 50-pound test monofilament leader with three hooks on each line. Hooks were comprised of non-stainless circle hooks of sizes 2/0-5/0, and occasionally 9/0 hook were used. The bait used varied, but the top and bottom hooks were usually baited with cut squid, and the middle hook was baited with a cut cigar minnow (*Decapterus spp*.). Rod and reel soak times varied but were usually between one and ten minutes per drop. The total fishing effort per rod and reel was between 15-90 minutes, but sometimes longer (SCDNR 2014).

Once fishes were caught they were identified on the boat, and length, weight, and sex were recorded. The stomachs and otoliths were removed on the boat and were taken back to the lab for further study. Stomachs were removed by making one cut through the esophagus as far anterior to the mouth as possible and one through the pyloric caeca at the beginning of the intestine. The whole stomach and all surround contents including regurgitated items from around the mouth were placed into a cheesecloth sack and labeled with the collection number and relative fish information. Once the stomachs were placed in their own cheesecloth bags they were immediately preserved on the boat in a 10% formalin solution. Stomachs that were completely everted upon capture were not kept for analysis. Preserved stomachs were transferred back to the lab. After 14 days stomachs were rinsed with tap water, and all contents from each stomach were removed, transferred to individual containers, and submerged in 70% ethanol. Stomach content from 88 Tomtate and 28 White Grunt stomachs were analyzed and prey items were identified to the lowest possible taxon, counted, and weighed. Whole prey items were measured in millimeters.

In order to analyze the diet of the sample fishes, prey items were grouped into 6 main categories including benthic mollusks, bony fish, crustaceans, pelagic mollusks, worms, and other. Prey items were also ecologically grouped into four categories based on SCDNR protocols including benthic, pelagic, benthic and pelagic, and sessile. Dietary analysis was done using four different indices including percent frequency of occurrence, percent number, percent weight, and the percent index of relative importance. The percent frequency of occurrence is equal to (# of stomachs containing a prey item) / (# of total stomachs) * 100 (Hyslop 1980). When the percent frequency of occurrence of prey is greater than 25% in two or more predators then competition is considered to be likely (Johnson 1977). The percent number prey items was calculated as (total # of specific prey item) / (total # of all prey items) * 100. The percent weight is equal to (total aggregate weight of specific prey item) / (total aggregate weight of all prey items) * 100 (Hyslop 1980). The index of relative importance (IRI) is equal to (% number + % volume or weight) x (% Frequency). An Amundsen factor test was used to plot percent frequency verses percent weight of the six prey categories mentioned earlier: benthic mollusks, bony fish, crustaceans, pelagic mollusks, worms, and other, in order to help analyze the feeding strategies of the two fishes. Points in the upper right hand corner display prey items important to the predator because of high frequency and high weight occurrences, and points in the lower left hand corner are not as important to the predator because of low frequency and low weight.

Results

Overall, tomtate and white grunt had a widespread diet and fed on prey items from nine higher taxonomic groups (Table 1). Tomtate fed on a total of 21 different prey items (Table 1). Bony fish composed the majority of their diet with 95% frequency followed by worms, benthic mollusks, pelagic mollusks, and crustaceans all under 10% frequency. Similar trends occur for %number, %weight, and %IRI data (Figure 1). Bony fish comprised the majority of tomtate prey with greater than 95% weight and %IRI, and comprised 72%number. Crustaceans, benthic and pelagic mollusks, worms, and other categories are all 5% or below for %N, %W, and %IRI. Bivalves, bryozoans, crabs, decapods, ostracods, stomatopods, and tunicates were not observed in any of the tomtate stomachs. Frequency of tomtate prey items by ecological distribution was 74% benthic, 41% bentho-pelagic, 7% pelagic, and 2% sessile (Figure 3). Because tomtate were caught with two different gear types, results were further broken down to analyze the prey frequency in chevron trap verses hook and line caught fish (Table 2). Bony fish comprised the greatest prey frequency in both trap and hook and line caught fish. However, bony fish were more frequent in trap catches with approximately 65% frequency, while the hook and line caught fishes only had 22% frequency. Tomtate that were caught in traps had less varied stomach contents; no sponges, snails, shrimp, echinoderms, copepods or amphipods were found in trap caught fish. Tomtate caught on hook and line consumed no plants, mollusks, isopods, or amphipods.

White grunt fed on a total of 52 varied prey items (Table 1). Bony fish were most frequently consumed with 82% frequency followed by worms with 60% frequency, then benthic and pelagic mollusk, 32% frequency, followed by crustaceans, 22% frequency and other with 9% frequency. The %number, %weight, and % IRI showed similar trends to %frequency but the percentages were slightly different (Figure 2). For example, the %number of bony fish in white grunt was 17% followed by worms at 12% then crustaceans, benthic and pelagic mollusks, and other all under 7%. Pelagic mollusks consisted of the greatest percent weight at 41%, followed by bony fish at 39%, then crustaceans, benthic mollusks, worms, and other under 7%. The %IRI was greatest for bony fish at 60% followed by pelagic mollusks at 22%, and worms, benthic mollusks, crustaceans, and other under 8%. Sponges and mollusks were not observed in any of the white grunt stomachs. Based on ecological distribution of prey, 60% of White Grunt prey items were benthic, 33% were benthic/pelagic, 6% were pelagic, and 1% was sessile (Figure 3).

The Amundsen Analysis charts interpret fish preference of prey and prey diversity (Figure 4). The graphs plot the prey-specific abundance (%weight) against the percent frequency of occurrence (% frequency) (Amundsen et al 1996). Based on tomtate Amundsen Analysis charts, bony fish are important in their diet and all other prey items are relatively unimportant. According to white grunt Amundsen charts, the fish display a wide dietary niche, not preferentially selecting any specific prey items.

Discussion

Tomtate fed on a variety of different prey items in the South Atlantic Bight. Prey items of tomtate in the Atlantic Bight consisted predominately of bony fishes in addition to a few species of mollusks, crustaceans, and other small frequency occurrences of annelids, tunicates, and plants. The plant items that were ingested were most likely attached to other prey items and were consumed unintentionally. Randall (1967) classified tomtate as a generalized carnivore and not an omnivore because the algae and plants were likely consumed incidentally. However, Beebe & Tee-Van (1928) stated that the main food items found in their tomtate off of Port-au-Prince Bay, Haiti were sand, mud, bottom detritus, and algae often in large amounts and consequently classified tomtate as omnivorous. The prey items found in the stomachs of Tomtate in the South Atlantic Bight in our study differed from similar dietary studies of tomtate in different regions. For example, Randall (1963) studied tomtate from Puerto Rico and the Virgin Islands and discovered 33.6% of the prey volume was shrimp and shrimp larvae and 31% of the prey volume was polychaetes, which is significantly higher than the .02% weight of shrimp and .08% weight of worms that made up the prey items of tomtate in our study. Randall's study also found unidentified eggs, hermit crabs, and other crabs in the tomtate stomach content, none of which were found in the stomach content of the tomtate examined in our study. Edwards (1973) studied tomtate caught in Venezuela and found the main food items to be polychaetes, amphipods, and mollusks. Sauskan and Olaechea (1974) studied tomtate on Campeche Bank and found 70% of the diet consisted of crustaceans and 18% consisted of polycheates, which drastically contrasts with the findings of our study where crustaceans exhibited a 2% frequency of occurrence and worms exhibited 7% frequency of occurrence. Parrish and Zimmerman (1977) analyzed tomtate stomachs from Puerto Rico and found that 44% of the stomachs contained crabs. Many other studies including Randall (1967), Davis (1967), and Beebe and Tee-Van (1928) all reported identifying crabs in the stomachs; none of our sampled tomtate stomachs contained crabs. The results in our study may different from other studies as a result of catch-methods used. Randall (1967) spearfished in Puerto Rico and the Virgin Islands to catch their fish. Sedberry (1981), a study that also took place in the South Atlantic Bight, trawled for their tomtate. Sedberry (1981) found that polychaetes made up the largest volume of prey as a result of their large size while fish made up the largest prey weight and frequency for our data. Half of our tomtate were caught in traps, where the fish likely gorged on the bait (Atlantic menhaden), potentially skewing our results to show a large proportion of fish in the stomachs of our sampled tomtate. We were not able to identify the fish prey items as trap bait because of deterioration. DNA analysis would have to be done on the fish prey items to ensure that they are Atlantic menhaden.

White grunt also feeds on a variety of different prey items in the South Atlantic Bight White grunt most frequently consumed bony fish, closely followed by worms, and pelagic and benthic mollusks. Many of the prey items that were found in our white grunt specimens were also found in similar studies. For example Beebe and Tee-Van (1928) collected white grunt specimens in Haiti that consisted of echinoderms, polychaetes, mollusks, shrimp, crabs, and fish in the stomach contents. White grunt collected from Alligator Reef contained polychaetes, majid crabs, alpheid shrimps, isopods, fish, and sand Davis (1967). In our study, we discarded sand and did not include it in our results. In Puerto Rico, Parrish and Zimmerman (1977) found crabs and amphipods in white grunt stomach contents. In Puerto Rico and the U.S. Virgin Islands, Randall (1967) found 26% of the stomach content volume to contain crabs, and 28.9% to contain worms, while only 3% by volume was fishes. This contrasts with our study where 39% of the weighted prey items were bony fish, 7% was worms, and 1% of the weight was crustaceans. Valdés Muñoz and Silva Lee (1977) reported in Cuba that 25% of the prey volume of white grunt stomach content in mangrove areas was polychaetes while 58.8% was unidentifiable. Valdés Muñoz and Silva Lee (1977) also reported white grunt diets of fish caught from natural reefs consisting of 52% by volume crustaceans and 42% by volume unidentifiable items. In the Valdés Muñoz and Silva Lee (1977) study, only .3% by volume of the prey items was fish in the mangrove area and there was no identified fish in the natural reef areas. This considerably contrasts with the 39% by weight of identified fish prey items that were found in our white grunt samples. In addition, 41.5% of the weight of the prey items consumed by white grunt was pelagic mollusks, which differs from Randall (1967) who reported no mollusk findings and Valdés Muñoz and Silva Lee (1977) who reported only 1.1% in mangroves and .5% by volume in natural reefs.

Amundsen Analysis charts examine feeding strategies by plotting 2-dimensional representations of the prey-specific abundance (%weight) and frequency of occurrence for the different prey categories (Amundsen 1996). Five of the tomtate prey categories are located in the lower left hand corner signifying that they are not important in the diet of tomtate. The plot located in the upper right corner represents bony fish, signifying that it is an important food source for tomtate. This analysis found that tomtate have a narrow specific niche, which contradicts previous results (Randal 1963, 1967). An explanation could be due to our catch-methods. Half of the tomtate were caught in traps, where the high quantity of bony fish in the tomtate stomachs could have been due to foraging on the bait in the traps, therefore skewing our results. All of the points on the white grunt are located below 50% for %weight, representing a generalized feeding strategy and a broad niche width, which corresponds to previous studies (Manooch 1976).

The data from this study support the findings that tomtate and white grunt are primarily benthic feeders. Many of the prey items such as shrimp, copepods, and gastropods found in tomtate and white grunt are classified as bentho-pelagic. Previous studies (Darcy 1983, Sedberry 1985) conclude that tomtate and white grunt have a benthic distribution among rocky bottoms, artificial reefs, and live-bottom habitats, where it could be assumed that they feed on benthic and bentho-pelagic prey items. Sedberry (1981) found that tomtate are not completely dependent on hard bottom habitat for prey as a result that many of the prey species consumed were pelagic. Our study supports Sedberry's (1981) conclusions, since many of the species found including unidentified fish and pelagic crustaceans are not benthic species. A similar summary can be concluded for white grunt. White grunt are found in benthic locations along live bottom habitats and artificial reefs and because of the ecological locations of their prey items they also live and forage on the bottom.

Tomtate and white grunt have been observed as nocturnal foragers (Randall 1963, Davis 1967, Parrish and Zimmerman 1877, Sedberry 1985). Sedberry (1981) found through scuba observations that there was no tomtate foraging behavior seen during the day and therefore concluded that tomtate exhibit a nocturnal feeding behavior. Tomtate have been found to feed on sandy bottom areas of the shelf at night and return to the reef for shelter during the day (Randall 1967, Davis 1967). This feeding strategy can be an important energy transfer mechanism between the bottom areas of the shelf and hard bottom reefs (Darcy 1983). White grunt has also been observed feeding on sandy or grassy areas at night and returning to the reef shelf during the day (Randall 1963, Davis 1967). This migratory pattern is an important provider of biomass between the two communities (Sedberry 1985). Due to our sampling schedule my data could not analyze the diel migrations of tomtate or white grunt. In the future I recommend that sampling take place at various points throughout a 24-hour time period both on reef areas and on sandy bottoms in order to create a sample set that can be analyzed based upon daytime verses nighttime feeding.

White grunt had a more diverse diet, feeding on a total of 52 varied prey items, while tomtate fed on 21 different prey items and consisted mostly of bony fishes. According to Johnson (1977), competition is possible among a prey item if the frequency of consumption by both species for the prey item is greater than 25%. Only bony fish were consumed with greater than a 25% frequency between white grunt and tomtate, therefore they may compete when feeding on bony fishes. However, white grunt fed on other groups such as benthic mollusks, pelagic mollusks, and crustaceans that play a more important role in their diet. Many items, such as arthropods and many amphipods, found in white grunt were not found in tomtate. Only a couple of items, including Mysida, *Monoculodes spp.*, and Porifera, were found in tomtate and not white grunt. Because white grunt was found to feed on a wide-niche according to the Amundsen Analysis, and bony fish are abundant, it is unlikely that there is competition between the two fish species. However, according to Darcy (1983), competition between Tomtate and White Grunt may occur on some reef sites due to competition for food and space as a result of diurnal-nocturnal migrations. There are no results that definitively make these conclusions though.

Future Work

There are a number of ideal enhancements that could be made to the project if we were not under such limited time constraints. We would have liked to conduct DNA analysis on the bony fish to determine the percentage of the bony fish as bait, and the percentage that was naturally consumed. Next we would have collected a larger sample size in order to provide a more thorough data analysis and conclusion. Future work done on this project could include analyzing seasonal differences in diet to determine if prey availability changes throughout the year. In addition, we could combine the dietary analysis data with age determination to determine if there are ontogenetic shifts in the prey analysis of the fish. We would analyze if feeding becomes more specific and targeted in older or larger fish and is more generalized and opportunistic in younger and smaller fish. Finally, we could include selectivity studies by sampling the prey field through sediment grabs or plankton nets. The selectivity studies would allow us to analyze whether the fish are actively selecting certain prey items or just eating what is available. In order to implement ecosystem based management, other informative studies such as reproductive potential and behavior, natural and fishing mortality, and physiological characteristics would be required to apply this management technique.

Acknowledgments

This work was done as part of the FISHHAB project of the College of Charleston, funded by the South Carolina Sea Grant Office. Gorka Sancho and Rachel Bassett provided outstanding mentorship throughout the research and writing process for this essay. Kevin Spanik dedicated much of his time to helping me identify the prey items and analyze the data; I would not have been able to do it without him. Taylor Avery, Zach Brooker, and Luke Rein were great colleagues as part of the FISHHAB project. Tracey Smart provided wonderful research oversight and logistical help. In addition, many thanks to the Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP) and Southeastern

Monitoring and Assessment Program–South Atlantic (SEAMAP-SA) staff, the crew of the *RV Palmetto* during an awesome research cruise to capture some of the fish, and the Southeastern Regional Taxonomic Center (SERTC).

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Table 1- Percent Frequency (F), percent number (N), percent weight (W), and percent index of relative importance (IRI) of food items in White Grunt and Tomtate.

	White Grunt				Tomtate			
Taxon Food Item	**F**	**N**	**W**	**IRI**	**F**	**N**	**W**	**IRI**
Annelida								
Glycera spp.	17.86	3.76	3.56	1.93	2.27	1.64	0.65	0.07
Onuphidae	3.57	0.75	0.24	0.05	1.14	0.82	0	0.01
Opheliidae	3.57	0.75	0.03	0.04				
Polychaeta	35.71	7.52	2.98	5.54	4.55	3.28	0.19	0.21
Arthropods								
Brachyuran zoea	3.57	0.75	0.01	0.04				
Inachinae	*7.14*	1.5	2.34	0.41				
Majidae	7.14	1.5	0.1	0.17				
Mithrax spp.	14.29	5.26	3.42	1.83				
Osachila semilevis	3.57	0.75	0.01	0.04				
Paguroidea	3.57	0.75	0.11	0.05				
Pilumnus spp.	7.14	1.5	0.06	0.17				
Portunidae spp.	3.57	0.75	0.02	0.04				
Stenorhynchus seticornis	3.57	1.5	1.8	0.17				
Bony Fish								
Unidentified bony fish	82.14	17.29	39.36	60.88	95.45	68.86	82.01	97.97
Crustacea								
Amphipoda								
Ampelisca sp.	7.14	1.5	0	0.16				
Gammaridae	7.14	1.5	0	0.16				
Erichthonius brasiliensis	3.57	0.75	0.01	0.04				
Monoculodes spp.					1.14	1.64	0	0.03
Unidentified amphipod					1.14	1.64	0	0.03
Copepoda								
Paguroidea	7.14	1.5	0	0.16				
Unidentified copepod	3.57	0.75	0.11	0.05	1.14	0.82	0	0.01
Decapoda								
Alpheidae	10.71	3.01	0.19	0.51				
Alpheus spp.	7.14	1.5	0.1	0.17				
Bowmaniella spp.					3.41	3.28	0.01	0.15

Taxon	Food Item	White Grunt F	N	W	IRI	Tomtate F	N	W	IRI
	Leptochela spp.	7.14	1.5	0.05	0.16	1.14	0.82	0	0.01
	Leptochela papulata					1.14	0.82	0	0.01
	Munida spp.	7.14	1.5	0.07	0.17				
	Mysida					2.27	1.64	0	0.05
	Sicyonia spp.	3.57	0.75	0.03	0.04				
	Synalpheus spp.	7.14	3.01	0.12	0.33				
	Synalpheus townsendi	3.57	0.75	0	0.04				
	Unidentified shrimp zoea	3.57	0.75	0	0.04				
	Unidentified decapoda	21.42	5.27	0.24	0.88	4.55	3.28	0	0.12
	Xanthidae sp.	3.57	1.5	0.26	0.09				
Gastropoda									
	Cerithiidae	7.14	1.5	0	0.16				
	Marginellidae	3.57	0.75	0.13	0.05				
Isopoda									
	Anthuridae	3.57	0.75	0	0.04				
	unidentified isopoda	3.57	0.75	0.03	0.04	1.14	0.82	0.52	0.02
	ostrocoda								
	unidentified ostrocod	3.57	0.75	0	0.04				
Stomatopoda		3.57	0.75	0.32	0.06				
	Gonodactylus spp.	3.57	0.75	0.58	0.07				
	Gonodactylus bedini	10.71	2.25	0.15	0.21				
Echinodermata									
	Arbacia punctulata	10.71	2.26	0.06	0.37				
	Echinoidea	3.57	0.75	0.03	0.04				
	Ophiuroidea	7.14	1.5	0.03	0.16				
	Unidentified echinoderm					1.14	0.82	0.01	0.01
Mollusca									
	Americardia media	3.57	0.75	0.1	0.04				
	Cardiidae	10.7	2.26	1.35	0.57				
	Petricola pholadiformis	3.57	0.75	0.06	0.04				
	Tellinidae	10.7	2.26	0.14	0.38				
	Terebridae	3.57	0.75	0.08	0.04				
	unidentified bivalve	3.57	0.75	0.06	0.04	2.27	1.64	0.5	0.07
Cephalopod									
	Teuthida	32.1	6.77	41.5	22.9	2.27	1.64	2.25	0.12

		White Grunt				Tomtate			
Taxon	**Food Item**	**F**	**N**	**W**	**IRI**	**F**	**N**	**W**	**IRI**
		4		5	5				
	unidentified cephalopod					1.14	0.82	0.13	0.01
Plantae		7.14	1.5	0.13	0.17	1.14	0.82	0.02	0.01
Sponges									
	Porifera					1.14	0.82	0.01	0.01
Tunicates									
	Thaliacea	3.57	0.75	0	0.04				

Table 2- Frequency of prey taxa consumed by trap-caught verses hook and line-caught tomtate.

Frequency of Tomtate Prey Differences by Gear		
Prey taxa category	**Hook & line**	**Trap**
Amphipods	2	0
Bony fish	22	66
Cephalopods	2	1
Copepods	1	0
Echinoderms	1	0
Isopods	0	1
Mollusks	0	2
Plants	0	1
Shrimp	11	0
Snails	1	0
Sponges	1	0
Worms	3	4

Figure 1: Catch Distribution of Tomtate (red) and White Grunt (blue) along the South Atlantic Blight.

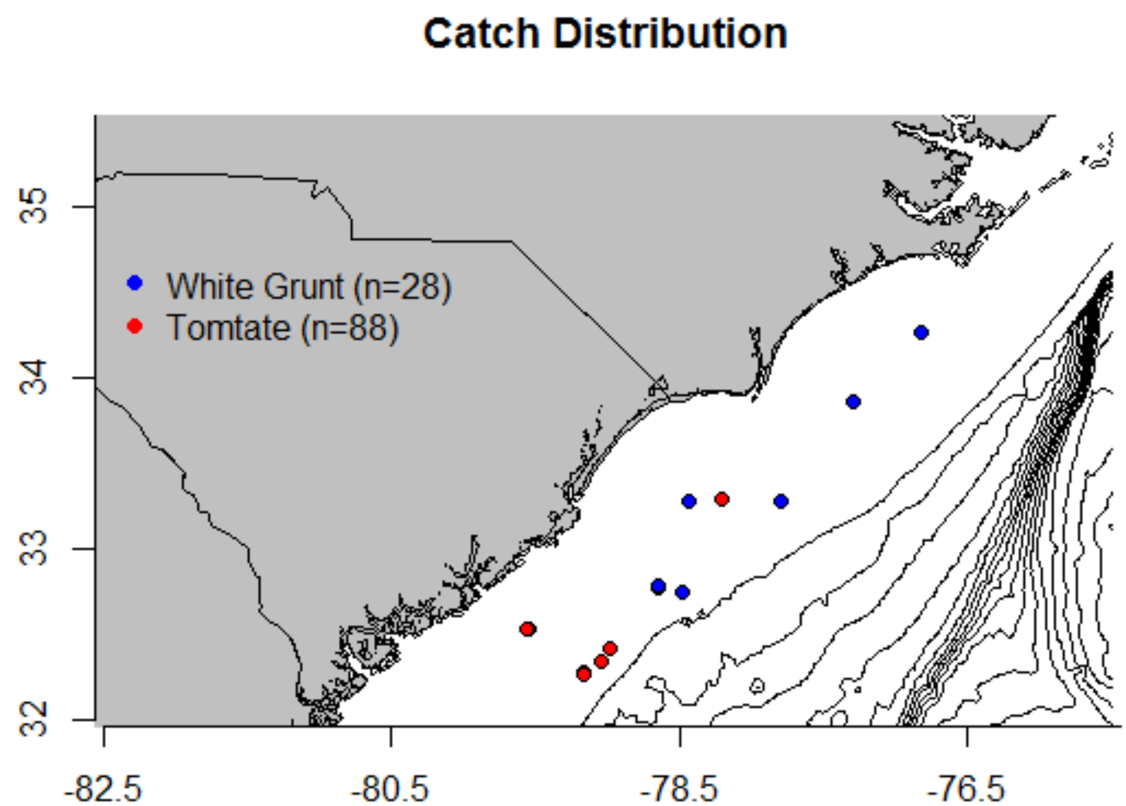


Figure 2- A. Percent number (%N) B. Percent Frequency (%F) C. Percent weight (%W) D. Percent index of relative importance (%IRI) of prey items in 6 categories including benthic mollusks, bony fish, crustaceans, pelagic mollusks, worms, and other. Red bars are tomtate and blue are white grunt.

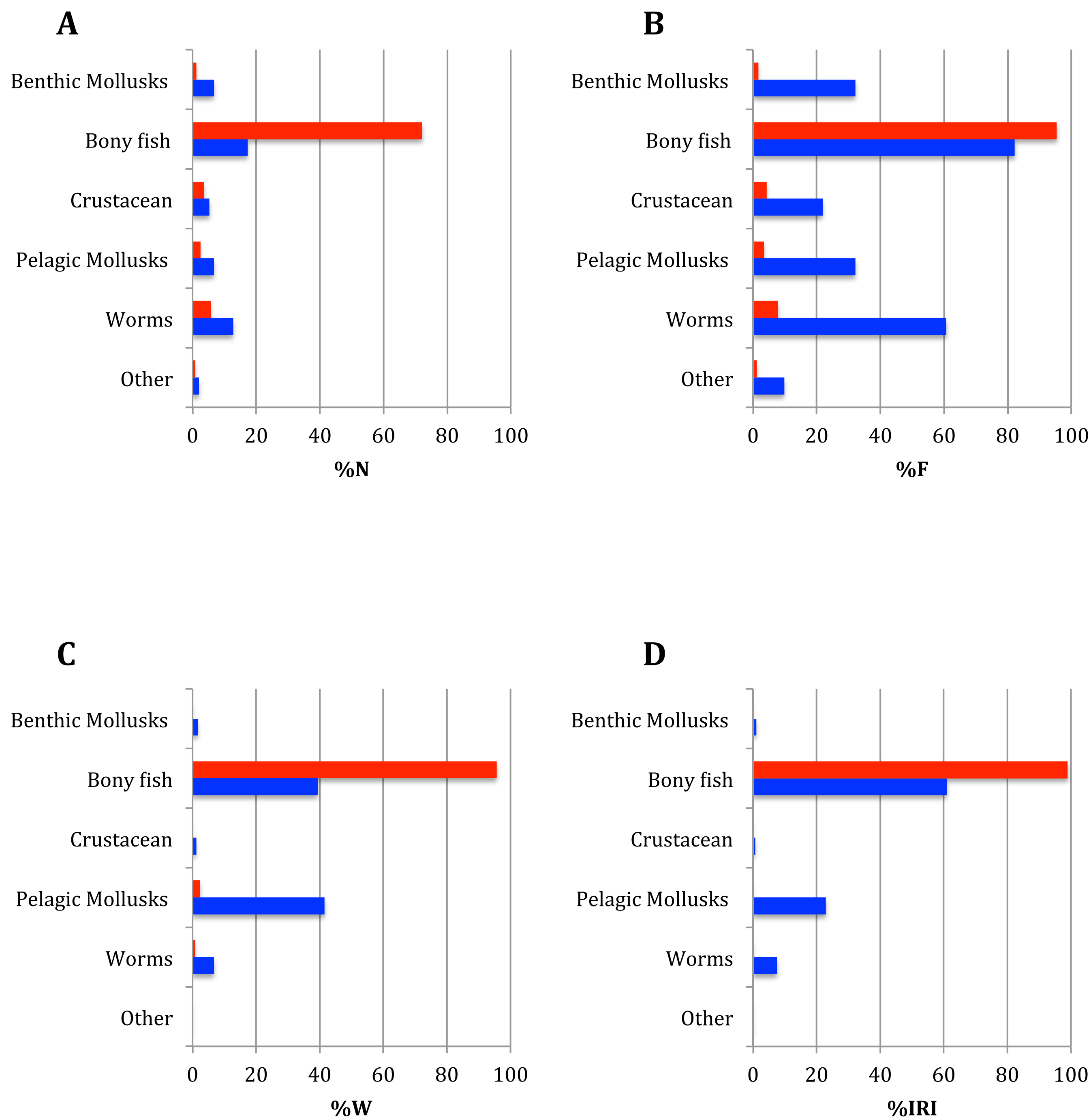
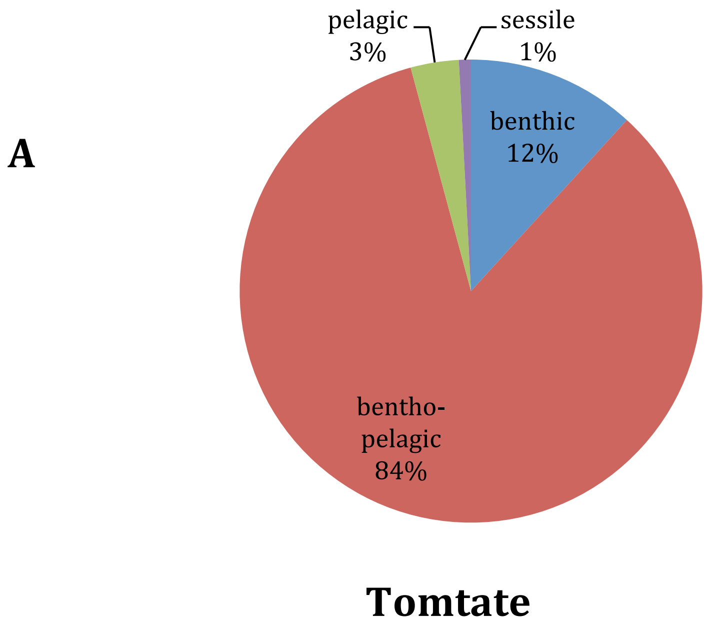


Figure 3: Ecological prey categories (%Frequency) of tomtate (A) and white grunt (B). The prey categories considered are benthic, bentho-pelagic, pelagic, and sessile. Benthic prey species are those species that are free moving along the bottom, and sessile prey species are immobile along the bottom.



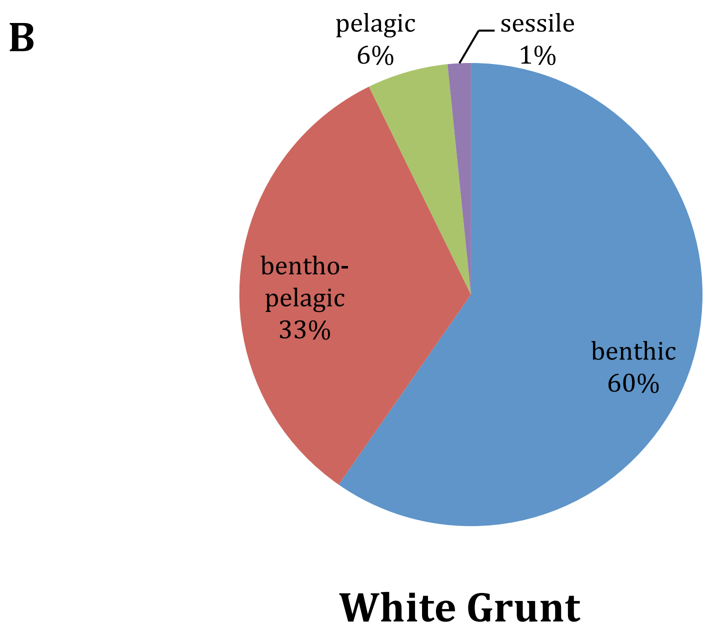


Figure 4: Amundsen Analysis Chart for tomtate (A) and white grunt (B). The food categories considered here are benthic mollusks, bony fish, crustaceans, pelagic mollusks, and other.