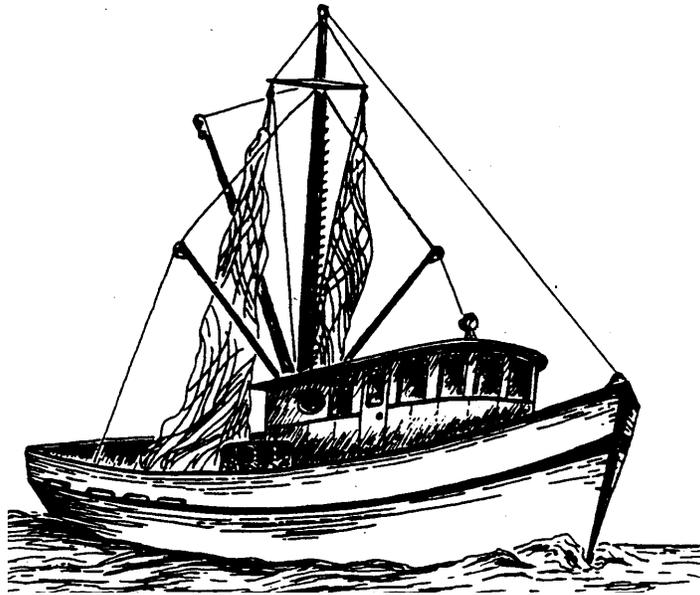




FINAL
BYCATCH REDUCTION DEVICE
TESTING PROTOCOL MANUAL



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Introduction

The development of a bycatch reduction device (BRD) testing protocol is mandated in Amendment 2 to the Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region (SAFMC 1996). A “BRD” is defined as any device, trawl modification, or a combination of devices (e.g., BRD/TED combination) which reduces finfish bycatch when compared to a unmodified “standard” trawl that uses only a certified Turtle Excluder Device (TED). This BRD testing protocol was developed based on the deliberations of the Council’s Ad Hoc BRD Advisory Panel and Scientific and Statistical Committee. This protocol specifies minimum data requirements, outlines a basic experimental design, and specifies a statistical technique for testing and analyzing new or modified BRDs. This protocol is to be used by the states and researchers testing the effectiveness of any new or modified BRD in reducing bycatch of target species as specified by the Council. The target species currently specified by the South Atlantic Council are Spanish mackerel and weakfish.

This testing protocol is designed for researchers conducting discrete testing programs (i.e. testing one BRD design to determine reduction performance so that it can be certified for use in the South Atlantic EEZ). The protocol is also designed to minimize cost of testing while ensuring adequate sampling is completed to evaluate if the new gear achieves the desired reduction of target species. The Council is requiring that new bycatch reduction devices reduce 40% in number of both target species, Spanish mackerel and weakfish. This protocol establishes and minimizes the data collection and statistical requirements necessary to provide a basic experimental design a researcher must follow to increase the likelihood of certification of a new or modified BRD. The analysis of the data collected under this testing protocol will be based on a modified paired t-test (See Appendix G). A 95% confidence interval should be calculated for the reduction estimate. The experimental design is therefore based on using paired comparisons of the BRD and control gear operating in commercial conditions. Tow times, time of day, and fishing techniques should simulate commercial fishing conditions. Consistent tow times are required in a given series of tows that constitute a test for an individual BRD. However, a window around a specific tow time is allowed (plus or minus 10% of tow time). Researchers must pre-tune the trawl gear to identify and eliminate bias between nets (e.g., make tows before placing experimental gear in net to determine and compensate for bias if necessary). A minimum sample size of 30 successful tows is required. However, additional tows may be needed to attain an adequate sample for statistical testing.

The total catch, total finfish catch, and total shrimp catch must be recorded. This will provide shrimpers with information on shrimp retention and whether the tow is acceptable for analysis. All target species (currently Spanish mackerel and weakfish, others to be addressed through the framework procedure) will be counted, weighed as a species lot, and individuals will be measured. This complete work-up of these species will provide absolute numbers to determine percent reduction and age class composition.

The basic data requirements include: an accurate detailed written description and diagram of the gear used, including the trawls, rigging, BRD, and TED types. The BRD must be rotated between outside nets on opposite sides to reduce net bias and increase the probability of collecting a valid sample. Specifying these basic parameters in the experimental design for testing new or modified BRDs should both reduce statistical problems by standardizing data collection and ensure information is collected to facilitate a timely certification process. If the gear is modified during the testing, it constitutes the beginning of a new test.

In order to reduce error, testing should be accomplished with at least the minimum number of tows of a net with an experimental BRD and certified TED compared to a net with only the same type of TED. Testing should also be done in an area where, and at a time when,

shrimp are commercially harvested and the catch of target species is likely. Researchers should refer to information presented in Appendices E and F for guidance on the occurrence and the bycatch of weakfish and Spanish mackerel. If catches of shrimp do not approximate commercial harvest levels or target species are not abundant, additional tows may be necessary.

Amendment 2 established responsibility of the researchers testing BRDs to also provide information on shrimp retention attributable to the new gear. The intent of this requirement is to ensure that fishermen who consider using any new BRDs will know what level of shrimp retention has been observed during testing of a particular device. The fisherman has the opportunity to weigh the benefits of using a gear with a specified shrimp retention against the new gears' ability to reduce large quantities of other unwanted bycatch. This protocol will ensure new gear achieve desired bycatch reduction while minimizing time needed to test and certify a bycatch reduction device for use in the South Atlantic EEZ. This protocol was developed specifically for collection of the target species (at this time Spanish mackerel and weakfish) to determine the effectiveness of a new or modified BRD in achieving the targeted reduction as specified by the Council.

BRD Certification and Development of This Testing Protocol:

The Council is providing a timely and effective certification process which will be in place in conjunction with Shrimp Amendment 2, that affords industry the chance to use conservation engineering in the development of new or modified BRDs. The NMFS Regional Administrator (RA) is responsible for review and certification of BRDs for use in the South Atlantic EEZ.

A BRD will be certified through public notice in the Federal Register if the Regional Administrator determines that it met the certification criteria and testing protocol specified by the Council. This process will lead to faster processing of BRD certification applications. Pursuant to Amendment 2, a state fishery management agency, a university, and other scientific investigators can work with shrimp fishermen and others in developing and testing BRDs for certification. BRDs reviewed and recommended by state agencies and which meet the criteria and testing protocol specified in the amendment may be used throughout the South Atlantic EEZ when certified by NMFS.

The RA will consider the following factors when certifying BRDs for use in the South Atlantic EEZ. These factors include bycatch reduction performance as well as adherence to the BRD testing protocol. The NMFS RA will certify new BRDs for use throughout the South Atlantic EEZ if the BRD reduces the bycatch component of fishing mortality for Spanish mackerel and weakfish by 50%, or demonstrates a 40% reduction in number of each of these species and the researcher has complied with testing parameters of the Council's BRD testing protocol.

Basic Provisions of the BRD Testing Protocol Specified in Shrimp Amendment 2:

Before conducting any certification test, or series of tests, the appropriate state director or designee, must be notified prior to conducting tests. In the event that the applicant plans to submit the certification proposal directly to the NMFS RA, the RA must be notified by the applicant in writing. This notification should include the information in the Vessel Information Form and the Gear Specification Form. Specifically, the requester should provide the vessel name, vessel identification number, application date, observer name and affiliation, vessel length, time range of test, sponsor of test, address of sponsor, and test location. In addition, the applicant should provide the information requested in the Gear Specification Form. The applicant should fully describe the BRDs and TEDs that will be used in the tests. All tests must

be conducted in accordance with state or federal laws. The appropriate state director or designee, will review the submitted notification information and if adequate will issue the applicant authority to conduct tests in state waters. Similarly, if testing in the EEZ is required, the state director will submit the applicant's notification to the RA, with the director's recommendation. Once the RA determines that the notification is complete and all applicable regulations are satisfied, the RA will issue the applicant a letter of authorization to conduct BRD testing in Federal waters. An applicant planning to use shrimp trawls for testing which do not have legally approved and fully operational TEDs installed, regardless of where the testing is to take place, must obtain a special permit from NMFS as authorized under the sea turtle conservation regulations.

The certification tests will follow a standardized testing protocol where paired identical trawls are towed by a trawler in areas expected to contain concentrations of shrimp and the target species or species groups. One of the identical trawls will contain the test BRD while the other is the control. The experimental gear must be rotated daily at a minimum to ensure that any positioning bias is eliminated. Identical TEDs are required in each of the trawls unless other arrangements have been made through the RA. Consistent tow times are required in a given series of tows that constitute a test for an individual BRD. However, a nominal overage/underage window around a specific tow time is allowed (plus or minus 10% of tow time). The contents of each trawl will be separated and sorted following each paired tow. Shrimp, total finfish, and total catch will be weighed. A basket (70-80 pounds) subsample will be weighed and sorted to obtain a percentage of finfish in the subsample. The percentage of finfish in the subsample will be used to estimate the total finfish in the catch. All target finfish species (currently Spanish mackerel and weakfish) will be weighed as a species lot, and individuals counted, and length measured. Collection of information on other important species is required (total weight and total numbers of individual species in subsample to estimate total weight and total numbers in catch). Important species for which information is required are seatrouts (weakfish, spotted, and silver), Spanish mackerel, king mackerel, cobia, gag, seabasses (black, bank, and rock), spot, croaker, red drum, black drum, pompano, kingfishes (southern and northern), flounders (southern, and summer), bluefish, scup, juvenile sharks, sturgeon, shad, and sea turtles (i.e., take only measurements that can be taken without harming turtles). Complete records will be required for all tows made for certification. All certification tests must be authorized by the state and / or NMFS and conducted with a state or NMFS approved observer on the trawler. These observers can be from NMFS, state fishery management agencies, universities, or private industry. It is the responsibility of the applicant, or his agent, conducting the certification tests to ensure that a qualified observer is on board during the tests. Compensation, if necessary, will be paid by the applicant, or his agent.

Summary of BRD Testing Experimental Design and Basic Data Requirements:

- The tests should use paired comparisons where one net is equipped with the new BRD design and the second net is a control net.
- Bycatch reduction will be computed using a ratio method (CPUE or numbers).
- The burden of proof is on industry to verify that a new BRD achieves the minimum required reduction rate.
- Both nets are to pull identical certified TEDs during the sampling.
- Experimental gear should be rotated daily between outboard/outside nets at a minimum.
- The total catch, total finfish, total shrimp, and total target species weight must be recorded. A basket (70-80 pounds) subsample will be weighed and sorted to obtain a percentage of finfish in the subsample. The percentage of finfish in the subsample will be used to estimate the total finfish in the catch.
- Target species (weakfish and Spanish mackerel) must be weighed as a species lot, and each individual counted and length measured. For large catches (more than 200), a subsample of selected individuals for each age class shall be measured.
- Collect information on other important species (collect total weight and total numbers of individual species in subsample to estimate total weight and total numbers in catch). [Species list: seatrouts (weakfish, spotted, and silver), Spanish mackerel, king mackerel, cobia, gag, seabasses (black, bank, and rock), spot, croaker, red drum, black drum, pompano, kingfishes (southern and northern), flounders (southern, and summer), bluefish, scup, juvenile sharks, sturgeon, shad, and sea turtles (i.e., take only measurements that can be taken without harming turtles).]
- A modified paired t-test is the statistical technique to be used for analyzing the data collected.
- A minimum of 30 successful tows are required to test a new or modified gear.
- A minimum catch (fish per tow) of 5 weakfish and/or 1 Spanish mackerel is required to qualify as a successful tow.
- Tow times, time of day, catch rates, and fishing techniques should be comparable to commercial operations.
- Consistent tow times are required in a given series of tows that constitute a test for an individual BRD. A nominal time window (plus or minus 10% of tow time) around a specific tow time is allowed.
- Basic operational cost differences should be recorded.
- Shrimp retention must be recorded.

VESSEL INFORMATION FORM

BRD TESTING PROTOCOL

VESSEL NAME: _____

VESSEL IDENTIFICATION NUMBER: _____

APPLICATION DATE (MONTH/DAY/YEAR): _____

OBSERVER NAME AND AFFILIATION: _____

VESSEL LENGTH (ft.): _____

TIME RANGE: (DAY/MONTH/YEAR) to (DAY/MONTH/YEAR) _____

SPONSOR NAME: _____

SPONSOR ADDRESS: _____

TEST LOCATION: _____

INSTRUCTIONS FOR VESSEL INFORMATION FORM

BRD TESTING PROTOCOL

VESSEL NAME: Enter the vessel's full name.

VESSEL IDENTIFICATION NUMBER: Enter State or Federal vessel registration number.

APPLICATION DATE: Enter month, day, and year.

OBSERVER NAME AND AFFILIATION: Write full name and affiliation of observer (state, NMFS or private).

VESSEL LENGTH (ft.): Enter the vessel's length in feet.

TIME RANGE: Identify the range of time during which certification tows will be conducted (Day/Month/Year to Day/Month/Year).

SPONSOR NAME: Self-explanatory.

SPONSOR ADDRESS: Self-explanatory.

TEST LOCATION: EEZ off: Give state, such as South Carolina.

Public reporting burden for this collection of information is estimated to average 30 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Edward E. Burgess, Southeast Regional Office, National Marine Fisheries (F/SEO12), 9721 Executive Center Drive N., St. Petersburg, FL 33702.

**BRD TESTING PROTOCOL
GEAR SPECIFICATION FORM**

VESSEL NAME

MONTH	DAY	YEAR
<input type="text"/>	<input type="text"/>	<input type="text"/>

DATE

NET POSITION

TOTAL NETS

<input type="text"/>							
----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------

VESSEL IDENTIFICATION NUMBER

<input type="text"/>	<input type="text"/>	<input type="text"/>
----------------------	----------------------	----------------------

TOW NUMBER

Net Type_____

Headrope Length_____

Footrope Length_____

Comments_____

OTHER GEAR MEASUREMENTS

BODY

Mesh Size _____ in.

COD END (TAILBAG)

Type (circle one) nylon or poly

Mesh Size _____ in.

Twine Number _____

Length _____ # of meshes

Circumference _____ # of meshes

Bag Ring Placement _____ # of meshes up from tailbag

Chafing Gear Type _____

Comments: _____

TICKLER CHAIN

Chain Length _____ ft. _____ in.

Chain Size _____

DOORS

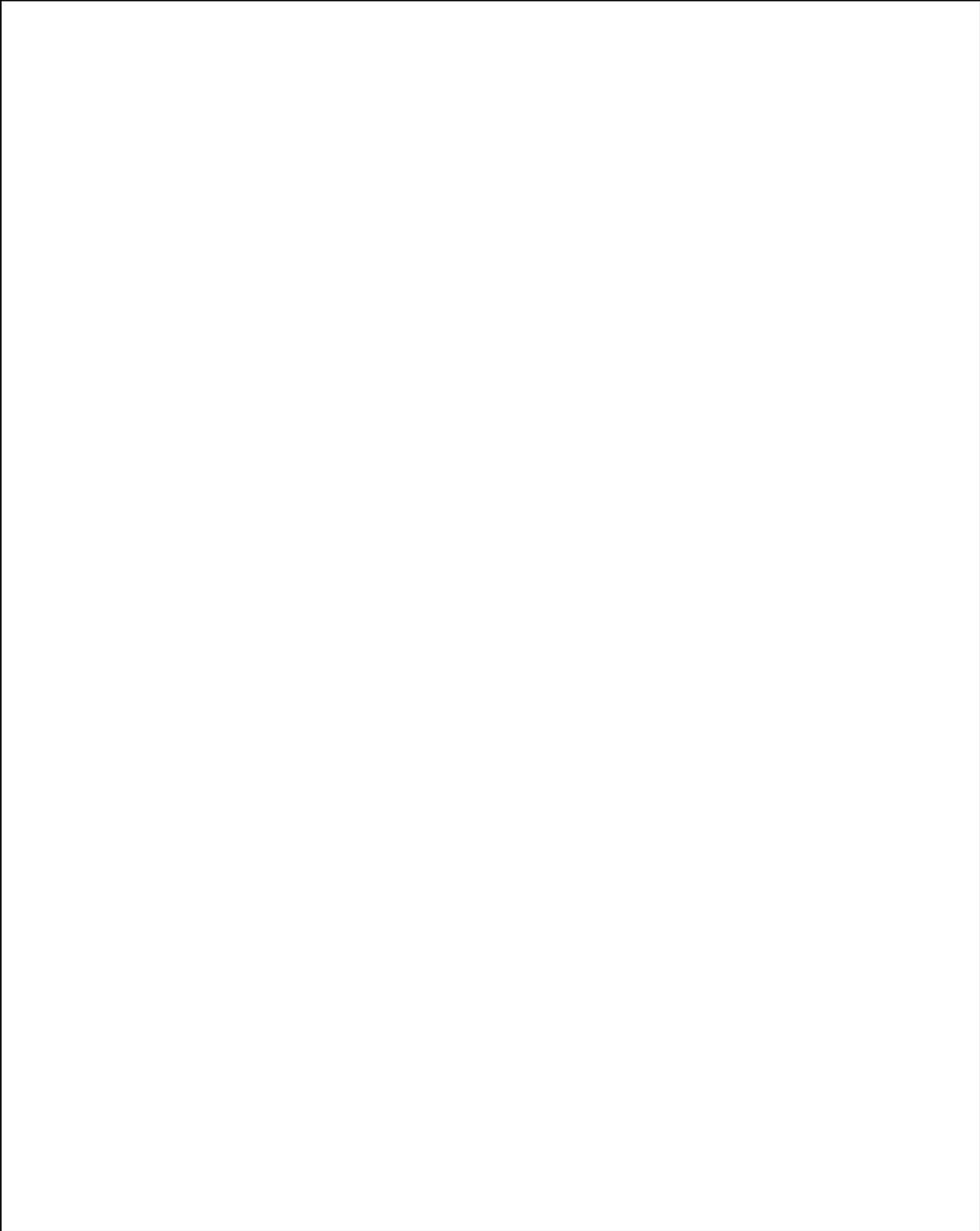
Door Type (circle one) wood aluminum

Door Length _____ ft. _____ in.

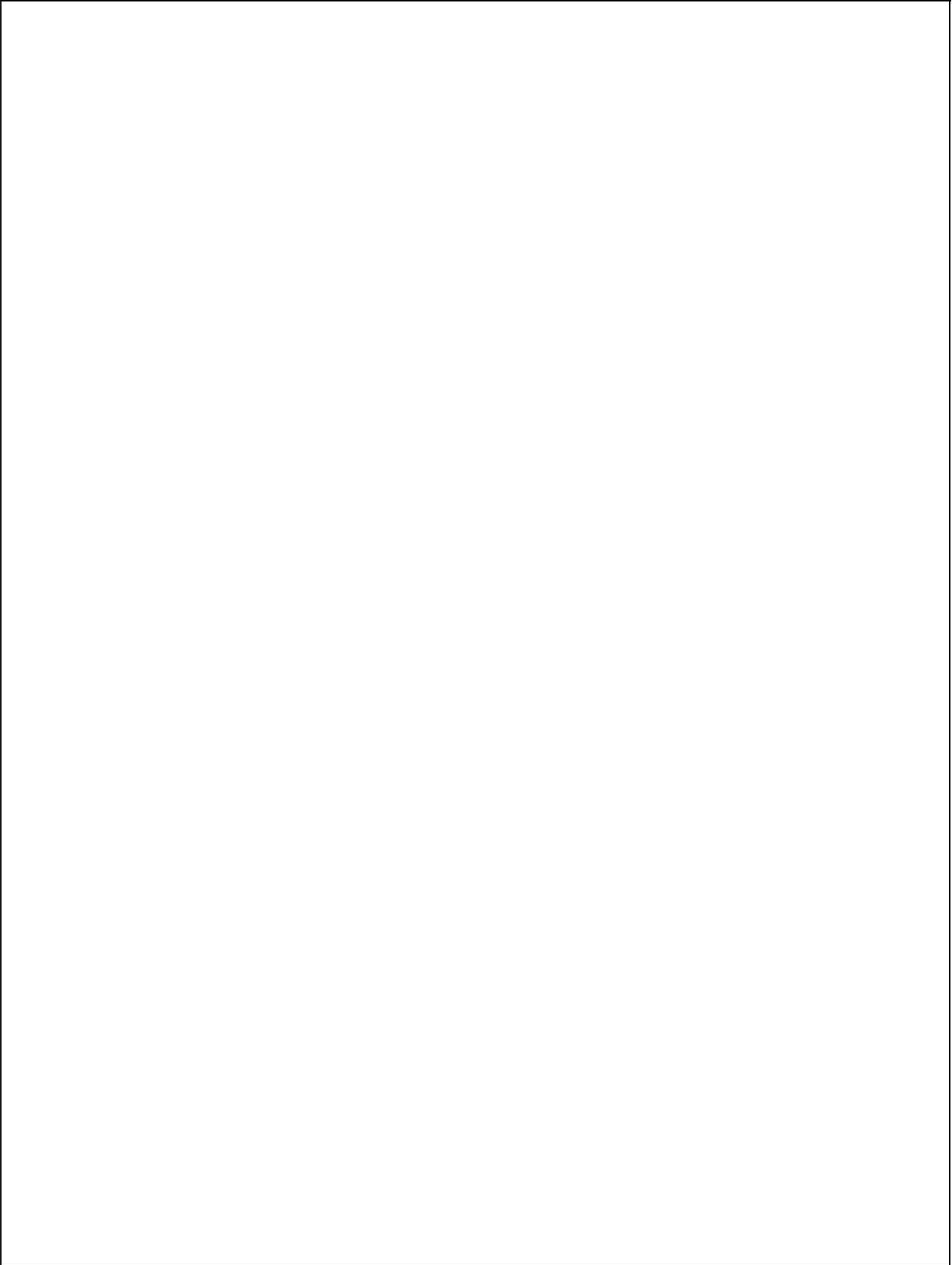
Door Height _____ in.

Comments: _____

Detailed BRD Diagram:



Detailed Gear Diagram:



INSTRUCTIONS FOR THE GEAR SPECIFICATION FORM

Gear Specification Forms must be completed once for each net used in trawling operations. If any gear configuration changes are made, an additional form (s) must be completed by the observer for the affected nets. Any change in gear configuration constitutes a new gear type and all requirements for the new gear must be followed (e.g. 30 tows minimum). All measurements should be recorded in feet and inches. Measurements should be converted to decimal form prior to data entry (10 feet and 6 inches = 10.5 feet, 3/4 inches = .75 inches). Detailed instructions are as follows:

VESSEL NAME: Enter the vessel name.

VESSEL IDENTIFICATION NUMBER: Enter the vessel identification number.

TOW NUMBER: Enter the starting tow number for a given vessel. If net or gear changes are made, enter the tow number when the changes occurred.

DATE: Enter the starting tow number date, or the date when the changes occurred.

NET POSITION: Enter 1 for outside port net; 2 for inside port net; 3 for inside starboard net; or 4 for outside starboard net.

TOTAL NUMBER OF NETS: Enter the total number of nets used in trawling operations.

NET MEASUREMENTS

NET TYPE: Specify: semi-balloon, balloon, flat, mongoose, etc.

HEADROPE LENGTH: Measure the length of the trawl headrope (feet and inches) where webbing is attached.

FOOTROPE LENGTH: Measure the length of the trawl footrope (feet and inches) where webbing is attached.

OTHER MEASUREMENTS

BODY:

MESH SIZE - Measure to nearest 1/4".

COD END: (TAILBAG)

TYPE - Circle the appropriate answer, nylon or poly.

MESH SIZE - Measure to nearest 1/4".

TWINE DIAMETER - Ask the Captain the twine number designation.

LENGTH - Measure the length of the cod end (number of meshes).

CIRCUMFERENCE - Measure Circumference of the opening of the cod end (number of meshes).

BAG RING PLACEMENT - Specify bag ring placement (number of meshes up from the tailbag).

CHAFING GEAR TYPE - Specify (i.e. mud, whiskers, and half or full).

TICKLER CHAIN:

CHAIN LENGTH - Measure the length of the chain (feet and inches) from door to door.

CHAIN SIZE - Measure the diameter of the stock of the link to the nearest 1/16 inch (do not measure the area where it is connected to another link or an area that has been welded.)

DOORS:

DOOR TYPE - Circle the appropriate answer, aluminum or wood.

DOOR LENGTH - Measure of the length of the door (feet and inches).

DOOR HEIGHT - Measure the height of the door (inches).

TED:

TED TYPE -

Circle the appropriate answer, hard or soft.

Circle the appropriate answer, weedless, curved bar, or straight.

Circle the appropriate answer, top opening or bottom opening.

Circle the appropriate answer, TED funnel or no TED funnel.

Circle the appropriate answer, TED flap or no TED flap.

ANGLE OF TED (in degrees) - Measure angle of TED in net.

SIZE OF TED - Specify dimensions of TED used in both control and BRD net.

MATERIAL - Identify what material TED is constructed of.

FLOATATION - List number and type of floats used.

BYCATCH REDUCTION DEVICE (BRD):

DETAILED DESCRIPTION - A detailed description of the configuration of the BRD is required.

BRD DIAGRAM - A detailed diagram of the BRD used is required to be provided.

Photographs of the BRD are required to be provided.

GEAR DIAGRAM - A detailed diagram (similar to Appendix A) of the BRD configuration including placement and measurements (e.g., number of meshes) of all trawl components including the BRD and TED used is required to be provided.

Public reporting burden for this collection of information is estimated to average 30 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Edward E. Burgess, Southeast Regional Office, National Marine Fisheries (F/SEO12), 9721 Executive Center Drive N., St. Petersburg, FL 33702.

COLLECTION OF BIOLOGICAL DATA

Data should be entered on the BRD Evaluation Station Sheets and the Length Frequency Forms. Detailed instructions for completing these forms are discussed later in this section.

Identifying BRD net or Control net and location:

Each of the following digits refers to a net position on a vessel. More specifically:

- 1 = outside port net
- 2 = inside port net
- 3 = inside starboard
- 4 = outside starboard

One outboard net will be designated as the experimental net (new or modified BRD/TED), and the other outboard net will be designated as a control (i.e., TED). The nets will be denoted by net position indicated above on your data sheets. To eliminate the effect of a try net on the trailing net, inboard nets will not be targeted for sampling, however, they will be outfitted with the same equipment as the (BRDs, TEDs, etc.) outboard net next to them. Data will only be collected from the inboard nets if information cannot be collected from an outboard net, i.e. the cod end became untied during the trawl, the net was lost or torn in half, etc. Should this occur in any one of the two outboard nets then both inboard nets should be sampled in place of the outboard nets. Under no circumstances should an inboard net from one side of a vessel be compared to the outboard net on the same side. If a try net is used ahead of a control or experimental net, enter 'Y' in the Operational Code section for that net on the BRD Evaluation Station Sheet and report in comments section. Do not add the try net catch to the main trawl catch. If in the event that double-rigged trawl (two net) vessel is used in a BRD Test, the port net = 2 and the starboard net = 3 will be used as the experimental and control nets.

Processing the catch and target species:

Become familiar with the species listed on the BRD Evaluation Station Sheet (i.e. brown shrimp, white shrimp, pink shrimp, Spanish mackerel, weakfish). Identify predominant penaeid shrimp (see Appendix I) in catch. Target species (Spanish mackerel and weakfish) must be weighed as a species lot, and each individual counted and measured. See appendices E and F for seasonal and areal distribution of catches of juvenile weakfish and Spanish mackerel.

Sampling the catch to obtain group weights for each of the following categories:

Total weights will be obtained for shrimp, Spanish mackerel, and weakfish. A total catch weight and total finfish weight will also be recorded. A basket (70-80 pounds) subsample will be weighed and sorted to obtain a percentage of finfish in the

subsample. The percentage of finfish in the subsample will be used to estimate the total finfish in the catch. All target finfish species (currently Spanish mackerel and weakfish) will be weighed as a species lot, and individuals counted, and length measured.

Sampling the catch to obtain total weight and total numbers of other important species:

Collection of information on other important species is required (total weight and total numbers of individual species in subsample to estimate total weight and total numbers in catch). Record the total weight and total number of each species in the basket (70-80 pounds) subsample and the estimated total weight and total number of each species in the catch. Important species (see Appendix I) for which information is required are seatrouts (weakfish, spotted, and silver), Spanish mackerel, king mackerel, cobia, gag, seabasses (black, bank, and rock), spot, croaker, red drum, black drum, pompano, kingfishes (southern and northern), flounders (southern, and summer), bluefish, scup, juvenile sharks, sturgeon, shad, and sea turtles (i.e., take only measurements that can be taken without harming turtles).

Additional instructions:

The purpose of the testing is to evaluate the effectiveness of a new or modified bycatch reduction device so observers should pay close attention to factors that may affect the efficiency of the BRDs and how they operate. In the Comments section of the BRD Station Sheet, record pertinent information including not only your observations, but also your assessments and insights about what factors influence the experimental catch and in what ways.

No special side experiments are allowed, such as tying the TEDs shut, putting closed bags over the TED/BRD opening to see what the TED/BRD is excluding, etc.

**STATION SHEET BRD EVALUATION
BRD TESTING PROTOCOL**

<input type="text"/> VESSEL NAME	<input type="text"/> TOW NUMBER	<input type="text"/> MONTH	<input type="text"/> DAY	<input type="text"/> YEAR	<input type="text"/> DATE	<input type="text"/> TMZN
<input type="text"/> VESSEL ID NUMBER	<input type="text"/> OP CODE	<input type="text"/> D/ N/ B	<input type="text"/> NET POSITION SAMPLED			
<input type="text"/> TIME IN	<input type="text"/> DEGREES MINUTES SECONDS LATITUDE IN	<input type="text"/> DEGREES MINUTES SECONDS LONGITUDE IN	<input type="text"/> FEET DEPTH IN			
<input type="text"/> TOTAL NETS	<input type="text"/> VESSEL SPEED	<input type="text"/> BRD NET POSITION	<input type="text"/> CONTROL NET POSITION			
<input type="text"/> TIME OUT	<input type="text"/> DEGREES MINUTES SECONDS LATITUDE OUT	<input type="text"/> DEGREES MINUTES SECONDS LONGITUDE OUT	<input type="text"/> FEET DEPTH OUT			
<input type="text"/> STAT ZONE	<input type="text"/> TOTAL WEIGHT (LBS)		<input type="text"/> HOURS TOWED			
<input type="text"/> TOTAL SHRIMP WEIGHT (LBS)	<input type="text"/> FINFISH SUBSAMPLE WEIGHT (LBS)		<input type="text"/> TOTAL FINFISH WEIGHT (LBS)*			
<input type="text"/> PREDOMINANT SHRIMP SPECIES						

	TARGET SPECIES	<input type="text"/> TOTAL WEIGHT (LBS)	<input type="text"/> TOTAL NUMBER
WEAKFISH		<input type="text"/> TOTAL WEIGHT (LBS)	<input type="text"/> TOTAL NUMBER
SPANISH MACKEREL		<input type="text"/> TOTAL WEIGHT (LBS)	<input type="text"/> TOTAL NUMBER

COMMENTS:

OBSERVER SIGNATURE AND AFFILIATION _____

CAPTAIN'S SIGNATURE: _____

OTHER SPECIES		
GENUS	<input type="text"/> SUBSAMPLE WEIGHT (LBS)	<input type="text"/> TOTAL WEIGHT (LBS)
<input type="text"/> SPECIES	<input type="text"/> SUBSAMPLE NUMBER	<input type="text"/> TOTAL NUMBER
GENUS	<input type="text"/> SUBSAMPLE WEIGHT (LBS)	<input type="text"/> TOTAL WEIGHT (LBS)
<input type="text"/> SPECIES	<input type="text"/> SUBSAMPLE NUMBER	<input type="text"/> TOTAL NUMBER
GENUS	<input type="text"/> SUBSAMPLE WEIGHT (LBS)	<input type="text"/> TOTAL WEIGHT (LBS)
<input type="text"/> SPECIES	<input type="text"/> SUBSAMPLE NUMBER	<input type="text"/> TOTAL NUMBER
SEA TURTLES	<input type="text"/> CARAPACE WIDTH (INCHES)	<input type="text"/> CARAPACE LENGTH (INCHES)

(*Sample format- record all other important species data from subsample in the same manner)

INSTRUCTIONS FOR THE STATION SHEET BRD EVALUATION

One BRD Evaluation Station Sheet must be completed for each net sampled (i.e., BRD and control net). The top part of the Station Sheet (excluding total catch and total sample weights) can be filled in before working up the catch. All numeric fields are right justified or aligned with the decimal place. Leading zeros are not required. All weights are in pounds.

VESSEL NAME: Enter the vessel name.

TOW NO.: For a given vessel, the tow number should start with “1” and run consecutively through at least 30 for a given test of an unmodified gear.

DATE: Enter month, day, and year.

TM ZN: Enter the time zone code as follows:

- 1 - Eastern Standard Time
- 2 - Eastern Daylight Savings Time

VESSEL ID NUMBER: Enter the state or Federal vessel registration number.

OP CODE: Enter the appropriate operational code for each net. Z designates successful tow. All other codes indicate unsuccessful or problem tows (Appendix B). Researchers, prior to testing, should refer to the list of factors affecting shrimp retention presented in Appendix H.

D/N/B: Enter D for a day tow, N for a night tow, or B for a tow that occurs both during the day and night time.

NET POSITION: Enter the position code of the net bag sampled.

TIME IN: Enter in military time (0000-2359) for start of a tow (dog-off time).

LATITUDE IN: Enter position occupied at tow start time in degrees, minutes, and seconds. If LORAN reads in the tenths of minute, multiply tenths of minutes X 60 to obtain seconds (for example, 0.5 X 60 = 30 seconds).

LONGITUDE IN: Enter position occupied at tow start time in degrees, minutes, and seconds. If LORAN reads in the tenths of minute, multiply tenths of minutes X 60 to obtain seconds (for example, 0.5 X 60 = 30 seconds).

INSTRUCTIONS FOR THE STATION SHEET BRD EVALUATION (cont.)

DEPTH IN: Enter the starting depth in feet. Ask the captain of the vessel if the depthfinder has been calibrated to read true depth or depth from the bottom of the boat. If the latter, then add the depth of the transducer to the depth reading.

TOTAL NETS: Enter number of nets used in test.

VESSEL SPEED: Enter the average vessel speed (in knots) during trawling operations.

BRD NET POSITION: Enter position code of the BRD net being sampled.

1 = outside port net

2 = inside port net

3 = inside starboard

4 = outside starboard

CONTROL NET POSITION: Enter position code of the control net being sampled.

TIME OUT: Enter in military time (0000-2359) for the end of a tow (the start of the haul-back).

LATITUDE OUT: Enter position occupied at tow start time in degrees, minutes, and seconds. If LORAN reads in the tenths of minute, multiply tenths of minutes X 60 to obtain seconds (for example, 0.5 X 60 = 30 seconds).

LONGITUDE OUT: Enter position occupied at tow start time in degrees, minutes, and seconds. If LORAN reads in the tenths of minute, multiply tenths of minutes X 60 to obtain seconds (for example, 0.5 X 60 = 30 seconds).

DEPTH OUT: Enter the ending depth in feet.

STAT ZONE: Enter statistical zone (Appendix D).

TOTAL WEIGHT: Enter the total weight (pounds) of the catch from the sampled net.

HOURS TOWED: Enter the total tow time in hours (observing one decimal).

INSTRUCTIONS FOR THE STATION SHEET BRD EVALUATION (cont.)

TOTAL SHRIMP WEIGHT: Enter the total weight (pounds) of the shrimp from the sampled net.

FINFISH SUBSAMPLE WEIGHT: Enter the weight (pounds) of the finfish from the 1 basket (70-80 pounds) subsample.

TOTAL FINFISH WEIGHT: Enter the estimated total weight (pounds) of the finfish in catch based on percentage by weight of finfish in 1 basket (70-80 pounds) subsample.

PREDOMINANT SHRIMP SPECIES: Record predominant penaeid shrimp species caught in net.

TARGET SPECIES: Record all Spanish mackerel and weakfish total weight and total number caught.

COMMENTS: Enter comments or observations.

OBSERVER SIGNATURE AND AFFILIATION: The observer should sign each BRD Evaluation Station Sheet and identify his or her affiliation.

CAPTAINS SIGNATURE: The vessel Captain should sign each BRD Evaluation Station Sheet to verify that this data was collected from his or her vessel.

OTHER SPECIES SUBSAMPLE WEIGHT AND TOTAL SPECIES WEIGHT: Enter the total weight (pounds) of each species (list in Appendix I) from the basket (70-80 pounds) subsample. Enter the estimated total weight (pounds) of each species in catch based on percentage by weight of that species in the basket (70-80 pounds) subsample.

OTHER SPECIES SUBSAMPLE NUMBER AND TOTAL SPECIES NUMBER: Enter the total number of each species (list in Appendix I) from the basket (70-80 pounds) subsample. Enter the estimated total number of each species in the catch based on percentage by number of that species in the basket (70-80 pounds) subsample. Enter the first seven characters of the genus and the first six characters of the species.

SEA TURTLES: Record carapace width and length in inches.

Public reporting burden for this collection of information is estimated to average 50 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for

reducing this burden to Edward E. Burgess, Southeast Regional Office, National Marine Fisheries (F/SEO12), 9721 Executive Center Drive N., St. Petersburg, FL 33702.

LENGTH FREQUENCY FORM (TARGET SPECIES)

	MONTH	DAY	YEAR			
VESSEL NAME	TOW NUMBER			DATE		

NET POSITION SAMPLED	CONTROL NET POSITION	OBSERVER NAME

GENUS													
SPECIES												MEAS. CODE	

	LENGTH (MM)			
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				

	LENGTH (MM)			
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				
96				
97				
98				
99				
100				

INSTRUCTIONS FOR LENGTH FREQUENCY FORM

BRD TESTING PROTOCOL

The only species that require length and weight measurements are weakfish, and Spanish mackerel in the catch. Length Frequency Forms should be filled out including each individual of these target species. Appendix C shows how length measurements are to be taken.

VESSEL NAME: Transcribe from Station Sheet.

TOW NUMBER: Transcribe from Station Sheet.

NET POSITION SAMPLED: Transcribe from Station Sheet.

CONTROL NET POSITION: Transcribe from Station Sheet.

OBSERVER NAME: Transcribe from Station Sheet.

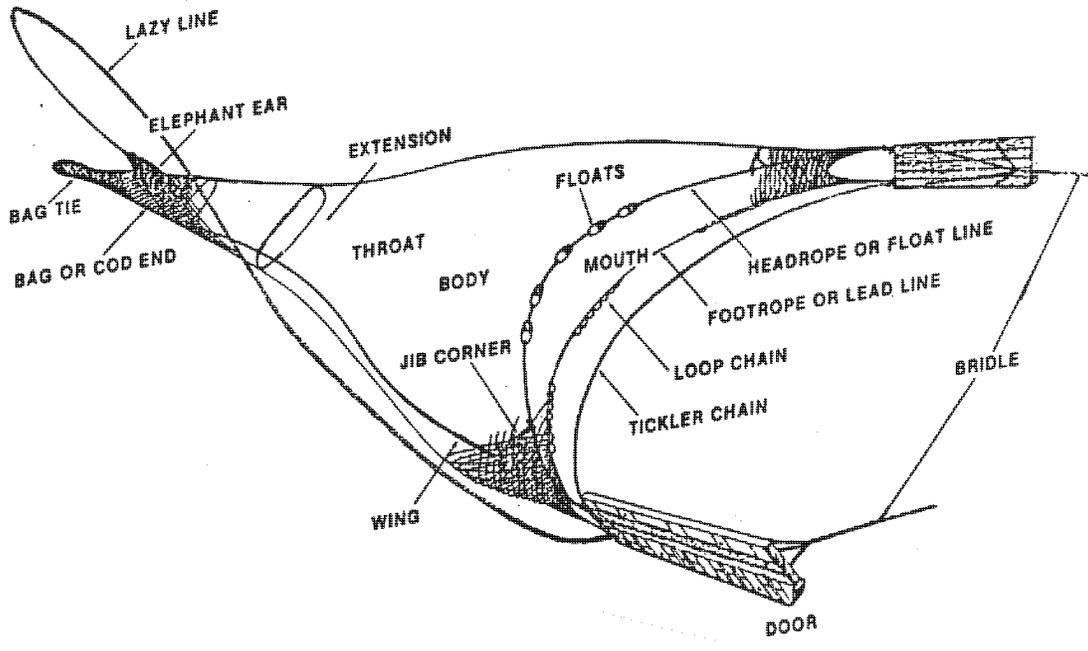
GENUS SPECIES: Enter the first seven characters of the genus and the first six characters of the species.

MEASUREMENT CODE: Enter 01, (Fork Length) for Spanish mackerel and 02 (Total Length) for weakfish (Appendix C).

LENGTH: (mm) Measure all individuals of target species. For large catches (over 200 fish), a subsample of 30-60 randomly selected individuals for each age class shall be measured.

Public reporting burden for this collection of information is estimated to average 50 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Edward E. Burgess, Southeast Regional Office, National Marine Fisheries (F/SEO12), 9721 Executive Center Drive N., St. Petersburg, FL 33702.

APPENDIX A. Otter Trawl Components (Source: NMFS 1991).



APPENDIX B. Operations Codes.

- A** = Nets not spread; typically doors are flipped or doors hung together so net could not spread.
- B** = Gear bogged; the net has picked up a quantity of sand or mud such that the net can not be easily towed.
- C** = Bag choked; the catch in the net is prevented from getting into the bag by something (grass, sticks, turtle, etc.) clogging net or by twisting of the lazy-line.
- D** = Gear not digging; the net is fishing off the bottom due to insufficient weight.
- E** = Twisted warp or line; the cables comprising the bridle get twisted (from passing over blocks which occasionally must be removed before continuing to fish). Use this code if catch was affected.
- F** = Gear fouled; the gear has become entangled in itself. Typically this involves the webbing and some object like a float or chains.
- G** = Bag untied; bag of net not tied when dragging net.
- H** = Rough weather; if the weather is so bad fishing is stopped, then the previous tow should receive this code if the rough conditions affected the catch.
- I** = Torn webbing or lost net; usually results from hanging the net and tearing it loose. The net comes back with the large tears if at all. Do not use this code if there are only a few broken meshes. Continue using this code until net is repaired or replaced.
- J** = Dumped catch; tow was made but catch was discarded, perhaps because too much trash, fish, sponge. Give reasons in comments.
- K** = No pick up; tow was made but net was dumped on deck because nets are brought up, boat changes location and nets are towed more before decking.
- L** = Hung up; untimely termination of a tow by a hang. Specify trawl(s) which were hung and caused lost time in Comments.
- M** = Bags dumped together and catches not separated.
- N** = Net did not fish; no apparent cause.
- O** = Gear fouled on object. Net may be towed but performance affected. Give specifics in Comments.
- P** = No measurement taken of shrimp or total catch.
- Q** = Cable breaks and net lost. Describe in Comments.
- R** = Net caught in wheel.
- S** = Tickler chained fouled.
- T** = Other problems.
- U** = Excluder gear disabled.
- W** = Defective excluder gear.
- Y** = Net trailing behind try net.
- Z** = **Successful tow.**

APPENDIX C. Fish Species and Length Measurement Codes.

Fish Measurement Codes.

- 01 Fish, fork length
- 02 Fish, total length

COMMON NAME	SCIENTIFIC NAME	MEASUREMENT CODE
Spanish Mackerel ADULT	<i>Scomberomorus maculatus</i>	Fork Length = 01
_____	_____Fork Length = 01	_____

JUVENILE

Black spots on dorsal in juveniles

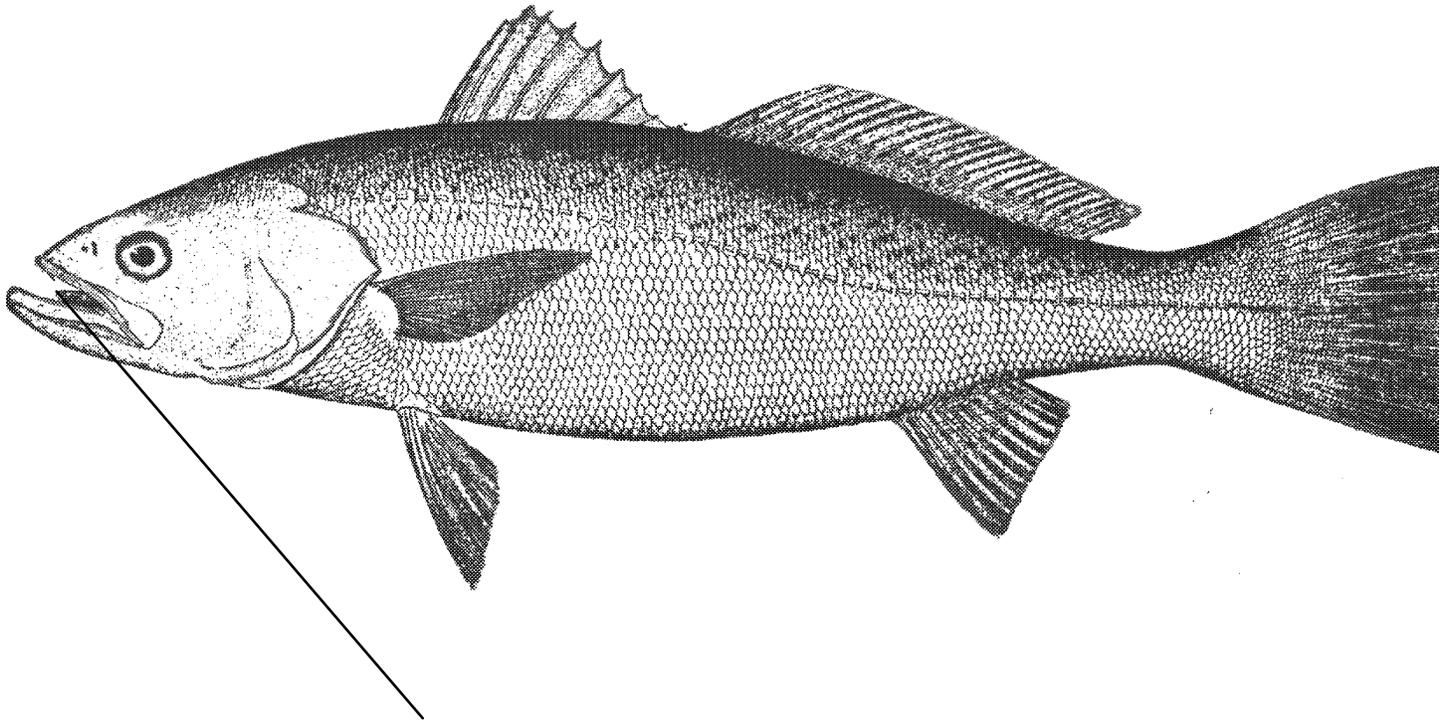
APPENDIX C. (cont.)

Fish Species and Length Measurement Codes.

COMMON NAME

SCIENTIFIC NAME

MEASUREMENT



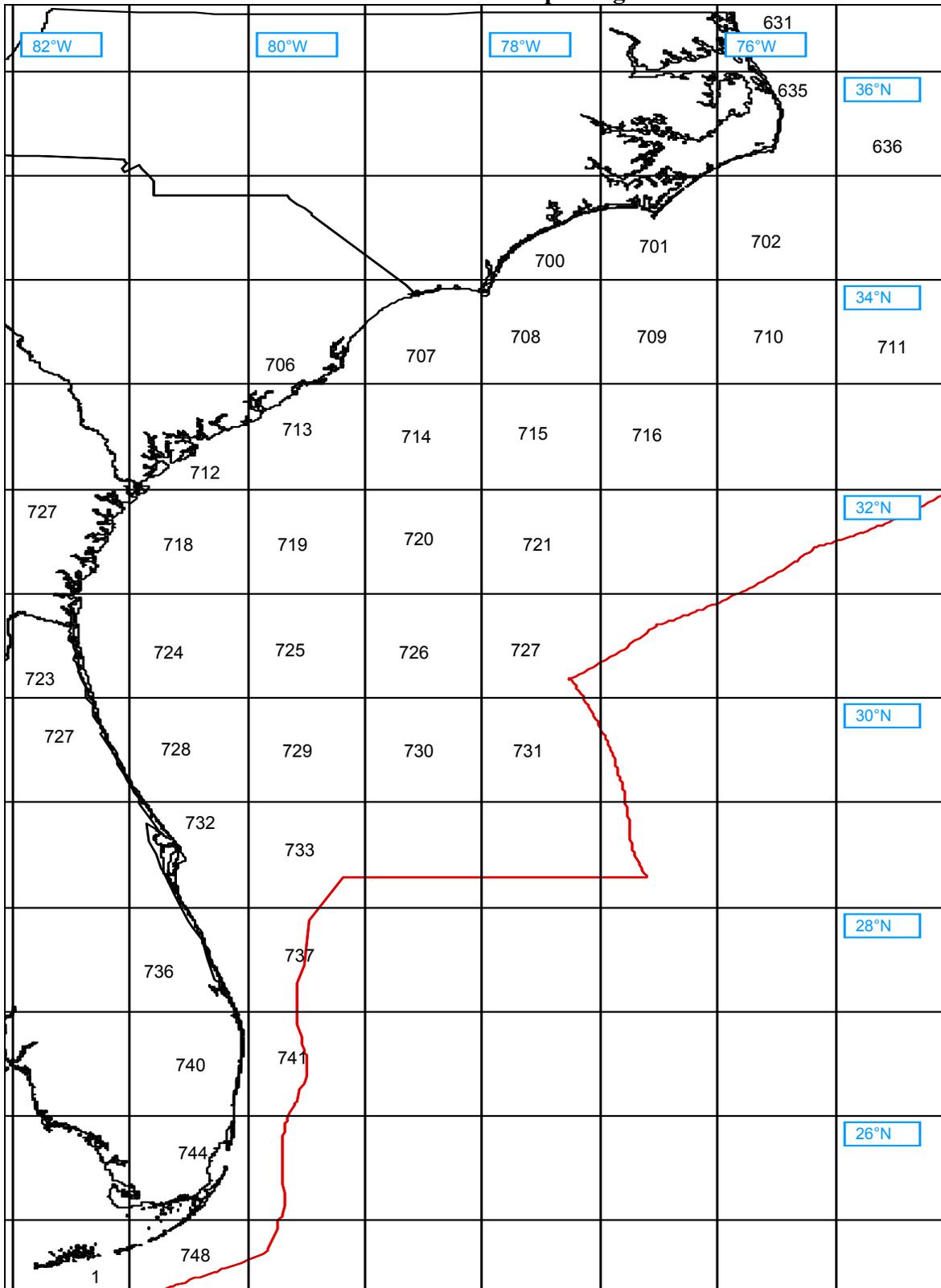
Pigmentation on end of tongue in juveniles.

JUVENILE

LARVAL

(illustrations from: Lippson and Moran, 1974) (from: Wilk 1979).

APPENDIX D. South Atlantic Statistical Reporting Zones.



Florida <30°N. latitude

APPENDIX E. Bycatch values of weakfish and Spanish mackerel, by season and location (ASMFC 1996)

Florida <30°N. latitude

Weakfish bycatch	
lb per trip	number per trip
69.00	355.07

Winter 94

Weakfish bycatch	
lb per trip	number per trip
69.00	355.07

Winter 94

Florida >30°N. latitude, Georgia, and South Carolina

Spanish mackerel bycatch	
lb per trip	number per trip
9.60	33.17

Winter 94

Spanish mackerel bycatch	
lb per trip	number per trip
9.60	33.17

Winter 94

Florida >30°N. latitude, Georgia, and South Carolina

Weakfish bycatch	
lb per trip	number per trip
2.18	13.93
82.28	722.03
38.42	1077.20
1053.34	9097.51
3952.43	5997.45
31.78	597.26
5.76	62.20
18.97	144.34
18.97	144.34
17.23	357.89
9.66	66.63
9.66	66.63
20.49	306.10
20.49	306.10

Spring 92
Spring 93
Spring 93 (Boat)
Summer 93
Summer 94
Summer 94
Fall 92
Fall 93
Fall 93
Fall 94
Fall 94
Winter 93
Winter 93
Winter 95

Spanish mackerel bycatch

Spanish mackerel bycatch	
lb per trip	number per trip
1.68	10.47
122.28	3447.97
122.62	3640.89
172.02	1296.05
157.89	1829.67
15.89	184.86
3.78	9.81
2.78	56.34
2.60	20.61
2.60	20.61
-	-
0.06	1.18
0.06	1.18

Spring 92
Spring 93
Spring 93 (Boat)
Summer 93
Summer 94
Summer 94
Fall 92
Fall 93
Fall 93
Fall 94
Fall 94
Winter 93
Winter 93
Winter 95

North Carolina

Weakfish bycatch	
lb per trip	number per trip
0.22	4.19
0.22	4.19
5.60	45.69
5.60	45.69
0.79	26.08
4.66	49.06
2.39	26.08
10.74	109.70
4.66	49.06
10.74	109.70

Summer 92 (Boat)
Summer 92 (Boat)
Summer 92 (Vessel)
Summer 93 (Boat)
Spring 93 (Boat)
Spring 93 (Vessel)
Spring 93 (Boat)
Fall 93 (Boat)
Spring 93 (Vessel)
Fall 93 (Boat)

Spanish mackerel bycatch

Spanish mackerel bycatch	
lb per trip	number per trip
0.36	1.93
20.36	4259.38
0.50	2591.85
0.20	91.95
0.50	113.53
1.68	2.42
0.99	3.53
0.13	0.76
1.68	2.42
0.13	0.76

Summer 92 (Boat)
Summer 92 (Boat)
Summer 92 (Vessel)
Summer 93 (Boat)
Spring 93 (Boat)
Spring 93 (Vessel)
Spring 93 (Boat)
Fall 93 (Boat)
Spring 93 (Vessel)
Fall 93 (Boat)

Spring: March, April, May, and June

Summer: July and August

Fall: September, October, and November

Winter: December, January, and February

Vessel: Documented craft of five tons or greater.

APPENDIX F. Estimates of density (numbers of individuals/hectare) of weakfish and Spanish mackerel among regions and seasons for 1989-1995 (Randy Beatty, SCDNR, pers. comm., 1996) (SEAMAP 1996).

The Southeast Area Monitoring and Assessment Program (SEAMAP) -South Atlantic

Weakfish

***Cynoscion regalis* SHALLOW WATER TRAWL SURVEY 1989-1995**

	Spring	Summer	Fall	Region
Weakfish	<i>Cynoscion regalis</i>			
Raleigh Bay	97.90	50.48	29.89	59.42
Onslow Bay	14.24	5.79	0.57	6.93
Raleigh Bay	97.90	50.48	29.89	59.42
Long Bay	14.67	2.16	0.73	5.86
Onslow Bay	14.24	5.79	0.57	6.93
South Carolina	2.62	3.84	1.36	2.60
Long Bay	14.67	2.16	0.73	5.86
Georgia	1.10	1.21	1.72	1.34
South Carolina	2.62	3.84	1.36	2.60
Florida	1.95	0.68	4.42	2.34
Georgia	1.10	1.21	1.72	1.34
Florida	1.95	0.68	4.42	2.34
Season	11.15	5.22	3.06	6.49

Spanish mackerel

Scomberomorus maculatus

Spanish mackerel

Scomberomorus maculatus

	Spring	Summer	Fall	Region
Raleigh Bay	0.25	0.51	1.39	0.72
Onslow Bay	0.35	2.64	2.60	1.86
Long Bay	0.81	2.37	1.00	1.40
South Carolina	1.12	1.61	0.49	1.07
Georgia	1.15	1.91	1.19	1.54
Florida	1.33	3.22	3.06	2.54
Season	1.02	2.11	1.37	1.50

Sampling cruise times
 Spring: April - May
 Summer: July - August
 Fall: October - November

APPENDIX G. Statistical Procedures for Analyzing BRD Evaluation Data.

All experimental tows must be conducted strictly under the guidelines specified under the BRD testing protocol. To reduce problems caused by no or low catches, a tow must contain a minimum catch of 5 weakfish and/or 1 Spanish mackerel in at least one net for inclusion in the analysis. Once conducted, the tow (and the corresponding collected data) become the permanent part of the record and cannot be discarded. Only the successful tows (meeting the minimum catch and other requirements) will count toward the minimum required, however all tows will be used in the analysis.

Statistical Approach:

You should start with the assumption that the BRD to be tested does not achieve the minimum required reduction rate, say R_o . This assumption will be rejected if the data provides sufficient evidence to do so. Hence, the hypotheses to be tested are as follows:

H_o : BRD does not achieve the minimum required reduction rate,

$$R = \frac{\mu_c - \mu_b}{\mu_c} \leq R_o, \text{ i.e. } (1 - R_o) \mu_c - \mu_b \leq 0.$$

H_a : BRD does achieve the minimum required reduction rate,

$$R = \frac{\mu_c - \mu_b}{\mu_c} > R_o, \text{ i.e. } (1 - R_o) \mu_c - \mu_b > 0.$$

Here R denotes the actual reduction rate (unknown), R_o denotes the minimum required reduction rate μ_c denotes the actual mean CPUE with the control, and μ_b denotes the actual mean CPUE with the BRD.

With any hypothesis testing, there are two risks involved known as type I error (rejecting the true H_o) and type II error (accepting a false H_o). The probabilities of committing these errors are denoted by alpha and beta, respectively, and those are inversely related with each other. As alpha increases, beta decreases and vice versa. The above test will be conducted with alpha of **(to be specified by NMFS)**. The above hypotheses should be tested using a 'modified' paired t-test.

The CPUE values for the control and BRD nets for each successful tow should be computed first and these will be used in the following computations. The test statistic to be used is given by:

$$t = \frac{(1 - R_o) x - y}{s_{d0} / \sqrt{n}},$$

where: x is the observed mean CPUE for the control,

y is the observed mean CPUE for the BRD,

s_{d0} is the standard deviation of $d_i = \{ (1 - R_o)x_i - y_i \}$ values

n is the number of successful tows used in the analysis, and

$i = 1, 2, \dots, n$.

APPENDIX G. Statistical Procedures for Analyzing BRD Evaluation Data. (cont.)

The H_0 will be rejected if $t > t_{\alpha, n-1}$ where $t_{\alpha, n-1}$ denotes the $(1 - \alpha)100^{\text{th}}$ percentile score in the t distribution with $(n - 1)$ degrees of freedom.

The computation of beta (for various assumed reduction rates, $R_1 > R_0$) are somewhat involved and requires the knowledge of unknown parameters (or at least good estimates) of μ_c and σ_{d0}^2 . Note that α_{d0}^2 is dependent on R_0 specified (under H_0) and equals:

$$(1 - R_0)^2 \sigma_{x_i}^2 + \sigma_{y_i}^2 - 2(1 - R_0) p \cdot \sigma_{x_i} \cdot \sigma_{y_i} ,$$

where p is the population correlation coefficient between x_i and y_i values. The computation of beta in advance (in the absence of any preliminary data, i.e., without good parameter estimates) is almost impossible. More work in this direction is still needed. However, it is clear that beta could be reduced by increasing alpha or n or both.

A $(1 - \alpha)100\%$ two-sided confidence interval on R consists of all values of R_0 for which

$H_0 : R = R_0$ (versus $H_a : R \neq R_0$) cannot be rejected at the level of significance of alpha. One-sided confidence intervals on R could also be computed appropriately.

APPENDIX H. Factors Affecting Shrimp Retention (Source: Georgia Marine Extension Service, 1997).

High Shrimp Retention - Fish Eyes

1. Fast towing speed (2.8 - 3.0 knots).
2. Fast winch retrieval speed.
3. 120 meshes or greater bag.
4. Minimal /no turning.
5. Minimal tides.
6. Minimal debris.
7. Fair weather.

Reduced Shrimp Retention - Fish Eyes

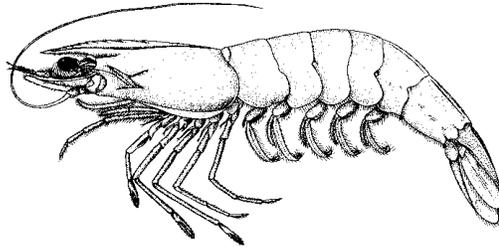
1. Reduced / restricted tow speed <2.3 knots.
2. Slow winch retrieval.
3. Small bags 80-100 meshes.
4. Excessive turning.
5. Strong tides.
6. Debris, crab traps and jellyfish.
7. Rough weather.

Reduced Shrimp Retention - Expanded Mesh

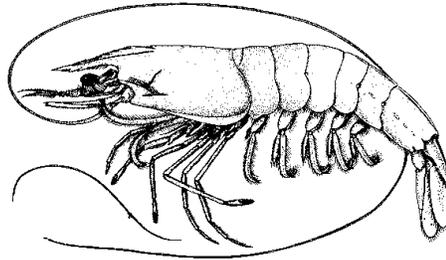
1. Excessive turning.
2. Strong tides.

APPENDIX I.

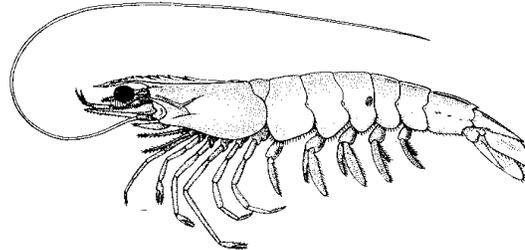
Penaeid Shrimp Illustrations and List of Species.



Brown shrimp (*Penaeus aztecus*)



White shrimp (*Penaeus setiferus*)



Pink shrimp (*Penaeus duorarum*)

Species list

- | | |
|---|--|
| weakfish (<i>Cynoscion regalis</i>) | Atlantic croaker (<i>Micropogonias undulatus</i>) |
| spotted seatrout (<i>Cynoscion nebulosus</i>) | red drum (<i>Sciaenops ocellatus</i>) |
| silver seatrout (<i>Cynoscion nothus</i>) | black drum (<i>Pogonias cromis</i>) |
| Spanish mackerel (<i>Scomberomorus maculatus</i>) | Florida pompano (<i>Trachinotus carolinus</i>) |
| king mackerel (<i>Scomberomorus cavalla</i>) | southern kingfish (<i>Menticirrhus americanus</i>) |
| cobia (<i>Rachycenton canadum</i>) | northern kingfish (<i>Menticirrhus saxatilis</i>) |
| gag (<i>Mycteroperca microlepis</i>) | southern flounder (<i>Paralichthys dentatus</i>) |
| black seabass (<i>Centropritis striata</i>) | summer flounder (<i>Paralichthys lethostigma</i>) |
| bank seabass (<i>Centropritis ocyurus</i>) | scup (<i>Stenotomus chrysops</i>) |
| rock seabass (<i>Centropritis philadelphica</i>) | juvenile sharks |
| spot (<i>Leiostomus xanthurus</i>) | sturgeon (<i>Acipenser sp.</i>) |
| shad (<i>Alosa sp.</i>) | bluefish (<i>Pomatomus saltatrix</i>) |
| sea turtles | |

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