SEDAR 4 - DW - 01.
Indices of abundance from commercial logbook data: U.S. South Atlantic stocks
Data Workshop
November 3-7, 2003
Charleston, SC

Applicability of the Logbook Data for Assessments

The question of the general usefulness of the logbook data for developing species indices was raised for group discussion. Two possible problems with using the data were discussed. First, the data do not allow obvious definition of effective effort. The fishery takes multiple species from a 'complex' that is not cleanly defined (in the sense of biology or targeting by the fishery). This makes it difficult to define fishing trips that caught none of a studied species, but had the potential to do so (i.e, effort but zero catch).

Second, the data are obtained from a directed fishery and therefore could contain problems associated with any fishery-dependent index. Change of the fishing efficiency of the fleet may have improved over time due to improved electronics (and how to address this possibility) was debated by the group. Associated with this question was the skill of fishermen, which may have changed over time. The possibility was raised that the best fishermen are now in the fishery and that fishermen of marginal skill were only present in the beginning of the data time series, particularly in the case of longline fishermen. This is based upon decreasing number of longline boats (in SC) and the expense of using that gear type. There was general agreement that change in skill of fishermen targeting deepwater species probably hasn't changed because marginally skilled fishermen never fished in deep water. Also of concern is the effect of changing market conditions and catchability. It was pointed out that there are problems associated with any abundance index and that very convincing evidence needs to be presented to not use the logbook data.

Recommendation:

The group decision was to compute logbook indices, and to compare them to fishery independent indices (MARMAP).

Available Data

Commercial logbook data are detailed in SEDAR4-DW-30. Each record in the reef fish logbook data set is of a single species caught on a single trip. Variables recorded are listed and described in Appendix 1. The full data set was pared by excluding records that did not report area fished, number of lines (or sets), number of hooks, time fished, length of longline (if appropriate), or days at sea. This excluded approximately 7% of the records. The data set was then constrained to areas in the South Atlantic (24-35 degrees latitude). The logbook data contain some data that are clearly misreported or misrecorded; records with reported values that seem suspect are excluded. The variable

effort (hooks/line) is constrained to between 1 and 40; the variable numgear (number of lines) is constrained to between 1 and 10; the variable crew (number on boat) is constrained to less than 12. In addition, the hours fished must be greater than 0. Data were explored in terms of number of records. The group also recommended exploring the data by catch (weight).

The time series of the reef fish logbook data is short (1992-present), with only partial reporting in 1992. It was suggested in the discussion that the longline dataset might be expanded by converting some North Carolina longline data to logbook format. Those data begin in the mid-1980's. The group decided that addition of those data would be of limited use because of the small geographic coverage of the additional data.

There was discussion about the possibility that there may be a trend in the logbook longline data in which hooks per line and time fished have both increased over time in the data set. In addition, the data should be examined for a tendency in the handline data of the reported number of hooks per line to equal the number of lines fished.

There was much, and repeated, discussion by the group concerning the criteria/rationale for including particular species in the deepwater complex. There was agreement that speckled hind was not, biologically, a deepwater species and should be analyzed separately. This data set contains no depth information (see below) and, therefore, subsetting the speckled hind (or any of the species) data by depth cannot be accomplished with the reef fish logbook data.

Warsaw grouper (649 records), queen snapper (505 records) and misty grouper (342 records) may not have adequate data to construct indices of abundance from the reef fish logbook data set. Available data, number of records per year, by species is provided in Table 1. Co-occurrence of species by trip is listed in Table 2.

Recommendations:

a. Examine the catch by year to identify data gaps in the available time series. Catch of speckled hind and warsaw grouper has been limited by regulation to one fish per vessel (and no sale) since 1994, most of the years represented in the logbook data. Explore methods for analyzing those species given this data limitation.
b. Limit the species that are further analyzed to those that make significant contributions to landings, both economically and in terms of total pounds landed. Significant contribution needs to be defined. This was the recommendation accepted by the group.
c. Defer further analysis of warsaw grouper and misty grouper due to lack of data.
d. Efforts could be best focused on snowy grouper, blueline tilefish, or (golden) tilefish.

Table 1. The number of records in the south Atlantic (SA) by species and year.

Species	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	Total
Sp. hind	462	504	294	171	180	154	129	104	101	136	125	**2360**
Snowy	669	1542	1607	1917	1918	2284	1617	1754	1705	1717	1536	**18266**
Yellow	86	171	149	141	192	231	183	196	243	216	230	**2038**
Misty	1	25	30	12	45	66	54	29	31	28	21	**342**
Queen sn	6	19	23	24	34	91	34	50	81	85	58	**505**
Tilefish	327	828	751	690	505	548	453	544	706	472	560	**6384**
Blueline	327	828	849	834	958	1252	838	847	811	872	858	**9274**
Warsaw	40	250	193	50	31	30	21	11	13	5	5	**649**
Total	**1918**	**4167**	**3896**	**3839**	**3863**	**4656**	**3329**	**3535**	**3691**	**3531**	**3393**	**39818**

Table 2.
Overlap of records from SA trips (1992-2002)

	Snowy	Blueline	Tilefish	Sp.hind	Yellow	Warsaw	Queen	Misty
Snowy	18266	7774	2993	641	1645	281	242	123
Blueline		9274	1587	266	1273	116	161	67
Tilefish			6384	49	958	57	15	16
Sp.hind				2360	58	49	5	6
Yellow					2038	21	27	26
Warsaw						649	3	4
Queen							505	24
Misty								342

Defining Catch

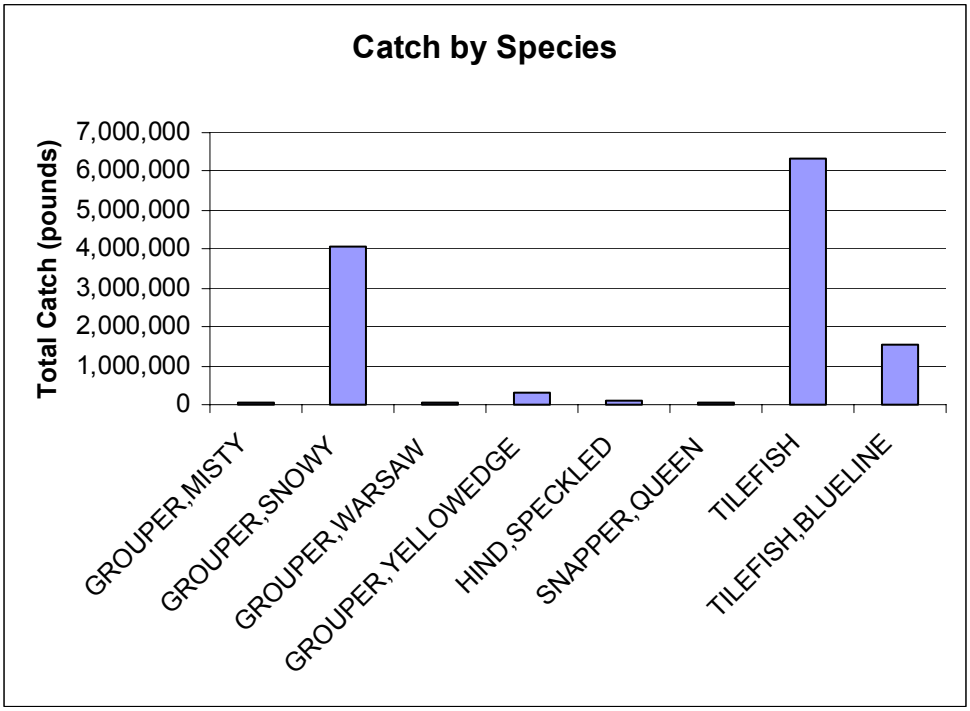
No depth information is available in this data set. Geographic resolution of fishing area is too coarse (one degree latitude by one degree longitude) to infer depth from reported area fished. Data are reported as total catch per species per trip with no age or size data available. The number of records is in Table 1 and the total catch by weight of each species is in Figure 1. Given the available logbook data, total pounds of

catch cannot be converted to number of fish caught. Similarly, changes in fishing patterns related to depth (shifting effort to different depths over years, seasons, geographic location, or when fishing different gear types) cannot be examined.

Recommendations:

a. **The group decision was to utilize the data as they are and report results in weight.**
b. Average weights from the TIP database may be used to convert weight from the logbook data to numbers of fish.
c. Subset catch by gear type in the TIP database to determine gear use by depth.
d. May use headboat data to get length/weight relationships of the deepwater species.

Figure 1. Total catch of the deepwater species complex reported in the commercial logbook program, 1992-2002.



Defining effort

Defining effort from the reef fish logbook data set is not straightforward. Changes in the method of reporting hours fished for longline gear (hours per set changed to total hours fished) lead to an undecipherable mix of time data reported in the data set. Also, the definition of a trip in which effort was directed at catching one of the deepwater species is not obvious. Without an adequate definition of "trip" a reasonable estimation of effort cannot be made. Multiple suggestions were considered by the group and are listed below.

Longline

1. The suggestion was made to accept all trips that use longlines. Regulations since 1992 (corresponding to the beginning of the reef fish logbook data time series) have limited longline gear to depths greater than 50 fathoms, therefore longline gear is fishing the deepwater complex. Longline trips targeting sharks should be excluded from the deepwater complex index of abundance analysis.

   Recommendations:

   a. Include all trips that use longlines except during shark open season. During shark open season, exclude shark trips by using species catch frequency data and eliminating trips when the deepwater species of interest comprise too small a percentage of the total catch (e.g. <10%) or, alternatively, include trips where sharks comprise a small percentage of the catch (e.g. <25%). Explore the data for reasonable delimiters.
   b. Include all trips with catch of the species of interest. The group recognized the problem of identifying trips with effort but no catch of the target species.
   c. Include all trips that use longlines except during shark open season. For periods of shark open season, use a species assemblage index to identify deepwater indicator species that can be used to identify trips targeting deepwater species. Other species (e.g. black belly rose fish) were suggested by the group as deepwater indicator species that might be used to identify deepwater trips.
   d. Examine longline gear configuration (hook density/longline and longline length and changes in those gear configurations over time) for differences between trips with predominantly shark and predominantly deepwater complex species in the catch. Use any gear configuration differences to identify trips targeting species in the deepwater complex. As was indicated in the group's discussion, longline length and distance between hooks will vary by area fished. North Carolina gear

configurations typically have longer longlines with fewer hooks when golden tilefish are targeted, but shorter longlines with many hooks are used when snowy grouper are targeted. Blueline tilefish were a bycatch of the snowy grouper targeted trips in earlier years. Examine longline gear configuration by area for primarily snowy grouper and primarily tilefish trips. Explore the data to determine what constitutes primarily snowy grouper and primarily tilefish trips (snowy grouper > 50% of the catch for a trip).

Initial Results:

Preliminary data exploration of gear configuration (no area delimitation) suggested no clear indication of targeted snowy grouper or tilefish by longline length or distance between hooks (Figure 2 A-D). Those analyses will be repeated by area.

Figure 2A. Pounds of snowy grouper catch by longline length.

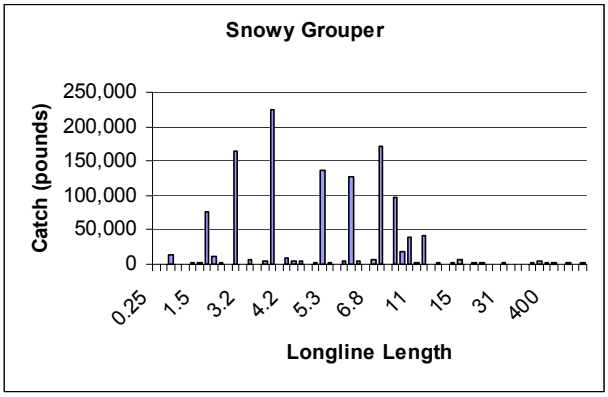


Figure 2B. Pounds of tilefish catch by longline length.

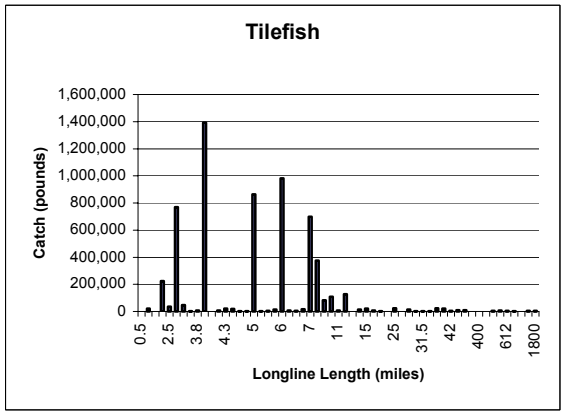


Figure 2C. Pounds of snowy grouper catch by distance between hooks.

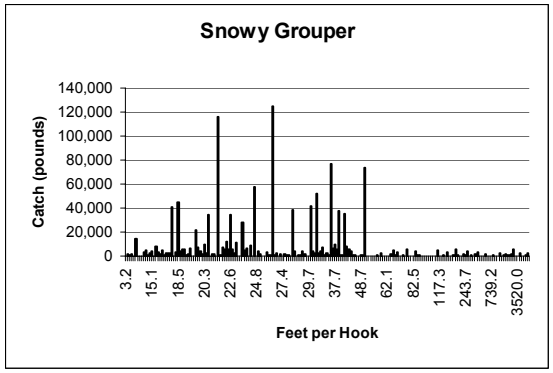
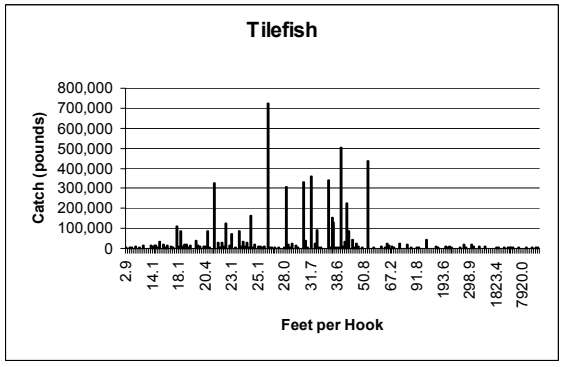


Figure 2D. Pounds of tilefish catch by distance between hooks.



e. Exclude shark trips by using species catch frequency data.
f. For each deepwater species, identify a subset of vessels that land a high proportion of the catch of the species of interest. The gear configuration of those vessels can be examined over the time series.
g. The group decision was to use an association statistic on all longline data to identify species assemblage (Appendix 2). The statistic was used to identify a list of possible species, from which species were selected based on biological knowledge (Table 3a,b).

Table 3a: Species assemblage for snowy grouper (longline)

common	code	N(s,x)	N(x)	association	keep?
GROUPER,SNOWY	1414	2314	2314	3.9563526	Y
SCORPIONFISH-THORNYHEADS	2959	259	259	3.9563526	Y
EEL,AMERICAN	1141	124	130	3.7737517	Y
PORGY,RED,UNC	3302	237	254	3.6915574	N
SNAPPER,VERMILION	3765	151	162	3.6877114	N
HAKE,ATLANTIC,RED & WHITE	1550	372	400	3.679408	Y
GROUPER,YELLOWEDGE	1415	899	981	3.6256483	Y
BLACK BELLIED ROSEFISH	2420	792	867	3.6141076	Y
LESSER AMBERJACK	1815	182	202	3.5646346	N
EELS,UNC	1140	234	264	3.5067671	Y
TILEFISH,BLUELINE	4474	1230	1410	3.4512863	Y
ALMACO JACK	1810	135	171	3.1234363	N
SCAMP	1424	133	181	2.9071541	N
GREATER AMBERJACK	1812	385	553	2.7544227	N
DOLPHINFISH	1050	559	975	2.2683088	N
TILEFISH	4470	1908	4027	1.8745271	Y
GROUPER,GAG	1423	126	363	1.3732794	
SHARK,UNC	3508	257	1366	0.7443504	
SHARK,HAMMERHEAD	3516	109	864	0.4991232	
SHARK,SANDBAR	3513	312	3515	0.3511755	

Table 3b: Species assemblage for tilefish (longline)

common	code	N(s,x)	N(x)	association	keep?
TILEFISH	4470	4027	4027	2.2734045	Y
HAKE,ATLANTIC,RED & WHITE	1550	389	400	2.2108859	Y
EEL,AMERICAN	1141	126	130	2.2034536	Y
BLACK BELLIED ROSEFISH	2420	824	867	2.160652	Y
SCORPIONFISH-THORNYHEADS	2959	243	259	2.1329625	Y
LESSER AMBERJACK	1815	186	202	2.0933329	N
GROUPER,YELLOWEDGE	1415	878	981	2.0347086	Y
EELS,UNC	1140	233	264	2.0064517	Y
TILEFISH,BLUELINE	4474	1179	1410	1.9009531	Y
GROUPER,SNOWY	1414	1908	2314	1.8745271	Y
SNAPPER,VERMILION	3765	133	162	1.866437	
PORGY,RED,UNC	3302	206	254	1.8437848	
DOLPHINFISH	1050	762	975	1.7767531	
ALMACO JACK	1810	131	171	1.741614	
GREATER AMBERJACK	1812	417	553	1.7143032	
SHARK,UNC	3508	424	1366	0.7056541	
GROUPER,GAG	1423	112	363	0.7014361	
SHARK,HAMMERHEAD	3516	196	864	0.515726	
SHARK,SANDBAR	3513	396	3515	0.2561218	

2. Hours fished cannot be determined unambiguously. Before 1993, longline hours fished was reported per set. Beginning in 1993, hours fished was to be reported as total hours fished. But old forms continued to be used, and some fishermen apparently continued to report hours fished per set even when using the new forms. This creates a problem in determining how hours fished was reported for many trips. This issue was examined prior to the DW, and an adequate solution was not found.

Recommendation:

The group decision was to use hook days for longline indices because hook hours incorporates unreliable data. Preliminary indices of abundance using hook hours or hook days were very similar.

Handline

Handline data are less ambiguous for determining effort. Hook hours may be reliably calculated from these data. **However, for consistency with longline, the group preferred using hook-days**. As with the longline data, there remains the problem of determining what constitutes a deepwater handline trip in the logbook data set. Several methods were suggested during group discussion to address this problem.

Recommendations:

a. Select trips with a percentage of the total catch that was a species of interest to define targeted trips (e.g. >50% snowy grouper in the catch for a trip indicates a snowy grouper trip).
b. Include all trips that caught species in the deepwater complex, but there is concern about which species were valid members of the deepwater complex.
c. Constrain analysis to areas where target species was caught; exclude areas in bottom five percent of catch. Include trips from those areas that landed any of the eight species from the South Atlantic deepwater complex.
d. Determine species composition for trips in which a minimum percentage (to be explored) of the catch consisted of deepwater species complex fish. Use the species composition of those trips to identify targeted trips.
e. Determine targeted trips for each of the deepwater species by examining gear configuration (hooks/line and number of lines) by area from trips reporting the species of interest in the catch. The predominate gear configuration found in those trips is used to characterize deepwater trips and include all trips using that gear configuration. There was some discussion that this will not be particularly useful in defining directed effort for deepwater species.
f. For each deepwater species, identify a subset of vessels that land a high proportion of the catch of the species of interest. The gear configuration of those vessels can be examined over the time series.
g. **The group decision was to use an association statistic on all handline (including electric reel) data to identify species assemblage. The statistic was used to identify a list of possible species, from which species were selected based on biological knowledge (Table 4a,b).**

Table 4a: Species assemblage for snowy grouper (handline)

common	code	N(s,x)	N(x)	association	keep?
GROUPER,SNOWY	1414	16668	16668	10.6957643	Y
BARRELFISH	193	499	577	9.2498898	Y
BLACK BELLIED ROSEFISH	2420	1422	1687	9.0156354	Y
TILEFISH,BLUELINE	4474	6864	8247	8.9021131	Y
EEL,CONGER	1142	112	152	7.8810895	Y
GROUPER,YELLOWEDGE	1415	844	1183	7.6307904	Y
HAKE,ATLANTIC,RED & WHITE	1550	187	266	7.5192027	Y
EELS,UNC	1140	101	170	6.3545423	Y
SNAPPER,QUEEN	3770	240	504	5.0932211	Y
BIGEYE	140	1159	2622	4.7278379	N
TILEFISH	4470	1056	2473	4.5672168	Y
SNAPPER,SILK	3758	987	2324	4.5424782	
GROUPER,WARSAW	4740	253	597	4.5327109	
SQUIRRELFISHES	4120	246	617	4.2644376	
TILEFISH,SAND	4478	283	749	4.0412568	
LESSER AMBERJACK	1815	1615	4418	3.9098369	
GROUPER,MISTY	1420	123	346	3.8022515	
TUNA,YELLOWFIN	4655	316	895	3.7763816	

Table 4b: Species assemblage for tilefish (handline)

common	code	N(s,x)	N(x)	association	keep?
TILEFISH	4470	2473	2473	72.0893651	Y
BLACK BELLIED ROSEFISH	2420	219	1687	9.3583705	Y
GROUPER,YELLOWEDGE	1415	105	1183	6.3984644	Y
GROUPER,SNOWY	1414	1056	16668	4.5672168	Y
TILEFISH,BLUELINE	4474	464	8247	4.0559556	Y
DOLPHINFISH	1050	454	19641	1.6663394	
MARGATE	1442	107	8371	0.9214624	
PORGY,RED,UNC	3302	320	26427	0.8729177	
SNAPPER,VERMILION	3765	381	31693	0.8666282	
GREATER AMBERJACK	1812	300	25396	0.8515833	
ALMACO JACK	1810	103	9039	0.8214631	
SCAMP	1424	264	24348	0.7816491	
SEA BASSE,ATLANTIC,BLACK,UNC	3360	208	23219	0.6457896	
SNAPPER,RED	3764	191	21451	0.6418847	
TRIGGERFISH,GRAY	4561	180	21997	0.5899025	
MACKEREL,KING AND CERO	1940	299	45491	0.4738238	
SNAPPER,MUTTON	3763	136	22108	0.4434663	
GROUPER,BLACK	1422	141	22960	0.4427091	
GROUPER,RED	1416	175	29454	0.4283167	
GROUPER,GAG	1423	167	28419	0.4236224	

Computing of indices of abundance

We used a delta-lognormal distribution (Lo et al., 1992, Can. J. Fish. Aquat. Sci., 49:2515-2526) to compute indices of abundance for snowy grouper and tilefish (Figure 3, 4). Factors were year, area, month, and gear. An empirical bootstrap will be used to obtain estimates of variance.

Figure 3a: Snowy grouper index of abundance

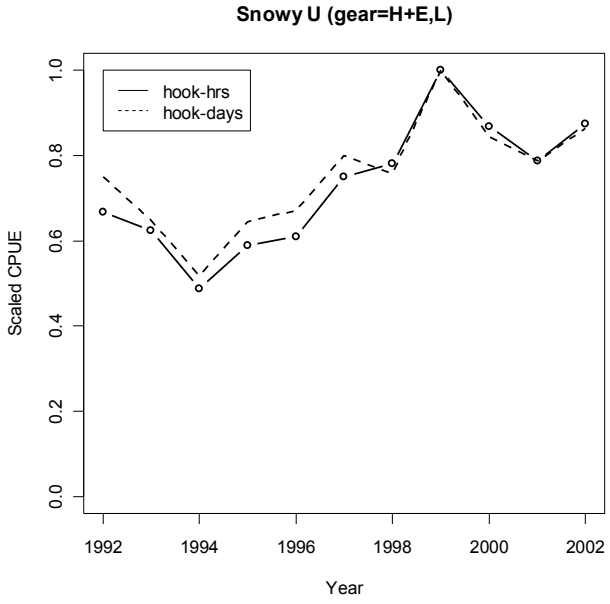
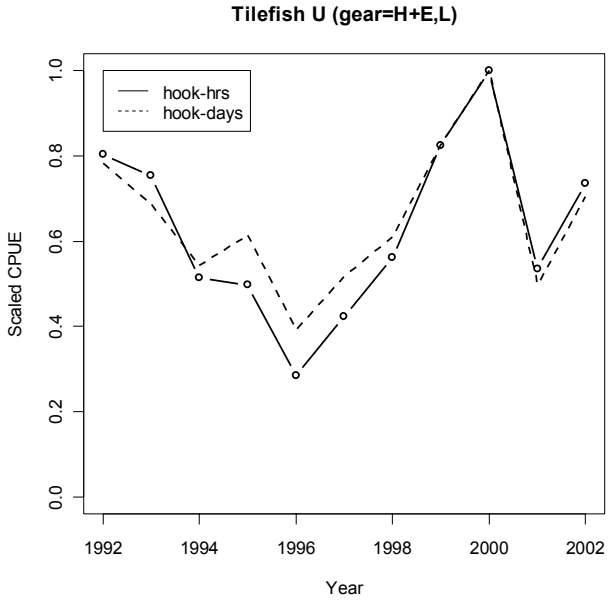


Figure 3b: Tilefish index of abundance



The indices were recomputed, but with a subset of vessels that were consistently in the fishery (Figure 4). Such vessels were determined as those that caught the studied species in at least 9 years of the 11-year period 1992-2002.

Figure 4a: Snowy grouper index of abundance, from subset of vessels

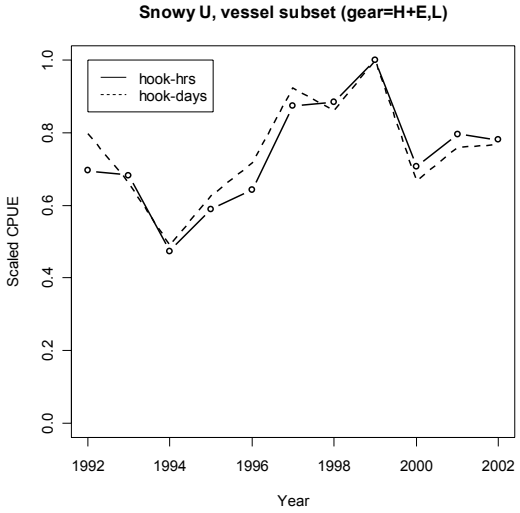
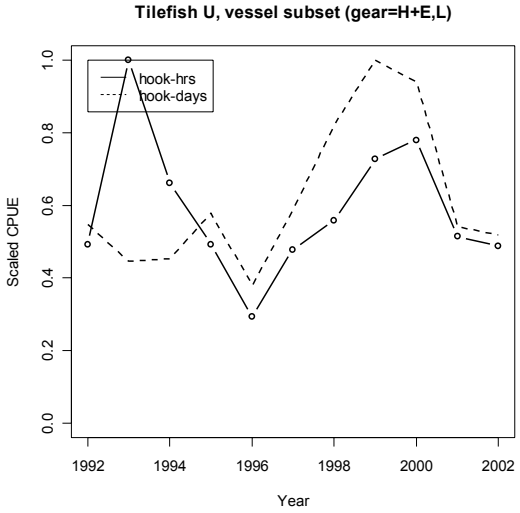


Figure 4b: Tilefish index of abundance, from subset of vessels



Appendix 1 The commercial logbook data set contains the following variables (all are numeric unless otherwise noted):

schedule: this is a unique identifier for each fishing trip and is a character variable
species: a character variable. Codes for the south Atlantic deepwater complex, as defined for SEDAR4, are 1414 = snowy grouper , 4470 = tilefish, 4474 = blueline tilefish, 1415 = yellowedge grouper, 1411 = speckled hind, 3770 = queen snapper, 1420 = misty grouper, 4740 = warsaw grouper. Tilefish may also be listed under 4471, 4473, 4475, and 4477 (those codes are for different size classes), however, records with those species codes are not in the data set. See the excel file "Nmfsspec.xls" for codes of other species.
gear: a character variable, the gear type, multiple gear types may be used in a single trip, L = longline, H = handline, E = electric reels, B = bouy gear, GN = gill net, P = diver using power head gear, S = diver using spear gun, T = trap, TR = trolling
area: area fished, in the south Atlantic these codes have four digits- the first two are degrees of latitude and the second two are the degrees of longitude
conversion: conversion factor for calculating total pounds (totlbs) from gutted weight
gutted: gutted weight of catch for a particular species, trip, gear, and area
whole: whole weight of catch for a particular species, trip, gear, and area
totlbs: a derived variable that sums the gutted (with conversion factor) and whole weights, this is the total weight in pounds of the catch for a particular species, trip, gear, and area
length: length of longline (in miles) or gill net (in yards)
mesh1 – mesh4: mesh size of traps or nets
numgear: the amount of a gear used, number of lines (handlines, electric reels), number of sets (longlines), number of divers, number of traps, number of gill nets
fished: hours fished on a trip, this is problematic for longline data as discussed later
effort: like numgear, the data contained in this field depends upon gear type; number of hooks/line for handlines, electric reels, and trolling; number of hooks per longline for longlines; number of traps pulled for traps; depth of the net for gill nets, this field is blank for divers
source: a character variable, this identifies the database that the record was extracted from, sg = snapper grouper, grf = gulf reef fish, all records should have this source code
tif_no: a character variable, trip identifier, not all records will have a tif_no
vesid: a character variable, a unique identifier for each vessel
started: numeric (mmddyy8) variable, date the trip started
landed: numeric (mmddyy8) variable, date the vessel returned to port
unload: numeric (mmddyy8) variable, date the catch was unloaded
received: numeric (mmddyy8) variable, date the logbook form was received from the fisherman

opened: numeric (mmddyy8) variable, date the logbook form was opened and given a schedule number
away: number of days at sea, this value should equal (landed-started+1)
crew: number of crew members, including the captain
dealer: character variable, identifier for the dealer who bought the catch, in some cases there may be multiple dealers for a trip
state: character variable, the state in which the catch was sold
county: character variable, the county in which the catch was sold
area1 – area3: areas fished, if the trip included catch from multiple areas, those areas will be listed here
trip_ticke: character variable, trip ticket number, a unique identifier for each trip not all trips have this identifier.

Appendix 2 Association statistic for determining species caught (by gear) in connection with a studied species.

To define "effective effort" in a changing fishery, we must choose trips that could have taken the studied species. We define those trips as those that take a species commonly caught in connection with the studied species. The following equation was used to determine species caught alongside the studied species.

$$Assoc.Stat. \quad \frac{N(s,x)/N(s)}{N(x)/N}$$

N(s) is the number of trips that caught the studied species; N(x) is the number of trips that caught species x; N(s,x) is the number of trips that caught the studied species and species x; N is the total number of trips. The statistic gives less weight to species that are more abundant in the overall catches, and more weight to species that tend to be caught in connection with the studied species. A potential problem with the statistic is that unreasonably high scores are given to species caught very infrequently, but alongside the studied species. Consequently, the group chose a minimum co-occurrence sample size of 100 (i.e., N(s,x)>100). Species were then ranked by association statistic to create a list of possible inclusions, and the group selected species from the list based on biological knowledge.