AN EVALUATION OF THE NATIONAL MARINE RECREATIONAL FISHERY STATISTICS SURVEY (MRFSS) ESTIMATES OF SAILFISH CATCH

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SUMMARY

Marine Recreational Fisheries Statistics Survey (MRFSS) landings data for sailfish (Istiophorus platypterus) for 1994 was evaluated. Survey estimation procedures were reviewed in conjunction with observed sailfish distribution within bi-monthly strata along the East Coast of Florida. The precision of MRFSS estimates for sailfish was compared with the precision of MRFSS estimates for other finfish species managed along the U.S. Atlantic Coast. The ratio of MRFSS estimates of 1994 sailfish released alive to kept and landed were compared to similar ratios obtained from the Recreational Billfish Survey (RBS) of tournament caught billfish. It is likely that the MRFSS estimation procedures for Florida's East Coast yield sailfish landings estimates which are biased and inaccurately high. The variance around MRFSS point estimates of sailfish landings is large, and greater than the typical variance of MRFSS landings estimates for other, more common, species managed along the U.S. Atlantic. A difference in behaviors between anglers fishing in, or outside of, tournaments does not seem to exist and would not account for the unexpectedly high MRFSS estimates of sailfish catch. It is recommended that alternative survey sources or analytical techniques be used to estimate the sailfish landings data supplied by the U.S. to ICCAT.

RÉSUMÉ

Les données pour 1994 des débarquements de voilier (Istiophorus platypterus) du Marine Recreational Fisheries Statistics Survey (MRFSS) ont été évaluées. Les processus d'évaluation des prospections ont été examinés conjointement avec la répartion de voilier observée dans des strates bi-mensuelles le long de la Côte Est de Floride. On a comparé le degré de précision des estimations du MRFSS sur le voilier et celui de ses estimations portant sur d'autres espèces gérées le long de la côte atlantique des Etats-Unis. La proportion, issue des estimations du MRFSS, de voiliers remis à l'eau vivants en 1994 par rapport à ceux conservés et débarqués a été comparée aux proportions similaires d'istiophoridés pris lors de championnats, provenant du Recreational Billfish Survey (RBS). Il est probable que les processus utilisés par le MRFSS pour l'estimation des débarquements de voilier fournissent des estimations biaisées et faussement élevées. La variation autour des points estimés du MRFSS quant aux débarquements de voilier est importante et plus grande que la variation habituelle qui existe pour d'autres espèces plus communes gérées le long de la côte atlantique des Etats-Unis. Il ne semble pas exister de différences de comportement entre les pêcheurs à la ligne pêchant lors de championnats ou indépendamment ; qui plus est, une telle différence n'expliquerait pas les fortes estimations inattendues des captures de voilier. Il est recommandé d'utiliser des sources de prospection ou des techniques analytiques alternatives pour évaluer les données de débarquement d'espadon transmises par les Etats-Unis à l'ICCAT.

RESUMEN

Se evaluaron los datos de desembarques de Marine Recreational Fisheries Statistics Survey (MRFSS) de pez vela (Istiophorus platypterus) para 1994. Se examinaron los procedimientos de estimación de los estudios en conjunción con la distribución observada de pez vela en los estratos bimensuales a lo largo de la costa este de Florida. Se comparó la precisión de las estimaciones de MRFSS para pez vela con la precisión de las estimaciones de MRFSS para otras especies con aletas que se gestionan a lo largo de la costa atlántica de Estados Unidos. El ratio de las estimaciones de MRFSS de pez vela liberados vivos en 1994, frente a los que se

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conservan y descargan, se comparó con ratios similares obtenidos de Recreational Billfish Survey (RBS) de concursos de captura de marlines. Es probable que los procedimientos de estimación de MRFSS para la costa este de Florida produzcan estimaciones de desembarques sesgados de pez vela y que sean impropiamente altos. La varianza en torno a las estimaciones puntuales de MRFSS de los desembarques de pez vela es amplia, y superior a las típicas varianzas de las estimaciones de desembarques de MRFSS para otras especies, más comunes, gestionadas a lo largo del Atlántico en Estados Unidos. No parece existir una diferencia entre los comportamientos de los pescadores durante o fuera de los concursos, y no se justifican las estimaciones inesperadamente altas de MRFSS respecto a la captura de pez vela. Se recomienda utilizar fuentes alternativas de estudio o técnicas analíticas para estimar los datos de desembarques de pez vela aportados por Estados Unidos a ICCAT.

1. INTRODUCTION

United States sailfish landings reported to ICCAT in 1995 were, for the first time, partially based on catch estimates generated from the Marine Recreational Fisheries Statistics Survey (MRFSS). The 1994 catch estimate (121 MT) was an order of magnitude higher than annual landings reported since 1988 (Figure 1), the first effective year of the U.S. Fishery Management Plan for Atlantic Billfish (U.S. Federal Register, 1988). The plan reserves Atlantic billfish almost exclusively for the recreational fishery, and for the most part eliminates the sale of this stock of billfish in the U.S. The use of the 1994 MRFSS data was an attempt to supplement previous catch estimate data which was known to be incomplete[3]. However, the reported increase in estimated landings seemed to conflict with previous conclusions that 80% to 90% of the recreational rod and reel catch is released.

The use of the MRFSS estimate was called into question during a September 1995 workshop (Graves *et al.*, 1995) where participants concluded "the MRFSS data may not be appropriate to provide accurate or precise estimates of catch and effort for 'rare event' species, such as billfish". Prior to 1995, billfish landings estimates from the recreational sector of the U.S. fishery were obtained from three different sources which cover varying, but overlapping geographic areas.

The Large Pelagics Survey (LPS) (Maine - North Carolina) is a survey vehicle designed to target the recreational catch of large, highly migratory species which are encountered infrequently, or in pulse events, by anglers. The Recreational Billfish Survey (RBS) (South Carolina - Texas) samples the catch and landings of billfish tournaments. The Billfish Landings Survey (BLS) (Florida) is a voluntary reporting of billfish landings by marina operators. All four surveys are coordinated by the NMFS, and a more detailed discussion of their methodology is given later in this paper. Although there are difficulties involved with assembling catch estimates from these four sources throughout the U.S. Atlantic and Gulf coasts, there is a general consensus that Florida billfish estimates are associated with the highest level of uncertainty, particularly for sailfish (Graves *et al.*, 1995).

Although the MRFSS estimates appear to many observers to be unrealistically high, they may reflect a tendency for non-tournament anglers in Florida to retain a greater proportion of their catch than do those anglers fishing in tournaments sampled by the RBS. Alternatively, the MRFSS sampling strategy may tend to produce inaccurate catch estimates of sailfish and other rare event species. This report attempts to examine the MRFSS sampling strategy, and resulting estimates, to evaluate the accuracy and precision of catch estimates for sailfish.

2. METHODS

To examine the performance of the MRFSS in estimating sailfish landings, we focused on three elements:

1) reviewing the effort estimating methodology, as it relates to the observed seasonal distribution of sailfish along the Florida East Coast, to determine if bias in the procedures may be affecting the accuracy of the estimates;

2) comparing the precision of MRFSS sailfish landings estimates with that of estimates used in assessments of other species managed along the U.S. East Coast; and

3) comparing the ratio of MRFSS estimates of caught to released sailfish with estimates derived from the RBS in an attempt to see if the practices or behaviors of anglers sampled by the MRFSS survey differ significantly from angling behaviors observed in the tournament samples (RBS).

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[3] Pers. comm. Joseph E. Powers. NMFS, Southeast Fisheries Science Center, Miami, FL 33149.

Data for 1994 was examined in detail. The cumulative record of the MRFSS sailfish dockside intercepts was also analyzed to develop the most accurate description of seasonal and areal sailfish distribution in the rod and reel harvest. The emphasis on Florida is justified by the preponderance of catch in the southern U.S., particularly along the Florida coast, and the unique geographic and zoogeographic features of Florida's lengthy coastline.

The following questions were posed:

1) Does the MRFSS assume a random distribution in time and space within all sampling strata of a particular state? Are sailfish randomly distributed in time and space along the Florida East Coast within all sampling strata?

2) Are coefficients of variation (CV) associated with MRFSS estimates similar to CV values of estimates used in assessment of other fish species managed along the U.S. Atlantic Coast?

3) Is the MRFSS ratio of kept and released sailfish significantly different than the ratio from the RBS?

Complete documentation of the methodology used in the MRFSS is published by the National Marine Recreational Fishery Statistics Survey Office[4]. An outline of the overall survey with particular emphasis on the calculation of 1994 sailfish estimates is given by Farber (1997). The MRFSS is essentially composed of a telephone survey of coastal residents, which is used to estimate total per capita saltwater fishing effort (trips), and a dockside intercept survey which is used to gather estimates of the percentage contribution of species to the total catch per trip. Effort estimates obtained from the telephone survey are used to expand observed landings to an estimate of total catch. The dockside survey also collects basic bioprofile data on the species examined. Mean species weights by strata thus obtained are used to transform estimates from total fish number to total fish weight. The MRFSS does not attempt to sample tournaments.

It should be noted that the MRFSS uses a modification of this technique to estimate charter boat effort[5]. Consideration of the effect of charter effort estimation on 1994 sailfish landings estimates is outside the scope of this exercise. Given the large contribution of charter MODE intercepts to the 1994 landings estimates (Table 2), we would recommend that a detailed examination of potential clustering effects on charter effort estimation also be conducted[6].

The LPS statistical methodology is somewhat similar to that of the MRFSS, although it additionally includes a mark-recapture component used to estimate fleet size. The LPS was developed for the express purpose of estimating the recreational catch of the large pelagic species fishery which is irregularly dispersed over a wide area where encounters with the target species are infrequent to rare. A detailed description of the statistical sampling and estimation procedures of the LPS, along with a critical review of the statistical methodology used in estimating catch, is presented in a 1996 document prepared by the NMFS[7].

The RBS and the BLS attempt to respectively sample tournament and non-tournament billfish landings through

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4 NOAA, Office of Research and Environmental Information, Fishing Statistics Division, 1315 East-West Highway, Room 12361, Silver Springs, MD.

5 Gray, G. et al. 1995. A Guide to the Use of the National Marine Recreational Fisheries Statistics Survey Database. ASMFC. 1776 Massachusetts Ave., N.W. Suite 600. Washington, D.C. 20036.

6 The low, but clustered, incidence of telephone reported charter fishing activity "frequently results in either an effort estimate greater than the maximum number of fishing trips possible for a state's fleet, or an estimate of zero fishing effort" (Gray et al., 1995). In order to smooth the effects of small sample size on effort estimates the MRFSS uses running five year averages to generate charter effort estimates within strata. Given that most charter customers are tourists from non-coastal states, the estimation procedure can lead to "unrealistically high estimates of fishing effort attributable to non-coastal or out-of-state anglers. This is common to the charter boat fishery in the South Atlantic and Gulf of Mexico subregions where there is a clustering effect of sampling all anglers on a boat who have similar demographic characteristics" (Gray et al., 1995). Given this potential additional source of bias in effort estimation, it would seem wise to closely examine the individual charter intercepts which generate expanded sailfish catch estimates. Adjustments to the expansion ratios might be warranted.

7 A Review of the Statistical Basis for Estimating Catch from the Large Pelagics Survey. 1996. NMFS. Office of the Senior Scientist. 1315 East West Highway, Silver Springs, MD.

a variety of volunteer, NMFS observer, and state observer data collection programs[8]. Ostensibly, the data collected should not overlap, since the RBS targets tournaments and the BLS attempts a volunteer reporting of sailfish landed at marinas outside of tournament events. Both surveys are expected to provide minimum landings estimates, and there are no estimates of variance associated with catch data from these two surveys.

3. RESULTS

3.1 MRFSS 1994 Sailfish Catch Estimates

The MRFSS intercept and telephone sampling efforts are stratified across time in bi-monthly WAVES (Jan/Feb, Mar/April, ... Nov/Dec), and geographically by STATE (Florida's East Coast is considered a single "state"). Additionally, information on MODE of fishing (charter vessel, private/rental vessel, shore) and AREA fished (inland, ocean < 3 miles offshore, ocean > 3 miles offshore) is collected for each trip. The AREA variable is not collected during phone interviews, and is not included as a variable in sample allocation stratification. As indicated in Table 1, AREA is used to post-stratify effort estimates. The catch from each intercepted trip is classified into three categories: TYPE A if landed and available for examination, TYPE B1 if landed and not examined, landed filleted, used as bait, or discarded dead, and TYPE B2 if released alive.

The within WAVE and STATE data from telephone and intercept surveys is combined to estimate total catch as follows:

Telephone data		Intercept data		Results
Number of trips by mode and area	X	Mean catch per trip by species, mode, and area	=	Number of each species caught by mode and area

Catch in weight is calculated from catch in numbers data by using the observed mean weights taken within each WAVE/STATE strata.

A detailed presentation of the effort expansion procedure is presented in Table 1 (1994 Florida East Coast, WAVE 1 telephone survey data). Sailfish landings estimation procedures are detailed in Table 2 (1994 Florida East Coast intercepts, WAVES 1 - 6)[9] Of particular importance here is to note that the baseline coastal population from which effort is calculated is composed of the U.S. Census estimates of the total number of households on Florida's East Coast (3,120,200, Table 1)[10].

If all anglers within the households in this pool of potential effort had access to sailfish during each WAVE of catch estimation, the total harvest estimates may be defensible. However, if sailfish were not equally available to all who might choose to fish, the estimates could contain a component of bias which would tend to overestimate fishing effort applicable to sailfish. Any overestimation of effort would also generate artificially high estimates of catch and landings.

All 13 sailfish which were sampled on Florida's East Coast by MRFSS intercepts during 1994 were caught in southeast Florida between Martin and Dade Counties (Figure 3). The total number of sailfish intercepts, by WAVE, over the period of 1981 - 1993, are plotted by county of catch in Figures 3 through 8. Again, 97% of all East Coast (217 of 224) sailfish observed since 1981 were caught in southeast Florida between Dade and St. Lucie Counties. The 7 fish observed north of this area were taken in the warmer months of March through October. The data clearly indicate that

[8] Pers. comm. Mark I. Farber. NMFS, Miami Laboratory, Miami, FL 33149

[9] Detailed explanations of these tables are found in Farber 1998 (This volume).

[10] Data set: 90CEN.SSD. Available from: NOAA, Office of Research and Environmental Information, Fishing Statistics Division, 1315 East West Highway, Room 12361, Silver Springs, MD.

sailfish are not randomly distributed, or equally available to all anglers, along the extent of Florida's East Coast.

Expansion estimates for the Florida East Coast sailfish catch in 1994 were based on a total of 3,120,200 coastal households. The total households available as potential sources of fishing effort in St. Lucie through Dade Counties (southeast Florida) is 1,787,300[11], only 57% of the total effort pool associated with the sailfish catch calculations. It is also probable that the demographic characteristics in southeast Florida which determine mean fishing trips per household, and the MODE and AREA distribution of these trips within WAVES, also differs from those of the total sample. The use of the entire coastal household pool for estimating available fishing effort for sailfish would appear likely to cause an overestimation of effort, and thus catch.

It is interesting to note that most intercepted sailfish were encountered on charter vessels. If the distribution of intercept effort is disproportionately weighted to high activity sites (i.e. marinas which support charter fishing operations), another potential source of catch over-estimation is introduced.

3.2 Precision of MRFSS Estimates

The confidence intervals around Atlantic Coast MRFSS sailfish catch estimates are fairly wide (Figure 9), with coefficients of variation (CV) ranging from 0.23 to 0.62 between 1983 and 1994. In 4 of the 12 years for which estimates are given, the lower 95% confidence interval approaches 0. Additionally, if base fishing effort for sailfish is overestimated, these relatively large CV values are actually artificially low due to an overestimate of the sample size (N).

Best and worst case examples of precision for Atlantic coast sub-region (i.e. North Atlantic, Mid Atlantic, South Atlantic) estimates of catch are presented by Gray, *et al.* [12]. Best case precision estimates for commonly caught species (bluefish, summer flounder, winter flounder, weakfish, striped bass) managed in the U.S. Atlantic have percent standard errors (PSE)[13] ranging from 5% to 11% within each sub-region. Worst case precision examples within sub-regions are associated with PSE ranging from 22% to 54%, and are associated with species or species groups such as eels, sculpins, mullet, cod/hakes, puffers and wrasses. For most commonly caught sport fish these values are below 20%, and in many cases are below 10%[14].

A comparison of the 1994 Florida East Coast MRFSS estimates of catch in numbers for sailfish and red drum (*Sciaenops ocellatus*) provides another perspective. Red drum is a commonly encountered inshore sciaenid which is distributed along the entire range of the Florida East Coast. An estuarine and nearshore fish which is perhaps the primary target of Florida inshore anglers, it is easily accessible to anglers from shore, bridges, piers, and vessels. In 1994 the estimated Florida East Coast catch (Types A and B1) was 120,942 with a PSE of 9.6%.[15] This in contrast to the catch estimate of 8,365 sailfish (Table 2) from the same area and year. The CV for the sailfish estimate was 0.43.

The precision of MRFSS sailfish catch estimates appears low relative to the precision of estimated catch for other, more common, species.

3.3 MRFSS and RBS Estimates of Catch Kept/Released

The RBS samples billfish tournaments exclusively. The MRFSS does not sample tournaments, and is presumed to be sampling a general cross-section of all anglers in the U.S. Data from the RBS for 1994 show that tournament anglers kept 11% of all billfish caught, and released, or tagged and released, 89% (Figure 10). Sailfish intercept observations conducted by the MRFSS in 1994 indicate that 18% of sailfish taken were kept or released dead, and 82% were released alive (Figure 11).

The data do not appear to indicate that there is a significant difference in the behavior of anglers sampled by the different surveys. MRFSS release estimates are consistent with previous reports, and sailfish catch estimates would not

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[11] Data set: 90CEN.SSD.

[12] Gray, G., et al. 1995. A Guide To The Use of the National Marine Recreational Fisheries Statistics Survey Database. Atlantic States Marine Fisheries Commission.

[13] PSE present CV values as percentages.

[14] Gray, G., et al. 1995.

[15] Pers. comm. Robert Muller. Florida Marine Research Institute, 100 8th Ave. S.E., St. Petersburg, FL 33701-5095.

appear to be influenced by sampled anglers retaining a higher proportion of fish than do anglers sampled by the RBS in tournaments.

4. CONCLUSIONS

The data examined in this exercise seem to indicate that the MRFSS sailfish catch estimates are of questionable utility for assessment or management purposes. There are indications that there is a methodological bias built into the MRFSS which tends to overestimate rare-event species with non-random distributions within time/area strata. If the distribution of intercept sampling effort is weighted towards high activity centers (i.e. major marinas serving professional charter operations) the potential for catch over-estimation is increased.

The variance around the point estimates is fairly large for assessment purposes. It is particularly difficult to reconcile the fact that the 1994 MRFSS estimates of catch would indicate that Florida East Coast Anglers landed roughly one sailfish for every 14 redfish caught and kept. Anyone with research experience in, and long-term familiarity with, Florida fisheries would find this ratio highly questionable.[16] We believe this apparent discrepancy, in and of itself, raises serious questions about the validity of the 1994 MRFSS sailfish catch estimate.

The problems associated with the MRFSS are particularly evident in Florida. The Florida coastline extends for over 6 degrees of latitude and includes areas with considerably different physical oceanographic features (Figure 12). The southeast portion of the coast below St. Lucie County has an extremely narrow shelf and nearshore waters are influenced considerably by the proximity of the Gulf Stream. The northern portion of Florida's coastline has a wide shelf and the Gulf Stream is well offshore. Climatological and zoogeographic changes in marine faunal distribution are widely recognized to be associated with these differences. The South Atlantic Fishery Management Council recognizes, and takes into account when developing regulations, distinct differences in target species and operational characteristics of fisheries North and South of Port St. Lucie, Florida. [17] Sailfish are simply not as available to anglers in the northern portion of the range as they are in southeast Florida.

Clearly, no single current survey vehicle is adequate for providing acceptable estimates of U.S. recreational sailfish catch. There are presently four estimates of U.S. Atlantic sailfish catch for 1994 (Farber, 1997) the MRFSS - 8,365 fish (circa 114 MT), the BLS - 328 fish (circa 6 MT); RBS - 17 fish (circa 0.3 MT), and an estimate taken from a survey of taxidermists - 1277 fish (circa 29 MT). An effort should be made to further reconcile these data and to attempt to recalculate previous estimates of U.S. recreational rod and reel catch from 1983 through the current year.

There are several possible means for improving the estimates of recreational rod and reel catch of billfish and other large, migratory pelagic species. The directed LPS could be extended throughout the Atlantic and Gulf of Mexico. The State of Florida licenses all anglers, as well as charter boat operators, and has the capacity to generate random sub-samples of these licensees. A survey of Florida license holders might prove to be a useful tool for estimating at least the majority of the U.S. sailfish harvest. It might also be possible to use such survey results to attempt to recalibrate results derived from other current sources.

We strongly advise that the MRFSS data not be used, in any event, without attempting to address the problems raised in this paper. Ultimately, the utility of MRFSS data could be improved by re-stratifying the sampling protocols to more accurately reflect the geographic and zoogeographic differences encountered along Florida's East Coast. Such an approach, along with significant increases in the number of intercepts, might improve the accuracy and true precision of the estimates for sailfish, as well as other species with similar distributions. This approach would not only improve the information available for sailfish and other billfishes, but it would provide significant improvements in the data collected for all finfish.

Without significant improvement in the MRFSS stratification protocol and sample size, it may still be possible to use currently available data to produce improved estimates of sailfish catch. It would be possible to post-stratify the Florida data to more accurately define the total potential effort pool which actually has access to sailfish. Techniques for

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[16] Pers. comm. Roy Williams. Florida Marine Fisheries Commission, 2540 Executive Center Circle West, Tallahassee, FL 32301.

[17] Brainerd, T. June 1996. Amendment 8 Options Paper. South Atlantic Fisheries Management Council. 1 Southpark Circle, Suite 306, Charleston, S.C. 29407-4699.

attempting this are given in Gray *et al.*[18] This approach might improve the accuracy of estimates, although it is probable that the actual estimated precision would show increases in the variance around point estimates. Certainly, given the importance of charter MODE intercepts to the overall expanded catch estimates, an attempt should be made to closely examine the charter intercepts in order to attempt to resolve potential problems previously discussed.

Finally, an alternative approach might be to utilize the total historic sailfish intercept data set found within the MRFSS 1983 - 1995 archive. Addressing only intercepts which did observe successful sailfish trips, discriminant function techniques could be used to attempt to more distinctly define the combinations of WAVE/MODE/AREA strata across East Coast county combinations where sailfish actually have been encountered. If appropriate strata combinations were identified, it should be possible to construct a probability distribution to use in assigning proportional effort to these newly identified combinations. Bootstrapping techniques could then be utilized to develop stochastic estimates of actual catch. This approach might allow for a re-estimation of the 1983 - 1995 U.S. catch.

5. LITERATURE CITED

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U.S. FEDERAL REGISTER, Vol. 33. No. 188, September 28, 1988, pg. 37765 - 37771.

[18] Gray, G., et al. 1995.

Table 1. Effort Estimates from the 1994 Marine Recreational Fishery Statistics Survey (MRFSS) : Telephone Survey
Example presented here is for Florida East Coast, Wave 1 (January/February)

Ob	Md	Tot_hsld	#_fish_ hshlds	#_non_ fish_hshlds	Hshl_ mean	Est_trips_ cstl[1]	Cstl_rsdnt_ intrcpt	Non_cstl_ rsdnt_intrcpt	Out_of_st_ rsdnt_intrcpt	Exp_fact_ non_cstl	Exp_fact_ out_of_st	Est_trips_ non_cstl	Est_trips_ out_of_st	Est_num_ trips_mode[2]
1	3	3,120,200	716	7,745	0.1853	618,314.4	902	0	376	0	0.4169	0	257,745.2	876,059.6
2	5	3,120,200	716	7,745	0.0080	25,087.7	127	0	307	0	2.4173	0	60,645.1	85,732.8
3	7	3,120,200	716	7,745	0.1836	572,880.3	1,185	0	113	0	0.0954	0	54,629.1	627,509.4

Ob: Observation number
Md: Mode of fishing: 3 = shore; 5 = charter; 7 = private/rental
Tot_hsld: Total number of households
#_fish_hshlds: Number of 2-month fishing households contacted
#_non_fish_hshlds: Number of 2-month non-fishing households contacted
Hshl_mean: Mean number of fishing trips reported
Est_trips_cstl: Estimated number of trips by coastal residents = Tot_hsld * Hshl_mean
Cstl_rsdnt_intrcpt: Number of coastal county residents interviewed from intercept survey
Non_cstl_rsdnt_intrcpt: Number of noncoastal county residents interviewed from intercept survey
Out_of_st_rsdnt_intrcpt: Number of out of state residents interviewed from intercept survey
Exp_fact_non_cstl: Expansion factor for noncoastal residents = Non_cstl_rsdnt_intrcpt / Cstl_rsdnt_intrcpt
Exp_fact_out_of_st: Expansion factor for out of state residents = Out_of_st_rsdnt_intrcpt / Cstl_rsdnt_intrcpt
Est_trips_non_cstl: Estimated number of trips by noncoastal residents = Est_trips_cstl * Exp_fact_non_cstl
Est_trips_out_of_st: Estimated number of trips by out of state residents = Est_trips_cstl * Exp_fact_out_of_st
Est_num_trips_mode: Estimated number of trips (state/mode/wave) = Est_trips_cstl + Est_trips_non_cstl + Est_trips_out_of_st

[1] Note that observation 1 required an adjustment due to proportion of households (from intercept survey) without telephones was higher than expected based on U.S. census numbers.

[2] This is the estimated effort (number of trips) from the telephone survey that is used with the intercept survey to derive the estimated total landings = A (fish caught, landed whole, and available for identification) + B1 (fish caught and filleted, released dead, given away, or disposed of). See Table 2.

Table 2. Estimates of Sailfish Catch (A+B1) from the 1994 Marine Recreational Fishery Statistics Survey (MRFSS): Intercept Survey.

Ob	Wav	Md	Area	A	Ct	B1	Ct	Intrv_ area	Tot_ intrv	Percent	Est_num_ trips_mode	Est_num_ trips_area	Fish/trip	navl_hrvst fish/trip	A expanded = Est_fish_ claimed	B1 expanded = Est_fish_ hrvst	Est_tot_ landings (# fish)
2	1	5	2	1	P	2	D	74	102	0.7255	*85,732.8*	62,198.3	0.01351	0.02703	840.52	1,681.04	2,521.6
4	1	7	2	0	-	1	B	189	1,298	0.1456	627,509.4	91,370.8	-	0.00529	-	483.44	483.4
7	2	5	2	1	P	0	-	85	123	0.6911	85,188.7	58,870.2	0.01176	-	692.59	-	692.6
13	3	5	2	1	P	0	-	111	127	0.8740	76,000.4	66,425.5	0.00901	-	598.43	-	598.4
15	3	7	2	0	-	1	M	555	1,303	0.4259	989,926.1	421,649.2	-	0.00180	-	759.73	759.7
20	4	5	1	2	B	0	-	32	136	0.2353	64,459.9	15,167.0	0.06250	-	947.94	-	947.9
25	5	5	2	1	D	0	-	35	75	0.4667	69,456.7	32,413.1	0.02857	-	926.09	-	926.1
30	6	5	2	3	*	0	-	58	98	0.5918	46,875.3	27,742.5	0.05172	-	1,434.96	-	1,435.0
Tot. Fla. East Coast				*9*		*4*						775,836.8			5,440.52	2,924.21	*8,364.7*
12	2	7	4	1	PN	0	-	158	1,430	0.1105	1,205,911.8	133,240.6	0.00633	-	843.29	-	843.3
34	6	5	4	1	MR	0	-	93	218	0.4266	82,045.1	35,000.9	0.01075	-	376.35	-	376.4
Tot. FL Gulf of Mex.				*2*		*0*						168,241.5			1,219.65	-	*1,219.6*
Grand Totals				*11*		*4*						944,078.3			6,660.17	2,924.21	*9,584.4*

Ob: Observation number

Wav: Wave represents a two-month interval: 1 = January/February; 2 = March/April; etc.

Md: Mode of fishing: 5 = charter; 7 = private/rental

Area: For the Florida East Coast: 1 = ocean <= 3 mi, 2 = ocean > 3 mi; for West Florida (Gulf of Mexico including the Keys) - 4 = ocean > 10 mi

A: Represents number of fish that were caught, landed whole, and were available for identification and enumeration by interviewers

Ct: County from which fish reportedly caught: B=Broward; D=Dade; MR=Monroe; M=Martin; P=Palm Beach; PN=Pinellas; *=Broward/Dade/Palm Beach

B1: Represents number of fish caught and filleted, released dead, given away, or disposed of

Intrv_area: Number of intercept interviews conducted in this state/wave/mode/area

Tot_intrv: Total number of intercept interviews conducted in this state/wave/mode

Percent: Percent of all intercept interviews given that occurred in this state/wave/mode/area = Intrv_area/Tot_intrv

Est_num_trips_mode: Estimated number of trips (state/wave/mode) derived from the telephone survey

Est_num_trips_area: Estimated number of trips in area = Percent * Est_num_trips_mode

Fish/trip: Claimed number of fish/trip = A / Intrv_area

Unavl_hrvst_fish/trip: Unavailable harvested fish/trip = B1 / Intrv_area

Est_fish_claimed: Estimated fish claimed = Est_num_trips_area * Fish/trip

Est_fish_hrvst: Estimated fish harvested = Est_num_trips_area * Unavl_hrvst_fish/trip

Est_tot_landings: Extrapoled estimated total landings of A+B1 fish = Est_fish_claimed + Est_fish_hrvst

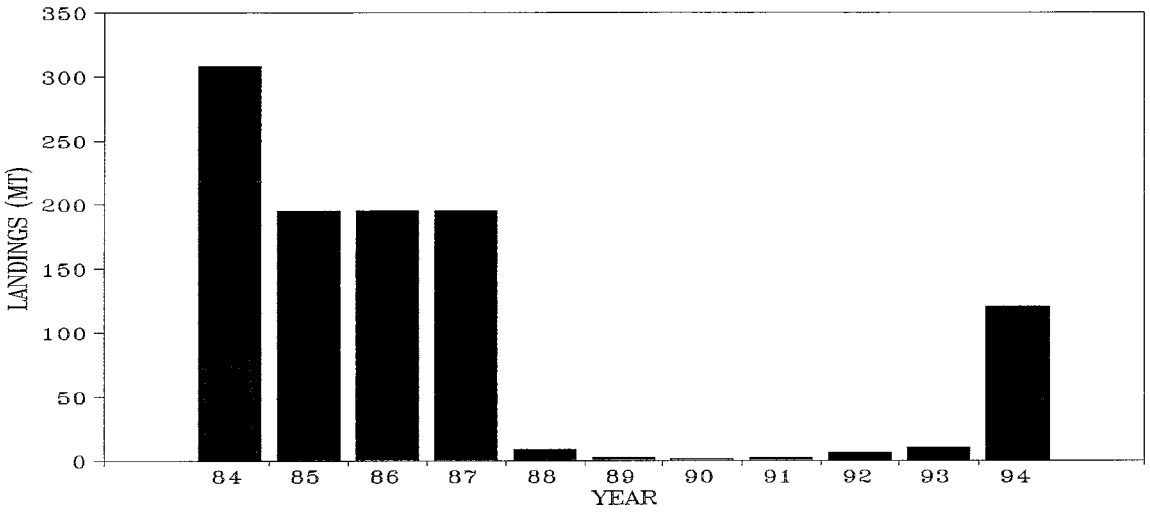

Fig 1. U.S. reported sailfish landings in metric tons by Rod & Reel, 1984-1994

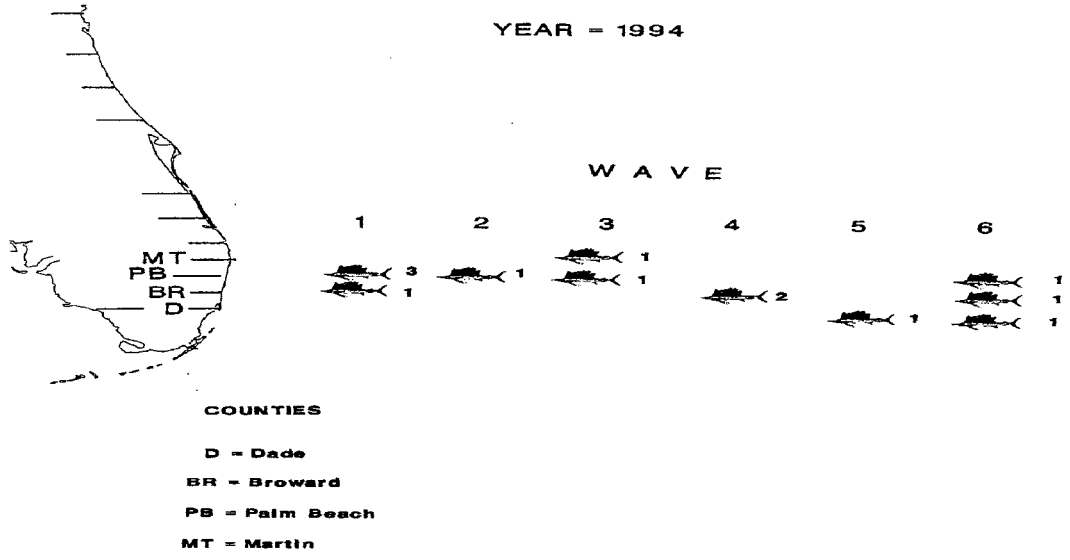

Figure 2. Distribution of the 13 sailfish recorded by the MRFSS in 1994 from the Florida East Coast. Wave 1 corresponds to January-February, etc.

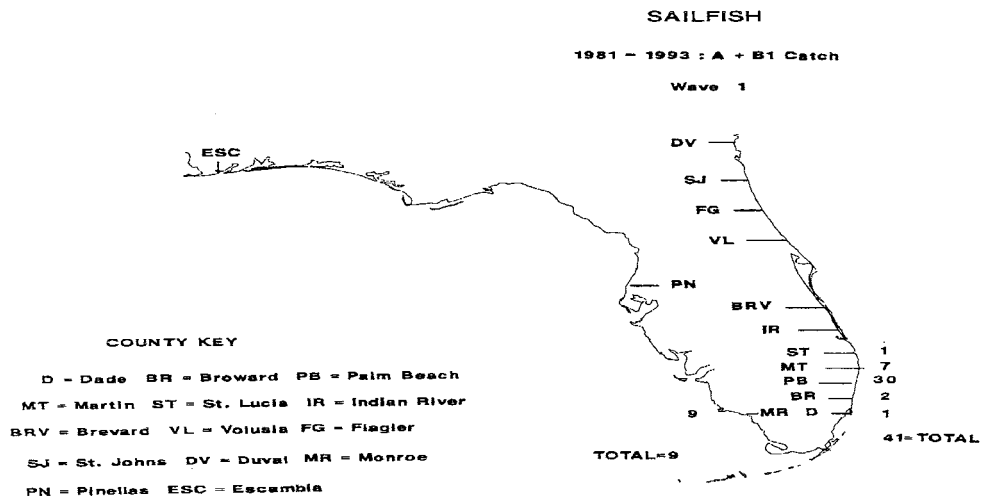

Figure 3. Historic Florida sailfish catch distribution: Jan/Feb.

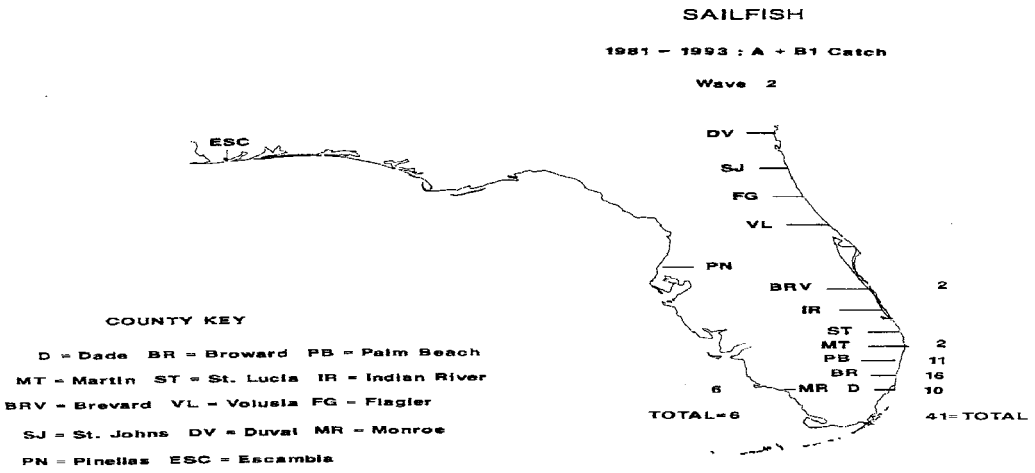

Figure 4. Historic Florida sailfish catch distribution: Mar/Apr.

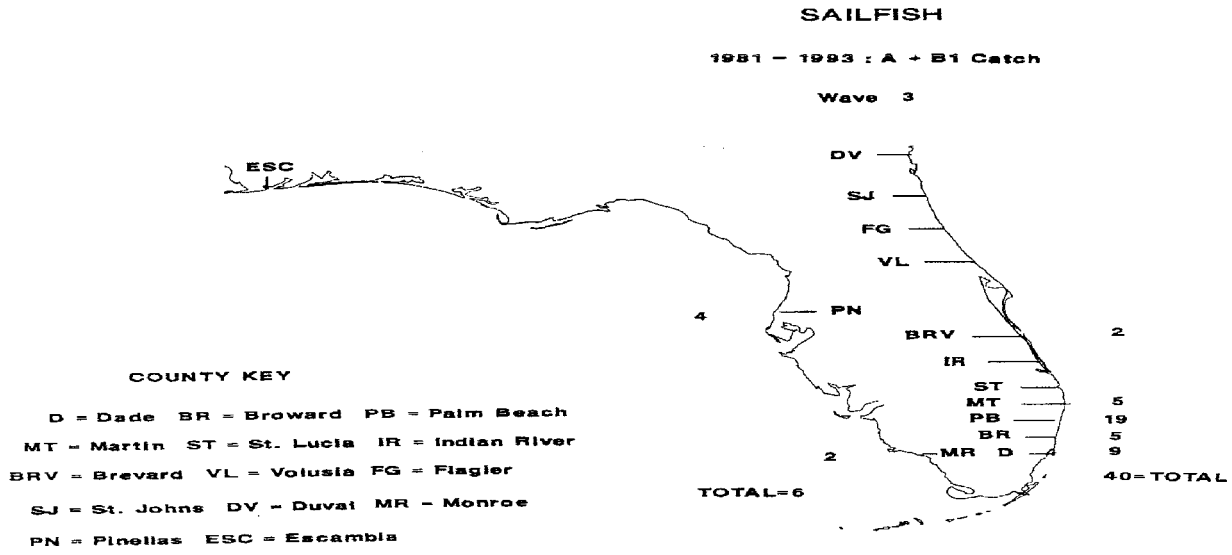

Figure 5. Historic Florida sailfish catch distribution: May/June.

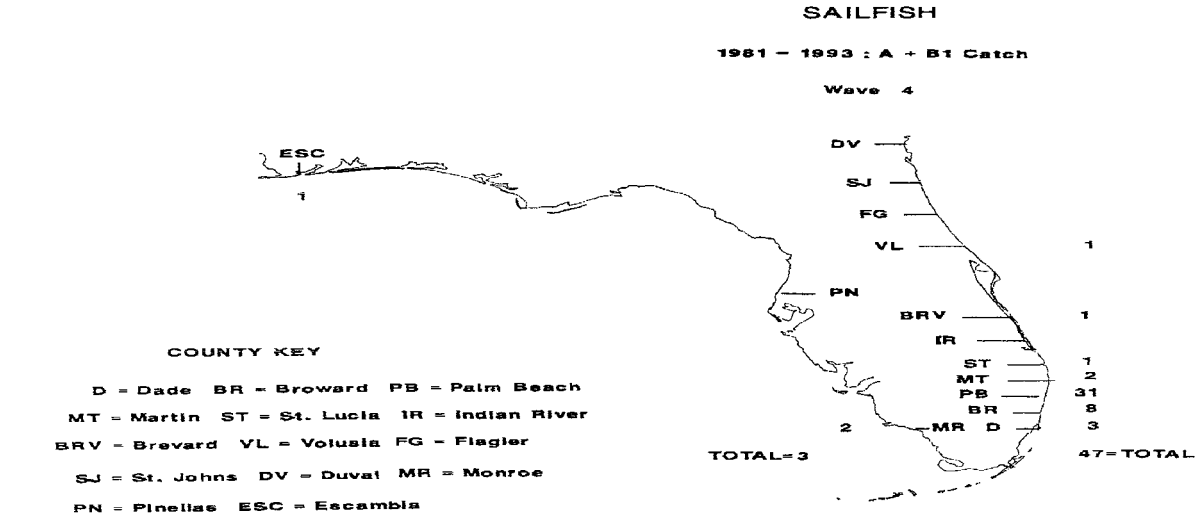

Figure 6. Historic Florida sailfish catch distribution: July/Aug.

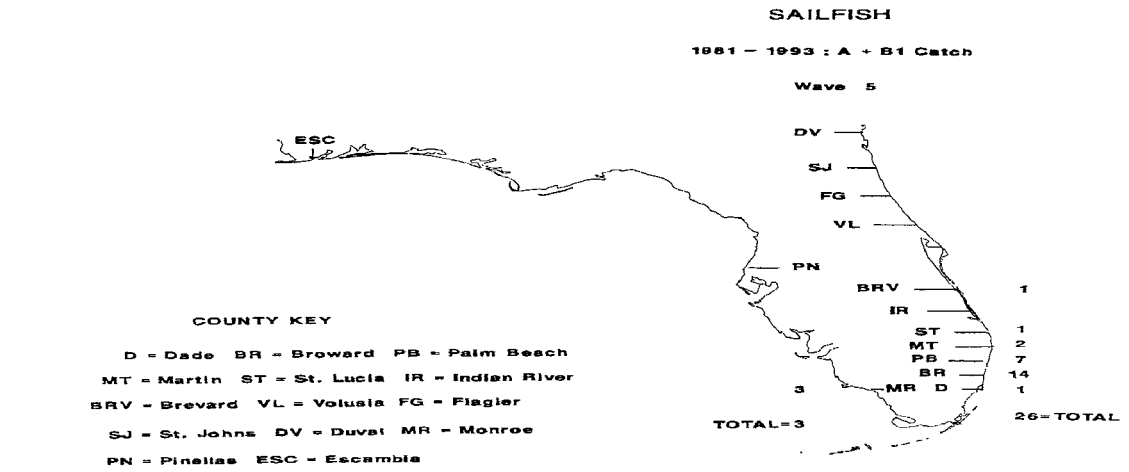

Figure 7. Historic Florida sailfish catch distribution: Sept/Oct.

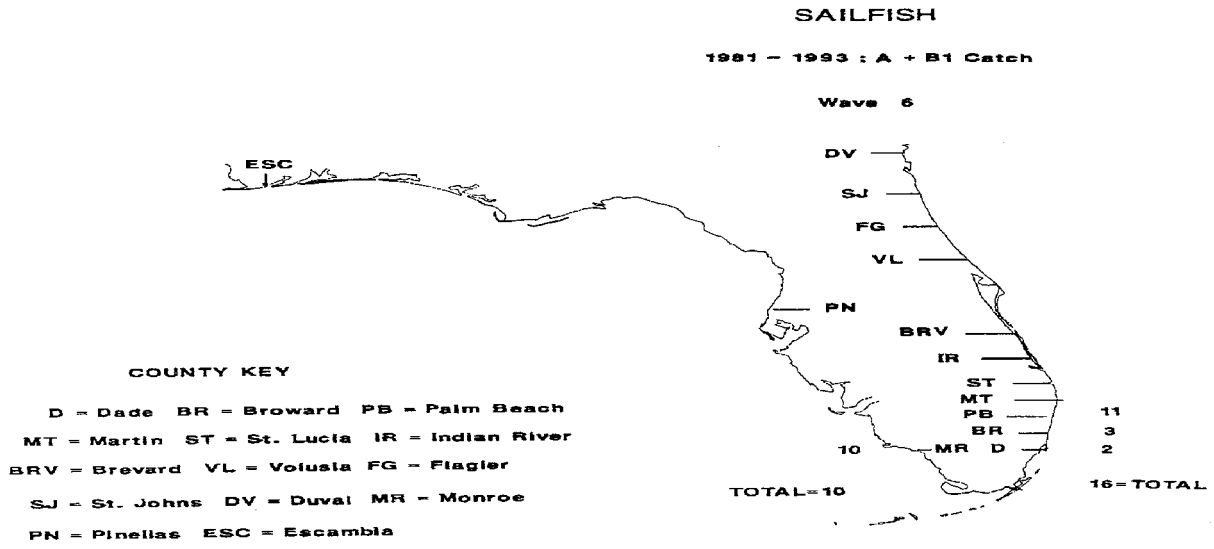

Figure 8. Historic Florida sailfish catch distribution: Nov/Dec.

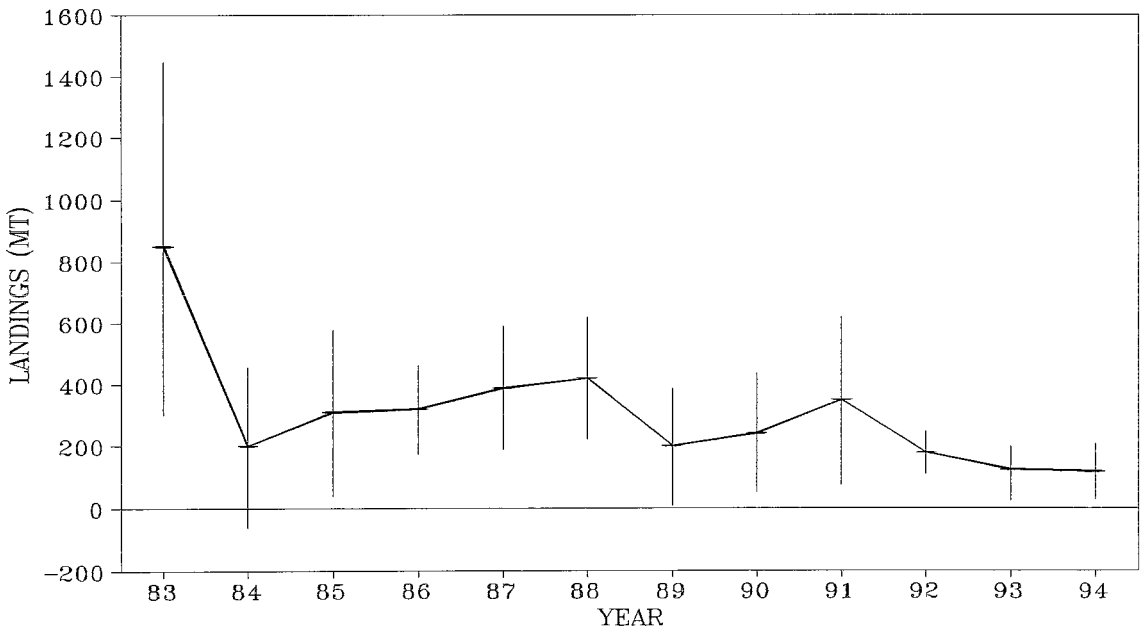

Figure 9. MRFSS sailfish landings (landed + released dead) with 95% confidence intervals: 1983-1994 - North Carolina through Florida.

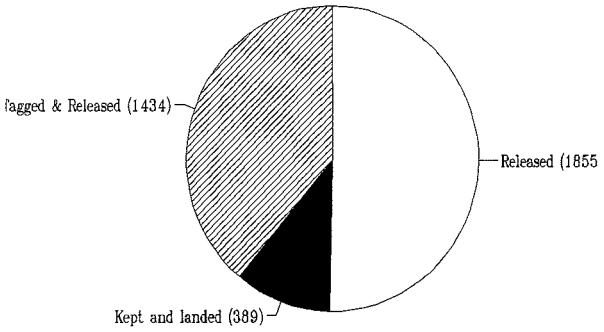

Figure 10. Recreational tournament billfish disposition, 1994: U.S., Bahamas, and Caribbean - Blue Marlin, White Marlin , and Sailfish (Source: 1995 US National Report to ICCAT).

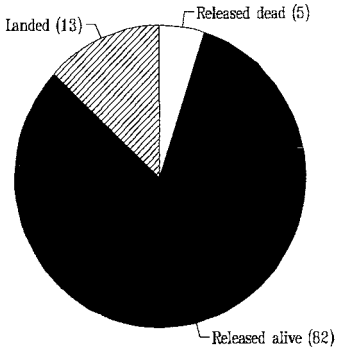

Figure 11. 1994 MRFSS sailfish disposition (percentatge of landed, released dead and released alive fish..

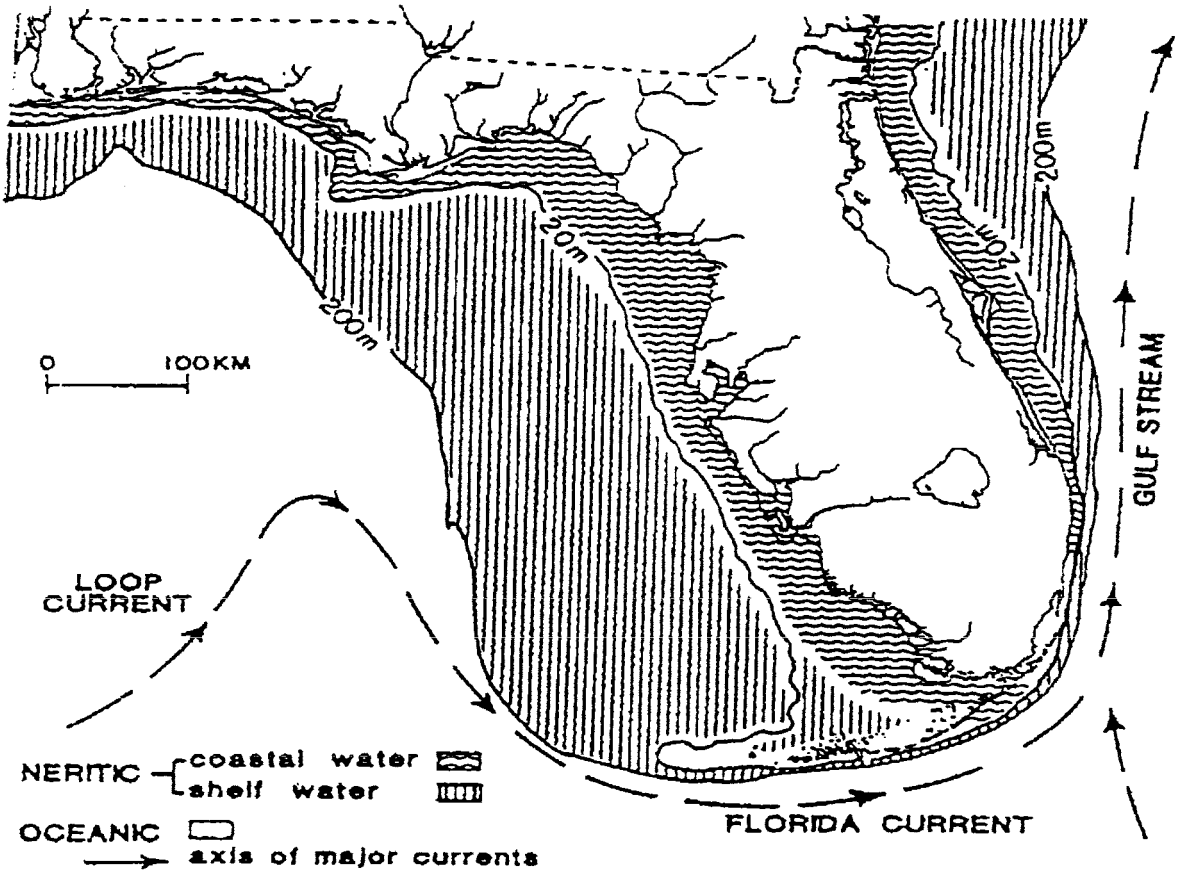

Figure 12. Florida oceanographic features.