

**ESTIMATES OF THE CATCH OF UNDERSIZED SWORDFISH BY THE U.S. LARGE PELAGIC FLEET
BASED ON LOGBOOK REPORTS AND SCIENTIFIC OBSERVATIONS**

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SUMMARY

Implementation of ICCAT recommended minimum size for swordfish has resulted in a cryptic mortality of swordfish smaller than the ICCAT minimum size of 25 kg. In order to allow estimation of the degree of cryptic mortality, the U.S. has implemented both a mandatory logbook reporting system and a mandatory fishery observer program. These data reporting programs provide measures of total effort and of the catch and mortality rate of discarded swordfish, which are assumed to be mainly < 25 kg whole weight, and other by-catch species. An analysis of these data sets is presented in which estimates of both the catch and mortality of discarded swordfish in the U.S. fleet are provided.

RESUME

L'application de la taille minimum recommandée par l'ICCAT a donné une mortalité mystérieuse de 25 kg d'espérons inférieurs à la taille minimum de l'ICCAT. Pour permettre d'estimer le degré de cette mortalité, les Etats-Unis ont instauré un système de registre de livres de bord et un programme d'observateur de la pêche obligatoires. Ces programmes qui transmettent des données fournissent des mesures de l'effort global de la prise et du taux de mortalité des rejets d'espéron, que l'on estime principalement inférieurs à 25 kg de poids total, et d'autres espèces capturées en tant que prises accessoires. Une analyse de ces jeux de données est présentée, pour lesquelles il est donné des estimations de la prise et de la mortalité des rejets d'espéron de la flottille des Etats-Unis.

RESUMEN

La implementación de talla mínima para pez espada recomendada por ICCAT se traduce en una mortalidad críptica de ejemplares inferiores a la talla mínima de ICCAT de 25 kg. Con el fin de permitir la estimación del grado de la mortalidad críptica, Estados Unidos ha implementado un sistema obligatorio de comunicación de cuadernos de pesca y un programa obligatorio de observador de pesquería. Estos programas de comunicación de datos facilitan medidas del esfuerzo total y de la tasa de captura y mortalidad de pez espada descartado, que se asume que es principalmente <25 kg peso total, y de otras especies capturadas fortuitamente. Se presenta un análisis de estos conjuntos de datos, en los cuales se facilitan las estimaciones tanto de la captura como de la mortalidad de pez espada descartado en la flota de Estados Unidos.

INTRODUCTION

Domestic regulations in conformity with ICCAT recommendations, limiting the taking and landing of swordfish weighing < 25 kg live weight (125 cm lower jaw fork length) by U.S. fishermen went into effect in June 1991 (Cramer *et al.* 1992). These regulations have resulted in reduced landings of swordfish < 25 kg by the U.S. fleet. The proportion of swordfish less than 25 kg in size frequency samples from U.S. longline vessels decreased from 41% in the first half of 1991 to about 16% in the second half of 1991 and have remained at about 15% through 1992 (Figure 1). Before 1991, the highest percentage of swordfish landed were in the 13-24 kg category; since 1991 the highest percentage of the landed catch has been in the 25-36 kg category. The percentage of annual landed catch made up of swordfish in the 13-24 kg category dropped from 32% in 1989 to 15% in 1992 (Figure 2). Reductions in landed catch of swordfish < 25 kg have occurred in all areas and months (Figures 3a-3c, Tables 1a-1b).

While the percentage of landed swordfish < 25 kg decreased, the percentage of reported discarded swordfish by the U.S. fleet increased from 6% in 1990 to 32% in 1992 (Tables 2a-2c). With the increase in numbers of discarded swordfish, estimation of cryptic mortality (mortality not evident in the landings data) has become important. The percentage of swordfish discarded dead reported by fishery observers in 1992 (Table 2b) is generally higher than self reported. The purpose of this paper is to compare fishery observer data to self reported mandatory logbook data to provide an estimate of this cryptic mortality of swordfish for the U.S. fleet in 1992.

MATERIALS AND METHODS

The mandatory logbook reporting system (LB) requires U.S. Atlantic fishing vessels which land swordfish to submit daily records of effort and catch, including swordfish discarded dead or alive. Similar information is collected through a mandatory fishery observer program (OBS) in which observers are placed on randomly selected U.S. longline vessels in order to confirm and augment fisheries information from the self-reported LB. The number of hooks reported and observed by area for LB and OBS are shown in Figure 5. In these analyses, catch rates of discarded swordfish reported by the LB and OBS are compared using general linear model (GLM) analyses.

Model variables included in the analyses and thought to influence catch of swordfish were quarter (time of year), target (tuna/swordfish), source (OBS/LB), and area (Caribbean, Gulf of Mexico, Florida East Coast, South Atlantic Bight, Mid Atlantic Bight, Northeast Coastal, and Northeast Distant). Separate analyses were done for live and dead discards from longline vessels in each of seven areas and for all areas combined. Cryptic catch was estimated as the product of the reported number of discarded live and dead swordfish by the ratio of the appropriate OBS and LB model estimated mean CPUE (LSMEANS were used), then summing the estimates. An estimate for total cryptic catch for all gears and all areas was made by multiplying reported live

and dead discards from all longline sets (this included reports with unknown locations) by the ratio of the model estimated mean catch rates for combined areas, summing the live and dead estimates, then adding the reported number of live and dead discards from other gears to the combined estimate. Thus, total estimated catch based on observer data is taken as:

$$\hat{C}_{OBS} = C_{LB} \left(\frac{CP\hat{U}E_{OBS}}{CP\hat{U}E_{LB}} \right)$$

where \hat{C}_{OBS} is the estimated catch based on observer sampling, C_{LB} is the reported catch from logbooks, and $CP\hat{U}E_{OBS}$ and $CP\hat{U}E_{LB}$ are the GLM estimates of marginal mean catch rates (LSMEAN) for the observer data and the logbook data sets.

RESULTS

In general, OBS reported higher catch rates for dead discarded swordfish and lower catch rates for live discarded swordfish compared to the LB reports (Table 3). Although the R-square values for the models were 20% or below (Appendix Tables 1-16), catch rates of OBS dead discards were consistently higher where source was a significant ($P > .01$) model variable. The low R-squared values is to a large degree due to the small number of OBS sets; 250 overall, and fewer than 30 each in the Mid-Atlantic Bight and Caribbean fishing areas. Estimated and reported discards are compared to the range and mean of the catch at size estimates for swordfish under 25 kg for 1986-1990 in Figures 4a-4h. Estimated total discards were below the 86-90 mean numbers of swordfish < 25 kg landed, except in three areas in the U.S. southeastern region. In the Caribbean, Gulf of Mexico, and the South Atlantic Bight the $CP\hat{U}E_{OBS}$ were more than four times $CP\hat{U}E_{LB}$ for dead discards (Table 4b). This resulted in estimates for dead discards that were considerably higher than the reported dead discards and higher than the 86-90 mean catch of swordfish < 25 kg. Eighty percent confidence intervals for estimates of dead discards when all areas and all gears are included range from 36,975 to 41,726 for 1992. The estimated average size of fish landed < 25 kg by the U.S. fleet from 1986-1991 was 15.7 kg. Applying this average size to the reported number of fish discarded dead in 1992 results in an estimate of estimated number of fish discarded dead in 1992 results in an estimate of from 580-655 MT of added mortality not accounted for in the U.S. landings statistics. For live discards, estimates range from 7,913 to 9,300 (Tables 4a_4b).

References Cited

Cramer J., A. R. Bertolino, and M. I. Farber. 1992. Some characteristics of the U.S. fishery for swordfish since 1987. SCRS/92/110

Table 1a. PERCENTAGE OF SWORDFISH LANDED CATCH < 25 KG BY AREAS (ANNUAL OF CATCH OF SWORDFISH < 25 KG IN AREA/ ANNUAL CATCH OF SWORDFISH IN AREA).

YEAR	AREA						
	CAR	GOM	FEC	SAB	MAB	NEC	NED
1989	36%	53%	55%	66%	61%	33%	32%
1990	23%	60%	52%	60%	50%	24%	22%
1991	15%	51%	39%	53%	22%	10%	8%
1992	9%	29%	27%	8%	6%	6%	16%

Table 1b. PERCENTAGE OF SWORDFISH LANDED CATCH < 25 KG BY AREAS (ANNUAL OF CATCH OF SWORDFISH < 25 KG IN AREA/ TOTAL ANNUAL CATCH OF SWORDFISH IN ALL AREAS).

YEAR	AREA							
	CAR	GOM	FEC	SAB	MAB	NEC	NED	SUM
1989	5%	9%	13%	3%	5%	3%	7%	46%
1990	3%	7%	15%	3%	7%	3%	3%	41%
1991	2%	10%	9%	2%	2%	1%	2%	28%
1992	1%	5%	4%	1%	1%	1%	3%	16%

Table 2. YEARLY TABULATIONS FOR SWORDFISH IN (a) 1990 LB, (b) 1991 LB, (c) 1992 LB (d) 1992 OBS. THE AREAS ARE DEFINED IN FIGURE 1. INFORMATION INCLUDES NUMBER OF FISH KEPT; NUMBER OF FISH DISCARDED; KEPT PLUS DISCARDED; EFFORT IN HOOKS; NUMBER OF SETS; AND AVERAGE OF THE INDIVIDUAL CATCH RATES, EQUIVALENT TO CPUE [AVG(C/E)], IN # OF FISH/100 HOOKS.

a. SWORDFISH TOTALS FOR 1990 (LB)

AREA	HOOKS	N	K+D	%KEPT	%DISC	AVG(C/E)
1	782524	1934	21201	95	5	2.811
2	1949036	4050	19527	91	9	1.593
3	974925	3533	26067	94	6	2.855
4	449229	1481	16482	95	5	3.928
5	8041632	2336	12573	92	8	1.267
6	834929	1715	10225	93	7	1.273
7	735363	1285	27820	96	4	3.755
8	50740	95	950	96	4	1.955
9	46927	92	1076	97	3	2.713
TOTAL	8865305	16521	136721	94	6	2.312

b. SWORDFISH TOTALS FOR 1991 (LB)

AREA	HOOKS	N	K+D	%KEPT	%DISC	AVG(C/E)
1	473371	1161	12272	92	8	2.772
2	2233814	3884	14618	82	18	1.159
3	841717	3066	25163	72	28	3.115
4	436103	1225	13067	68	32	3.515
5	1228367	2438	8405	61	39	0.723
6	1003353	1811	7901	67	33	0.801
7	738719	1166	26325	86	14	3.657
8	4422	7	38	95	5	0.939
9	118156	223	2214	96	4	2.038
TOTAL	1078022	14981	110003	78	22	1.970

c. SWORDFISH TOTALS FOR 1992 (LB)

AREA	HOOKS	N	K+D	%KEPT	%DISC (dead)	%DISC (alive)	AVG(C/E)
1	559900	1199	10691	79	12	9	2.178
2	2749460	4227	12479	56	28	18	0.698
3	766875	2654	17899	58	28	15	2.580
4	381359	1087	11217	56	33	11	3.400
5	1446149	2513	7396	59	22	19	0.542
6	885863	1380	5562	68	16	16	0.667
7	844879	2437	26531	83	8	9	3.188
8	7057	11	105	95	1	4	1.523
9	169186	287	2185	94	3	4	1.330
TOTAL	7810728	15408	97083	68	19	13	1.700

d. SWORDFISH TOTALS FOR 1992 (OBS)

AREA	HOOKS	N	K+D	%KEPT	%DISC (dead)	%DISC (alive)	AVG(C/E)
1	4556	12	177	67	28	5	3.838
2	38185	61	276	22	54	24	0.883
3	9863	40	247	45	46	9	3.085
4	9305	31	340	56	40	4	3.859
5	6072	13	20	40	45	15	0.329
6	30097	48	43	77	16	7	0.118
7	35112	45	497	62	29	8	1.501
TOTAL	133190	250	1600	43	44	13	1.682

Table 3 : Comparisons between estimates of cryptic catch rates of swordfish. The source with the highest estimate is listed when source is a significant ($P < 0.01$) in the model.

AREA	LIVE DISCARDS	DEAD DISCARDS	TOTAL DISCARDS
CARIBBEAN		OBS	OBS
GULF OF MEXICO	OBS	OBS	OBS
FLORIDA EAST COAST	LB		
SOUTH ATLANTIC BIGHT		OBS	OBS
MID ATLANTIC BIGHT			OBS
NORTHEAST COASTAL	LB		LB
NORTHEAST DISTANT	LB	OBS	
ALL AREAS	LB	OBS	OBS

FIG. 1. SIZE FREQUENCY FROM U.S. LONGLINE VESSELS

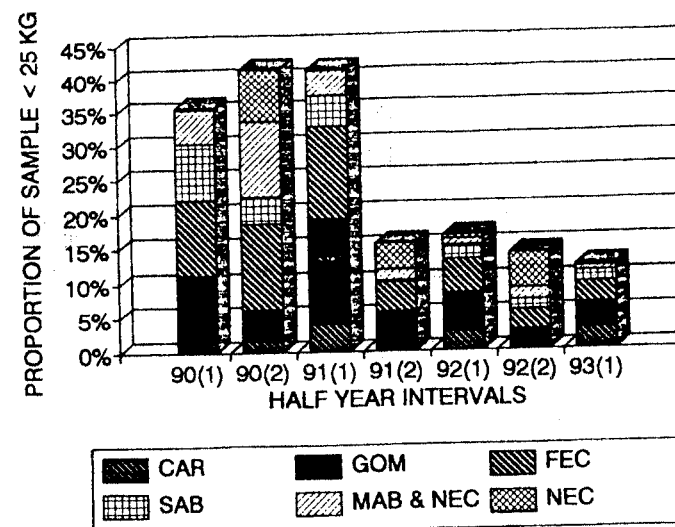
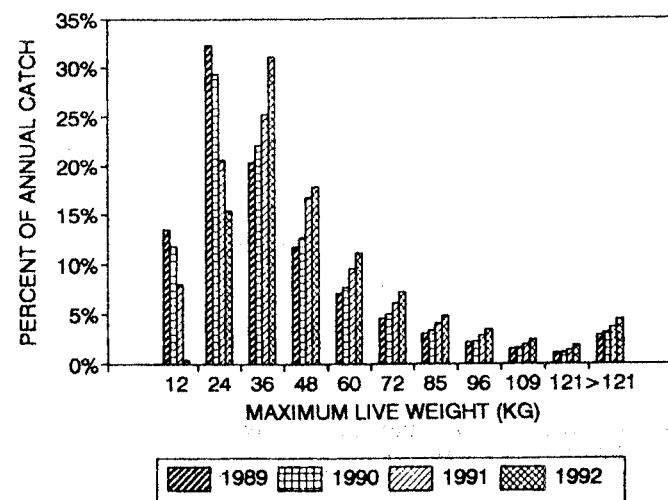
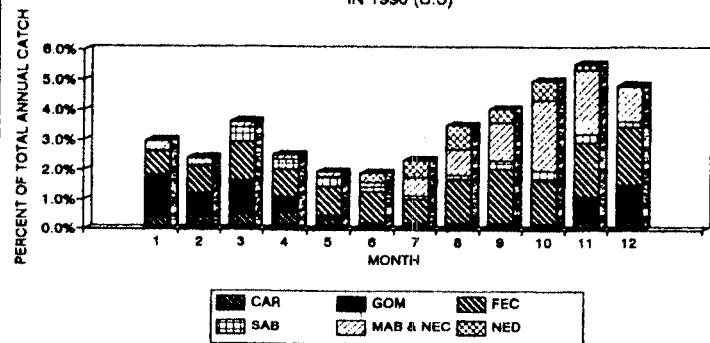


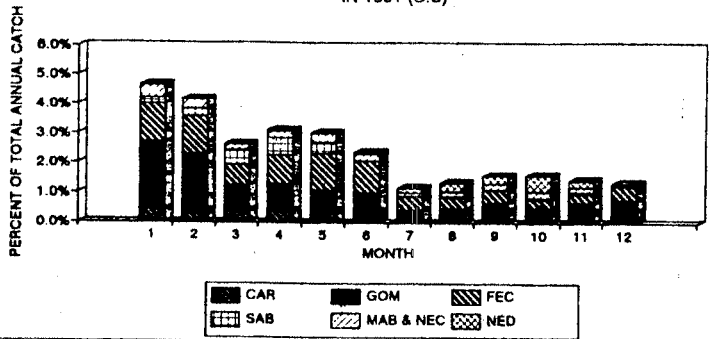
FIG. 2. US CATCH AT SIZE



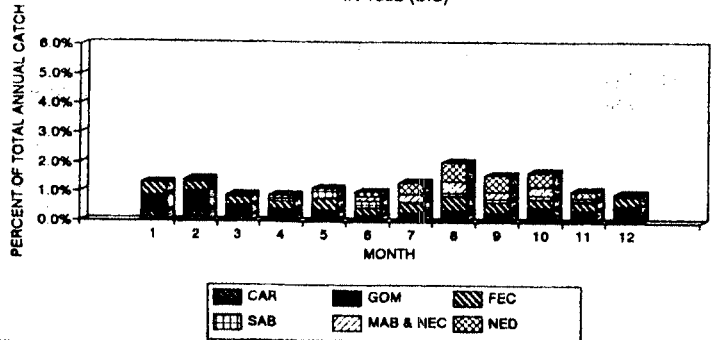
**FIG. 3a. PERCENT LANDED CATCH < 25 KG
IN 1990 (U.S)**



**FIG. 3b. PERCENT LANDED CATCH < 25 KG
IN 1991 (U.S)**

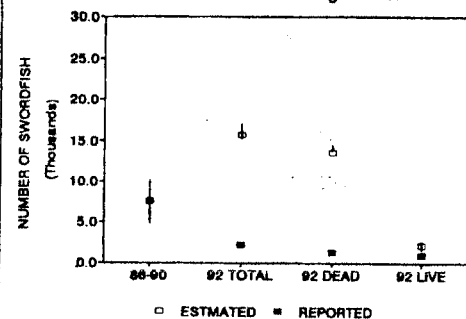


**FIG 3c. PERCENT LANDED CATCH < 25 KG
IN 1992 (U.S)**

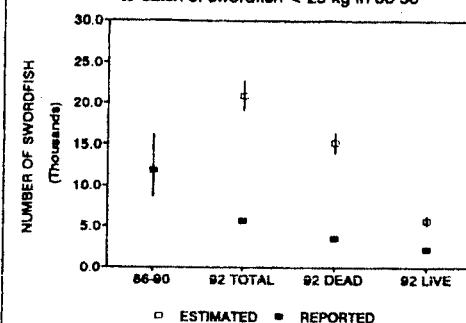


FIGURES 4a-4h. RANGE AND MEAN VALUES FOR CATCH OF SWORDFISH LESS THAN 25 KG FROM 1986 TO 1990 (86-90). REPORTED AND ESTIMATED (WITH 80% CONFIDENCE INTERVALS) DEAD, LIVE AND TOTAL (LIVE + DEAD) DISCARDS FOR 1992.

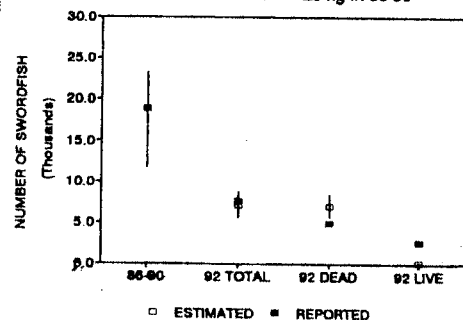
4a. Caribbean discards compared to catch of swordfish < 25 kg in 86-90



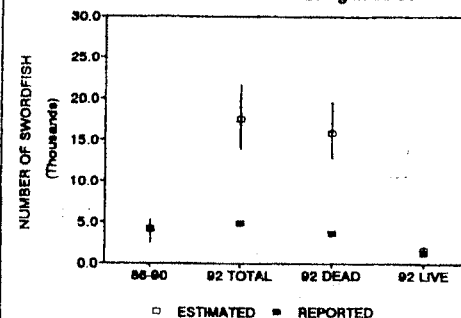
4b. Gulf of Mexico discards compared to catch of swordfish < 25 kg in 86-90



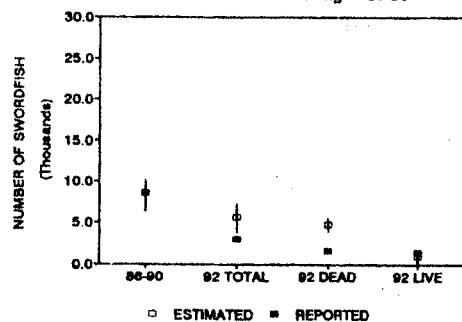
4c. Florida East C discards compared to catch of swordfish < 25 kg in 86-90



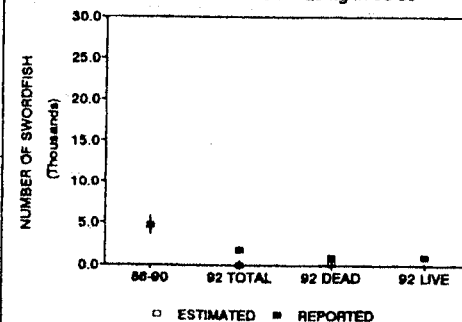
4d. South Atl Bight discards compared to catch of swordfish < 25 kg in 86-90



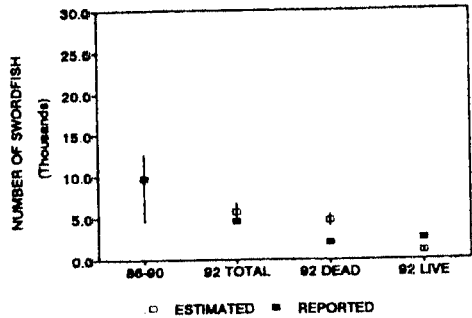
4e. Mid Atl Bight discards compared to catch of swordfish < 25 kg in 86-90



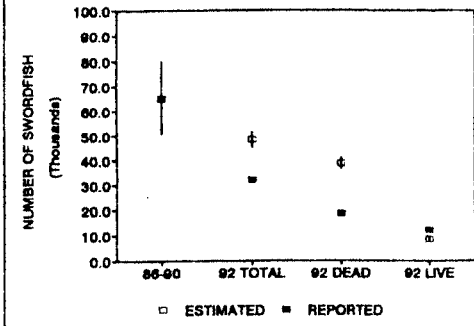
4f. Northeast Coast discards compared to catch of swordfish < 25 kg in 86-90



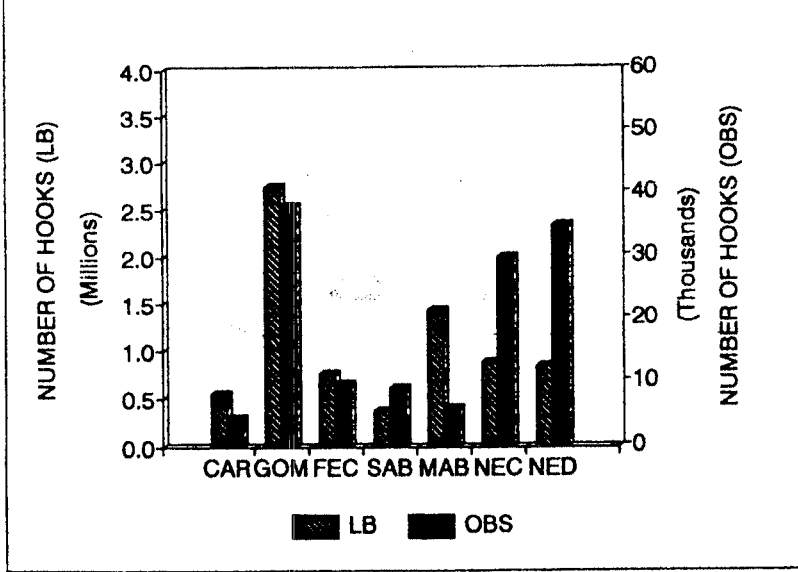
4g. Northeast Dist discards compared to catch of swordfish < 25 kg in 86-90



4h. All discards in 1992 compared to catch of swordfish < 25 kg in 86-90



5. Number of hooks reported by area in the LB and OBS data sets.



Appendix 1. GLM output

Appendix Table 1. Live Discards - Caribbean

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	40.25389583	8.05077917	10.93	0.0001
Error	1204	887.23922072	0.73690965		
Corrected Total	1209	927.49311655			

R-Square	C.V.	Root MSE	LSWOA Mean
0.043401	130.6822	0.858434	0.656887

Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	3	36.92519145	12.30839715	16.70	0.0001
TARGET	1	3.89529223	3.89529223	5.29	0.0217
SOURCE	1	0.81113561	0.81113561	1.10	0.2943

Least Squares Means

SOURCE	LSWOA LSMEAN	Std Err LSMEAN	Pr > T NO:LSMEAN=0
OBS	0.69863364	0.26797576	0.0092
LB	0.37402525	0.09956903	0.0002

Appendix Table 2. Live Discards - Gulf of Mexico

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	95.82317246	19.16463449	36.29	0.0001
Error	4246	2242.49400948	0.52814272		
Corrected Total	4251	2338.31718194			

R-Square	C.V.	Root MSE	LSWOA Mean
0.040980	205.8771	0.726734	0.352994

Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	3	77.34265564	25.78088521	48.81	0.0001
TARGET	1	3.55367485	3.55367485	6.73	0.0095
SOURCE	1	9.69324807	9.69324807	18.35	0.0001

Least Squares Means

SOURCE	LSWOA LSMEAN	Std Err LSMEAN	Pr > T NO:LSMEAN=0
OBS	0.80893333	0.09382036	0.0001
LB	0.39361746	0.02695762	0.0001

Appendix Table 3. Live Discards - Florida East Coast

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	242.4102790	48.4820558	43.21	0.0001
Error	2688	3015.6701362	1.1219011		
Corrected Total	2693	3258.0804151			

	R-Square	C.V.	Root MSE	LSWOA Mean
	0.074403	120.4912	1.059198	0.879067

Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	3	69.1032395	23.0344132	20.53	0.0001
TARGET	1	179.5505251	179.5505251	160.04	0.0001
SOURCE	1	57.4426754	57.4426754	51.20	0.0001

Least Squares Means

SOURCE	LSWOA LSMEAN	Std Err LSMEAN	Pr > T HO:LSMEAN=0
OBS	0.11348550	0.17436465	0.5152
LB	1.49940366	0.05171507	0.0001

Appendix Table 4. Live Discards - South Atlantic Bight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	73.82559226	14.76511845	14.20	0.0001
Error	1110	1154.30396640	1.03991348		
Corrected Total	1115	1228.12955866			

	R-Square	C.V.	Root MSE	LSWOA Mean
	0.060112	116.1892	1.019761	0.877674

Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	3	54.72415653	18.24138551	17.54	0.0001
TARGET	1	17.93124055	17.93124055	17.24	0.0001
SOURCE	1	0.64808332	0.64808332	0.62	0.4300

Least Squares Means

SOURCE	LSWOA LSMEAN	Std Err LSMEAN	Pr > T HO:LSMEAN=0
OBS	0.91747908	0.19823528	0.0001
LB	0.74586722	0.05886680	0.0001

Appendix Table 5. Live Discards - Mid Atlantic Bight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	4.73612065	1.57870688	4.03	0.0073
Error	1335	523.04782661	0.39179612		
Corrected Total	1338	527.78394726			

	R-Square	C.V.	Root MSE	LSWOA Mean
	0.008974	165.5445	0.625936	0.378107

Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	1	4.06397209	4.06397209	10.37	0.0013
TARGET	1	0.90953303	0.90953303	2.32	0.1278
SOURCE	1	0.08572277	0.08572277	0.22	0.6400

Least Squares Means

SOURCE	LSWOA LSMEAN	Std Err LSMEAN	Pr > T HO:LSMEAN=0
OBS	0.19937867	0.17940426	0.2666
LB	0.28106283	0.05441302	0.0001

Appendix Table 6. Live Discards - Northeast Coastal

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	11.49678391	3.83226130	10.23	0.0001
Error	1276	477.93313629	0.37455575		
Corrected Total	1279	489.42992020			

	R-Square	C.V.	Root MSE	LSWOA Mean
	0.023490	149.2540	0.612010	0.410046

Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	1	2.76946350	2.76946350	7.39	0.0066
TARGET	1	1.81603332	1.81603332	4.85	0.0278
SOURCE	1	4.77380772	4.77380772	12.75	0.0004

Least Squares Means

SOURCE	LSWOA LSMEAN	Std Err LSMEAN	Pr > T HO:LSMEAN=0
OBS	-0.03540411	0.09932446	0.7216
LB	0.29348600	0.04767669	0.0001

Appendix Table 7. Live Discards - Northeast Distant

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	10.05569632	3.35189877	4.37	0.0045
Error	1025	785.36139127	0.76620624		
Corrected Total	1028	795.41708759			
R-Square		C.V.	Root MSE	LSWOA Mean	
0.012642		90.52970	0.875332	0.966900	
Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	1	1.39427792	1.39427792	1.82	0.1776
TARGET	1	1.25622967	1.25622967	1.64	0.2007
SOURCE	1	8.70604904	8.70604904	11.36	0.0008

Least Squares Means

SOURCE	LSWOA LSMEAN	Std Err LSMEAN	Pr > T HO:LSMEAN=0
OBS	0.47633835	0.13987908	0.0007
LB	0.93165802	0.04127934	0.0001

Appendix Table 8. Live Discards - all areas

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	907.1831557	82.4711960	112.45	0.0001
Error	12908	9466.7639244	0.7334028		
Corrected Total	12919	10373.9470801			
R-Square		C.V.	Root MSE	LSWOA Mean	
0.087448		144.2662	0.856389	0.593618	
Source	DF	Type III SS	Mean Square	F Value	Pr > F
AREA	6	777.0181718	129.5030286	176.58	0.0001
QUARTER	3	75.4744061	25.1581354	34.30	0.0001
TARGET	1	16.8082068	16.8082068	22.92	0.0001
SOURCE	1	7.9340360	7.9340360	10.82	0.0010

Least Squares Means

SOURCE	LSWOA LSMEAN	Std Err LSMEAN	Pr > T HO:LSMEAN=0
OBS	0.58134749	0.05455589	0.0001
LB	0.76714348	0.01773248	0.0001

Appendix Table 9. Dead Discards - Caribbean

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	246.5129337	49.3025867	56.40	0.0001
Error	1204	1052.5187404	0.8741850		
Corrected Total	1209	1299.0316740			
R-Square		C.V.	Root MSE	LSWOD Mean	
0.189767		127.8251	0.934979	0.731452	
Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	3	208.3835304	69.4611768	79.46	0.0001
TARGET	1	9.0283332	9.0283332	10.33	0.0013
SOURCE	1	16.4220756	16.4220756	18.79	0.0001

Least Squares Means

SOURCE	LSWOD LSMEAN	Std Err LSMEAN	Pr > T HO:LSMEAN=0
OBS	1.88115860	0.29187041	0.0001
LB	0.42057295	0.10844732	0.0001

Appendix Table 10. Dead Discards - Gulf of Mexico

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	161.7610517	32.3522103	40.06	0.0001
Error	4246	3429.2278728	0.8076373		
Corrected Total	4251	3590.9889245			
R-Square		C.V.	Root MSE	LSWOD Mean	
0.045046		192.3190	0.898686	0.467289	
Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	3	129.0616321	43.0205440	53.27	0.0001
TARGET	1	0.0119813	0.0119813	0.01	0.9031
SOURCE	1	34.4284469	34.4284469	42.63	0.0001

Least Squares Means

SOURCE	LSWOD LSMEAN	Std Err LSMEAN	Pr > T HO:LSMEAN=0
OBS	1.21406935	0.11601913	0.0001
LB	0.43135631	0.03333605	0.0001

Appendix Table 11. Dead Discards - Florida East Coast

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	409.5821812	81.9164362	51.99	0.0001
Error	2688	4235.2653728	1.5756196		
Corrected Total	2693	4644.8475540			
R-Square		C.V.	Root MSE	LSWOD Mean	
0.088180		92.92064	1.255237	1.350870	
Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	3	372.5389765	124.1796588	78.81	0.0001
TARGET	1	13.2084909	13.2084909	8.38	0.0038
SOURCE	1	2.3099694	2.3099694	1.47	0.2261

Least Squares Means

SOURCE	LSWOD LSMEAN	Std Err LSMEAN	Pr > T HO:LSMEAN=0
OBS	1.85539556	0.20663641	0.0001
LB	1.57747328	0.06128660	0.0001

Appendix Table 12. Dead Discards - South Atlantic Bight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	259.3821275	51.8764255	28.12	0.0001
Error	1110	2047.8239018	1.8448864		
Corrected Total	1115	2307.2060293			
R-Square		C.V.	Root MSE	LSWOD Mean	
0.112423		81.09122	1.358266	1.674985	
Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	3	211.4119536	70.4706512	38.20	0.0001
TARGET	1	34.4345043	34.4345043	18.66	0.0001
SOURCE	1	34.8448779	34.8448779	18.89	0.0001

Least Squares Means

SOURCE	LSWOD LSMEAN	Std Err LSMEAN	Pr > T HO:LSMEAN=0
OBS	2.69268420	0.26403844	0.0001
LB	1.43433451	0.07840732	0.0001

Appendix Table 13. Dead Discards - Mid Atlantic Bight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	19.74091110	6.58030370	15.17	0.0001
Error	1335	578.96819494	0.43368404		
Corrected Total	1338	598.70910604			
R-Square		C.V.	Root MSE	LSMOD Mean	
0.032972		183.3728	0.658547	0.359130	
Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	1	17.74037359	17.74037359	40.91	0.0001
TARGET	1	0.00552839	0.00552839	0.01	0.9101
SOURCE	1	2.18298367	2.18298367	5.03	0.0250
Least Squares Means					
SOURCE	LSMOD LSMEAN	Std Err LSMEAN	Pr > T NO:LSMEAN=0		
OBS	0.71736124	0.18875106	0.0002		
LB	0.30515462	0.05724789	0.0001		

Appendix Table 14. Dead Discards - Northeast Coastal

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	11.48353459	3.82784486	9.68	0.0001
Error	1276	504.71358899	0.39554357		
Corrected Total	1279	516.19712357			
R-Square		C.V.	Root MSE	LSMOD Mean	
0.022246		166.2420	0.628923	0.378318	
Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	1	5.18725017	5.18725017	13.11	0.0003
TARGET	1	2.06960514	2.06960514	5.23	0.0223
SOURCE	1	2.09452014	2.09452014	5.30	0.0215
Least Squares Means					
SOURCE	LSMOD LSMEAN	Std Err LSMEAN	Pr > T NO:LSMEAN=0		
OBS	0.02091218	0.10206930	0.8377		
LB	0.23876371	0.04899424	0.0001		

Appendix Table 15. Dead Discards - Northeast Distant

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	24.24737723	8.08245908	9.40	0.0001
Error	1025	880.94840228	0.85946186		
Corrected Total	1028	905.19577951			
R-Square		C.V.	Root MSE	LSMOD Mean	
0.026787		110.4874	0.927072	0.839074	
Source	DF	Type III SS	Mean Square	F Value	Pr > F
QUARTER	1	9.21814452	9.21814452	10.73	0.0011
TARGET	1	0.71700715	0.71700715	0.83	0.3613
SOURCE	1	10.93569561	10.93569561	12.72	0.0004
Least Squares Means					
SOURCE	LSMOD LSMEAN	Std Err LSMEAN	Pr > T NO:LSMEAN=0		
OBS	1.24683343	0.14814712	0.0001		
LB	0.73652932	0.04371930	0.0001		

Appendix Table 16. Dead Discards - all areas

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	3070.514774	279.137707	268.33	0.0001
Error	12908	13428.135690	1.040296		
Corrected Total	12919	16498.650464			
R-Square		C.V.	Root MSE	LSMOD Mean	
0.186107		129.0793	1.019949	0.790172	
Source	DF	Type III SS	Mean Square	F Value	Pr > F
AREA	6	2509.144992	418.190832	401.99	0.0001
QUARTER	3	365.330848	121.776949	117.06	0.0001
TARGET	1	0.907419	0.907419	0.87	0.3503
SOURCE	1	53.880933	53.880933	51.79	0.0001
Least Squares Means					
SOURCE	LSMOD LSMEAN	Std Err LSMEAN	Pr > T NO:LSMEAN=0		
OBS	1.34069535	0.06497537	0.0001		
LB	0.85651539	0.02111916	0.0001		