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### An Assessment of the Redfish Stock in NAFO Division 3M

by

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# Introduction

There are three species of redfish which are commercially fished on Flemish Cap: beaked redfish (*Sebastes mentella*) golden redfish (*S. marinus*) and American (acadian) redfish (*S. fasciatus*). Because of identification difficulties these species are not identified in commercial catches and considered together as a single management unit. Only in EU-Spanish surveys have the species been identified separately, starting in 1991.

# **Description of the Fishery**

In 1993 a directed redfish fishery was conducted primarily by Latvia, Lithuania, Estonia, Cuba, Portugal and Russia with bottom and midwater trawls as well as with gillnets.

From 1983-1985, catches averaged 20 000 tons (Table 1), increased to the record high of 81 000 tons in 1990 and have subsequently declined to the level of the mid-1980s. The 1993 catch was estimated to be about 29 000 tons. A substantial amount of catch has been estimated since 1989 primarily because of the activity of non-Contracting Parties. The portion of the catch that has been estimated has ranged between 7 600 tons in 1991 to 14 200 tons in 1990. Catch figures for 1990-1992 have been revised based upon updated information related to catches by non-Contracting Parties.

Catches were over double the 20,000 ton TAC in 1987 (at 44,000 tons) and about three times the 20,000 ton TAC in 1989 (at 58,000 tons). Catches have been at the TAC level since 1991:

TACs and catches for last five years were:

	1989	1990	1991	1992	1993
TAC	20	50	50	43	30
Catch	58'	81 <sup>1,2</sup>	481	43 <sup>1,2</sup>	29 <sup>1,2</sup>

Includes estimates of non-reported catches.

<sup>2</sup> Provisional.

#### Commercial Fishery Data

Catch and effort data were obtained from ICNAF/NAFO Statistical Bulletins for 1959 to 1990 and were combined with provisional 1991-1992 NAFO data. These were supplemented by preliminary data available from Canada. Portugal, and Russia. Only those data where redifish comprised more than 50% of the total catch were selected for further analysis with the exception of data from Portugal because they were considered confounded with directed effort for other species. The data for Portugal were obtained from data available in Portuguese research reports in the NAFO SCS Document series for 1989-1994.

The CPUE data were analyzed with a multiplicative model (Gavaris 1980). Effects included in the model were a combination country-gear-tonnage class category type (CGT), NAFO division, month, and

a category type representing the amount of by-catch associated with each observation. Catch or effort data of less than 10 units were eliminated prior to analysis, however, for the analysis utilizing the effort in terms of days fished, any catch less than 10 tons or effort less than an arbitrarily chosen 5 days fished were not included in the analysis. Category types with less than five samples were also eliminated with the exception of the year category type. For all analyses an unweighted regression was run because of unknown percentages of prorating prior to 1984.

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The regression utilizing effort in hours fished was significant (p < 05), explaining 62% of the variation in catch rates (Table 2). All category types were significant. There is much variability in the series prior to 1972 (Table 4, Fig. 1). Generally, catch rates were stable from 1974 to 1984 and increased thereafter until it peaked in 1987 at the highest rate since 1971. A trend of decline followed to 1993. The estimated catch rate for 1993, based on information from the Portuguese and Russian fleets is the lowest in the time series.

In addition to a standardized CPUE based on hours fished a standardized series based on days fished was also conducted on the premise that such a unit of effort may reflect time searching for concentrations of redfish.

The regression utilizing effort in days fished was significant (p < 05), explaining 70% of the variation in catch rates (Table 3). All category types were significant. There is much variability in the series prior to 1974 (Table 5, Fig. 2). Trends were similar to the index based on hours fished. Generally catch rates were stable from 1974 to 1984, increased successively to 1987 at the highest rate since 1972, dropped sharply in 1988 and remained stable to 1992. The preliminary for 1993 suggest a decline to the lowest estimated since 1967.

Sampling data were limited and consisted of *S. mentella* and *S. marinus* length and age composition for Portuguese gillnetters (Alpoim et al., 1994) and length composition from bycatches in the Spanish pair-trawl fishery (Vazquez, 1994).

Fish in the range of 17-53 cm occurred in the Spanish pair-trawl catches. Males 30-33 cm and 39-43 cm and females 29-34 cm and 38-43 cm dominated the catches. Among catches obtained during April-July redfish specimens appeared to be larger in June (0.9 kg mean weight).

Portuguese directed effort for redfish stayed relatively constant between 1992 and 1993 but catch rates dropped from 0.891 t/h in 1992 to 0.471 t/h in 1993 and was the lowest one observed since 1989.

Portuguese gillnet catches consisted of *S. mentella* in the range of 18-65 cm and *S. marinus* 16-69 cm long. For both species lengths 35-40 cm dominated the catches. Smaller fish at modal 30 were also well represented in catches. Mean length in the *S. mentella* catches increased by 5 cm for males and 2 cm for females in 1993 compared to 1992.

# **Research Survey Data**

Two surveys were conducted in June-July 1993: EU bottom trawl survey on board R/V Saavedra (Vazquez, 1994) and a Russian trawl-acoustic survey on board of R/V Vilnius (Vascov, 1994). Trawlable biomass (Table for EU survey was divided into three redfish species and an aggregate juvenile group (<15 cm). Redfish species identification during Russian survey was not conducted. Each survey was based on a stratified random design and utilized the same stratification scheme down to 732 m (400 fathoms).

The EU trawl survey and the Russian trawl acoustic survey have both shown a gradual decrease of stock since 1988 to 1991 (Table 6). In 1992 blomass index of EU-survey indicated higher stock while, the bottom component on the Russian data decreased significantly while the total blomass remained at about the same level as 1991. From 1992 to 1993, trawlable blomass estimates decreased for the EU survey but increased for the Russian survey. Total blomass from the Russian survey in 1993 increased 1.5 times (147.1 thous, tons) compared with the 1991-1992 level.

As in previous years *S. mentella* produced the biggest portion of total biomass estimated from the EU survey. Compared with 1992 its biomass declined almost 3 times and made up 25.1 thous, tons in 1993. Individuals in the range of 15-48 cm occurred in catches.

Length frequencies from the Russian bottom trawl survey indicate a mode at about 15-16 cm that corresponds to the 1990-1991 years classes. These size groups represented about 20% of the research catch in the 1993 survey. These size groups were also dominant in the EU survey results.

#### Prognosis

The biomass of this stock has declined at least from 1988 to 1991-1992. Large catches over the past eight years that have likely been well above the stock sustainable production and have resulted in high fishing mortalities. This stock will continue to decline into the future if the present level of catches is maintained. Both Russian and EU surveys indicated a relatively good pulse of recruitment that will start recruiting to the commercial fishery in the late 1990s, however, the abundance of these cannot be precisely determined.

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There is no information to evaluate where the current TAC (26,000 tons) stands in relation to an appropriate reference catch. Therefore, a cautious approach is warranted in establishing an appropriate catch level. In consideration of this there continues to be non-reported catch from the Regulatory area that is primarily due to activity by non-Contracting Parties.

#### References

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Country	1983	1984	1985	1986	1987	1988	1989 <sup>a</sup>	1990	1991	1992	1993	
CAN	0	0	0	0	0	0	0	C	2	0	10	
CUB	2324	1562	1831	1764	1757	1759	1765	4195	1772	2303	945	
DDR	40	98	0	68	0	0	0	4025	0	0	0	
GRL	0	0	0	0	0	0	0	0	0	1	0	
JPN	390	389	313	400	131	393	885	2082	1432	1424	967	
SUN/RUS	14517	15005	15703	15045	19875	13747	13937	34581	24661	2937	2035	
LVA	0	0	0	0	0	0	0	0	0	7441	5099	
ĒTU	0	0	0	0	0	0	0	0	0	0	2128	
EST	-	-	-		-	-	-	-	-	-	2188	
E GER	0	769	848	145	0	0	2	91	5847	3443	0	
E ESP	589	282	281	643	825	146	211	1916	472	204	100	
EGBR	0	0	· 0	0	0	0	0	0	5	0	0	
E PRT	1667	2123	1306	10783	21823	7101	13012	11665	3787	3198	4781	
KORIS	0	0	0	5	0	43	17885	8332	2936	8350	2962	
FAROE IS	0	0	0	C	0	0	0	0	0	16	0	
OTHER*	-	•	-	-	-	-	10405	14159	7575	14000	7778	
TOTAL	19527	20228	20282	28873	44411	23189	58102	81048	48489	43317	28993	-

Nominal catches of Redfish in Div. 3M for 1983-1993 (1991-93 are provisional).

Estimates of non-reported catch from various sources.

TABLE 1.

NILTIPLE 8	REGRESSION OF MULTIPLICATIVE WODEL						CATEGORY	CODE VARIABLE		COEFFICIENT	STD, ERROR	NO. OBS.	
HULTIPLE 8 SQUARED.         0.424         3157         28         0.245         9           AMALTSIS OF VARIANCE         (2)         1         29         0.235         0.105         62           SWERE 0F         SUMARTSIS SQUARES         F-VALUE         5         2         0.145         0.060         62           VARITION         OF         SQUARES         F-VALUE         5         2         0.145         0.062         60           VARITION         OF         SQUARES         2.302E1         3         0.333         0.033         0.035         57           INTERCEPT         1         2.302E1         2.302E1         3         0.333         0.035         57           REGRESSION         77         2.5452         3.22.745         11         33         0.245         0.106         42           Variat (12)         11         1.592E2         2.706         12.465         12         39         0.417         13           Variat (2)         4.2         0.245         0.245         14         0.406         14         0.455         0.246         14         0.425         0.417         13           Variat (2)         4.4450         3.9131	MULTIPLE	R	0	. 790				(1)	27125	27	0.170	0.233	6
ANALYSIS OF VARIANCE         (2)         1         29         0.11:         BS           SOURCE OF         SUMS OF         MEXN         3         31         0.325         0.016         42           VARTION         OF         SOURCE         F-VALUE         5         32         0.145         0.022         10           VARTION         OF         SOURCE         F-VALUE         5         32         0.145         0.022         10           INTERCEPT         1         2.38261         2.38261         33         0.033         0.033         56           REGRESSION         T1         2.5582         3.45200         12.451         10         37         0.441         0.016         40           Systach RC1         13         4         0.032         10         36         0.033         57           Systach RC1         13         4         0.032         1.018         40         0.048         0.118         33           Systach RC1         13         4         0.048         0.118         33         0.035         57           TOTAL         555         4.562         4.66         0.048         0.118         33	MULTIPLE	R SQUARE	) 0.	.624					31157	28	-0.208	0.245	9
SURCE OF SUMS OF HOAN 5 SURVE OF HOAN 5 SURVE OF HOAN 5 SURVE OF SUMMES SUMMES F-HALLE 5 S S SUM FOR SUMMES SUMMES F-HALLE 5 S S S SUM FOR SUMMES SUMMES F-HALLE 5 S S S S S S S S S S S S S S S S S S S		ANALYSIS	OF VARIANCE					(2)	1	29	0.291	0.111	36
SUBJE DF         SUBLE OF									2	30	-0.325	Q.105	42
VARIATION         DF         SQUARES         S	SOURCE OF		SUMS OF	MEAN					3	31	-0.320	0.090	68
B         33         0.033         0.033         0.033         0.033         0.035           INTERCEPT         1         2.382E1         2.382E1         3         9         36         0.333         0.033         60           20utr(ry/Gear/TC (1)         28         1.7842         5.30620         22.745         11         38         0.043         0.065         57           20utr(ry/Gear/TC (1)         28         1.7842         5.30620         22.745         11         38         0.046         0.118         0.118         0.118         0.118         0.118         0.118         0.118         0.118         0.118         0.118         0.045         22         38         0.045         22         38         0.045         23         0.168         0.119         33           Vear (4)         34         2.9155         8.568511         3.093         65         41         0.455         0.045         12         13         13         55         40         0.455         0.066         102           107AL         55         4.9442         0.155         61         40         0.337         0.255         44         0.255         10         127         0.177         1 </td <td>VARIATION</td> <td>DF</td> <td>SQUARES</td> <td>SQUARES</td> <td></td> <td>F-VALUE</td> <td></td> <td></td> <td>5</td> <td>32</td> <td><sup>-</sup>0.145</td> <td>0.092</td> <td>60</td>	VARIATION	DF	SQUARES	SQUARES		F-VALUE			5	32	<sup>-</sup> 0.145	0.092	60
INTERCEPT         1         2.382E1         2.382E1         8         35         0.385         0.082         0.083         065           HEGRESSION         77         2.455E2         3.432E0         12.461         10         31         70.441         0.106         44           MURTY (bar) (1)         28         1.342E         5.306E0         22.745         11         33         70.481         0.106         44           Murty (bar) (1)         28         1.342E         5.306E0         23.745         11         33         70.481         0.106         45           Sycatch RCT [3]         4         1.036E1         2.7455E         13.05         40         0.488         0.117         31           Sycatch RCT [3]         4         1.395E2         2.706E1         65         41         0.455         0.066         50           StisJULIS         57.7         1.395E2         2.706E1         65         44         0.425         2         2         2         2.706E1         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50 <td>********</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>6</td> <td>.33</td> <td>-0.338</td> <td>0.093</td> <td>61</td>	********								6	.33	-0.338	0.093	61
INTERCEPT         1         2.322:1         8         35         TO 322         0.003         66           REGRESSION         77         2.65622         3.492E0         12.461         10         37         0.441         0.106         40           Month (F)         11         3.70251         0.866         12         33         0.106         40           Month (F)         11         3.70251         0.866         0.117         31           Bycsich PCT (3)         4         1.08851         2.74550         9.913         (3)         55         40         0.468         0.119         33           Year (4)         34         2.9151         8.568271         3.093         65         41         70.465         0.066         55           Prest         4.35         0.7150         0.322         0.706         0.328         4           Accensission COEFFLICIENTS         52         4.428         0.328         4         4         0.0302         5           CATEGORY         CODE         VARIABLE         COEFFLICIENTS         53         66         50         70.191         0.564         1           CATEGORY         CODE         VARIABLE								٠.	7	34	-0.265	0.092	70
HEBRESSION         77         2.658/22         3.42E0         12.461         10         37         7.0.441         0.106         42           Cuntry/Ber/TC (1)         28         1.78422         6.300E0         22.745         11         38         7.0.441         0.106         42           Wonth (2)         14         6.732E0         7.33847         2.866         12         39         70.184         0.117         31           Bycatch PC (1)         28         1.53867         2.3392         65         41         70.455         0.008         52           War (4)         34         2.3321         8.55867         3.093         65         41         70.455         0.0085         52           FESIDUALS         577         1.5382         2.77067         85         64         0.61         44         0.637         0.425         0.206           REGRESSION COEFFICIENTS         50         65         64         0.61         45         0.730         1           CALEDORY         0.00E         VARIABLE         COEFFICIENTS         50         51         0.127         0.583         1           Call of the south ry/Serrit 2         20.116         0.128         0.1165<	INTERCEPT	1	2.382E1	2.382E1					8	35	-0.302	0.093	56
HEBRESSION         PT         2.8582         3.45260         12.461         00         37         07.441         0.106         42           Country/Ger; TC (1)         20         1.75452         5.300E0         22.7455         11         38         7.261         0.106         40           Ment (2)         11         3.720E1         7.326E1         2.380E1         2.745E0         9.913         (3)         55         40         70.488         0.117         31           Byrach ACT (3)         4         1.098E1         2.770E71         55         4.2         70.488         0.0065         152           RESIDUALS         577         1.598E2         2.770E71         65         4.4         0.637         0.425         2           TOTAL         655         4.49422         (4)         64         46         0.157         0.328         4									9	36	-0.383	0.095	57
Country/Gear/TC (1)         28         1.7542         6.300E0         22.746         11         38         0.281         0.106         40           Match (2)         11         0.732E0         7.938E1         2.866         12         38         0.186         0.117         31           Syster, PC (1)         24         6.08E1         2.746E0         9.913         (1)         55         40         0.488         0.117         31           Syster, PC (14)         34         2.913E1         8.568E1         3.093         75         42         0.246         0.680         52           RESIDUALS         577         1.59862         2.770E11         85         43         0.136         0.066         102           TOTAL         55         4.49422         (4)         61         45         0.750         0.285         45           CATEGONY         CODE         WARABLE         COEFFICIENT         53         65         50         0.191         0.564         1           Konth         4         82         0.286         0.286         57         10.162         0.286         5           Year         79         0.106         0.197         10	REGRESSION	77	2.658E2	3.452E0		12.461			10	37	-0,441	0.106	42
Wonth (2)         11         8.732E0         7.332E1         2.866         12         39         0.168         0.117         31           Byractor, PCT (3)         4         1.008E1         2.74860         9.913         [3]         55         40         0.468         0.119         33           Year (4)         34         2.913E1         8.568E1         3.003         75         42         0.246         0.080         50           RESIDUALS         577         1.598E2         2.770E11         65         44         0.637         0.425         2           TOTAL         555         4.948E2         (4)         55         4.494E2         0.246         0.328         4           PEGRESSION COEFFICIENTS         52         64         0.447         0.302         5           CATEGORY         CODE         WARHABLE         COEFFICIENT         STD. ERROR         NO.085.         64         44         0.157         0.177           Month         4         57         10.27         0.368         0.166         655         65         50         0.193         0.584         1           Year         59         1.052         1.077         1.077         0.107<	Country:Gear:TC	(1) 28	1.764E2	6.300E0		22.745			11	38	-0.261	0.106	40
Bycstch PCT [3]         4         1,088E1         2,745E0         9,913         [3]         55         40         0.468         0.119         93           Year (4)         34         2,112E1         8,568E11         3,003         65         41         0.455         0.086         52           PESIDUALS         577         1,598E2         2,770E11         85         43         0.135         0.066         102           TOTAL         655         4,494E2         (4)         60         45         0.780         0.226         4           CATEGONY         CODE         VARIABLE         COEFFICIENT         STD. ERRON         NO.085.         65         49         0.427         0.326         4           Guartry/Sear/TC         20127         INTERCEPT         0.666         0.166         655         66         50         0.131         0.564         1           Marth         4         9245         2         0.106         0.197         10         70         54         1.074         0.280         53           Year 59         5         0.1010         0.265         5         71         50         0.684         0.210         1         1.074         0.	Month	(2) 11	8.732E0	7.938E-1		2.866			12	39	-0,168	0.117	31
Vear (4)         34         2.9321         8.968E*1         3.093         65         41         70.455         0.086         52           RESIDUALS         577         1.598E2         2.770E*1         85         43         TO.135         0.086         50           IOTAL         655         4.494E2         (4)         60         44         0.637         0.425         2           IOTAL         655         4.494E2         (4)         60         44         0.637         0.425         2           INCOME         VARIABLE         COEFFICIENTS         52         63         47         0.447         0.302         5           Cartregomy         CODE         VARIABLE         COEFFICIENT         STD. ERROR         MO.0ES.         64         48         0.157         0.577         1           North         4         67         51         0.127         0.583         1         1         0.286         5           Year         93         53         0.152         0.399         0.296         5         1         1         0.266         5         71         5         0.683         0.191         1         0.774         0.260         717	<b>Bycatch PCT</b>	(3) 4	1.098E1	2.746E0		9.913		(3)	55	· 40	~0.488	0,119	33
75         42         70         24.6         0.030         50           DTAL         577         1.538E2         2.770E"1         85         4.3         70.136         0.066         102           TOTAL         655         4.494E2         61         45         0.136         0.026         4           ENDERSSION COEFFICIENTS         62         44         0.425         0.326         4           CATEGORY         CODE         VARIABLE         COEFFICIENT         STD. ERROR         NO. 085.         64         48         0.157         0.577         1           CUTEGORY         CODE         VARIABLE         COEFFICIENT         STD. ERROR         NO. 085.         64         48         0.157         0.577         1           Cuntry/Sear/TC         20127         INTERCEPT         0.868         0.168         655         66         50         70         1.191         0.584         1           Bystch PCT         95         0.168         0.197         10         70         54         1.074         0.260         7           3125         1         0.168         0.1174         12         72         56         0.083         0.198         17	Year	(4) 34	2.913E1	8.568E <sup>-1</sup>		3.093			65	41	-0.455	0.086	52
RESIDUALS         517         1.59822         2.70E*1         85         4.3         7.1.36         0.066         102           TOTAL         655         4.49422         (4)         60         44         0.637         0.425         2           REGRESSION COEFFICIENTS         62         45         0.447         0.302         5           CATEGORY         CODE         VARHABLE         COEFFICIENT         510         63         47         0.447         0.302         5           Country/Gear; TC         20127         INTERCEPT         0.666         855         66         50         70.191         0.564         1           Weart 59         69         53         0.152         0.366         0.295         5           Year         53         0.152         0.197         10         70         54         1.074         0.266         7           Year         59         53         0.152         0.369         0.270         14         12         72         56         0.093         0.198         17           3155         0.170         70         54         1.074         0.260         7									75	42	-0.246	0.090	50
TOTAL         555         4.49452         (4)         60         44         0.837         0.425         2           REGRESSION COEFFICIENTS         61         45         0.760         0.326         4           CATEGORY         CODE         VARIABLE         COEFFICIENT         STD. ERROR         KO.085.         84         48         0.157         0.377         1           CATEGORY         CODE         VARIABLE         COEFFICIENT         STD. ERROR         KO.085.         84         48         0.157         0.377         1           Country/Sear/TC         20127         INTERCEPT         0.868         0.165         5           GS         68         52         68         0.369         0.346         0.346         3           VIEC5         1         0.644         0.152         0.446         0.439         0.346         0.349         0.346         0.345         5           YEAR         5         0.452         0.452	RESIDUALS	577	1.598E2	2.770E-1					85	43	-0.136	0.066	102
And Control         61         45         0.760         0.328         4           CATEGORY         CODE         VARIABLE         COEFFICIENTS         63         47         0.447         0.302         5           CATEGORY         CODE         VARIABLE         COEFFICIENT         STD. ERROR         NO.085.         64         48         0.157         0.377         1           Country/Sear/IC         20127         INTERCEPT         0.868         0.166         655         66         50         0.191         0.584         1           Nonth         4          63         52         0.399         0.286         5           Year         59          68         52         0.399         0.286         7           Year         59          0.162         0.174         12         72         56         0.093         0.198         17           3154         4         70.062         0.210         8         73         57         0.067         0.242         8           3155         5         0.246         0.148         21         74         58         0.018         0.198         17           1127 </td <td>TOTAL</td> <td>655</td> <td>4.494E2</td> <td></td> <td></td> <td></td> <td></td> <td>(4)</td> <td>60</td> <td>44</td> <td>0.637</td> <td>0.425</td> <td>2</td>	TOTAL	655	4.494E2					(4)	60	44	0.637	0.425	2
REGRESSION COEFFICIENTS         62         46         0.426         0.326         4           CATEGORY         CODE         VARIABLE         COEFFICIENT         SID. ERROR         NO. 065.         64         48         0.147         0.302         5           Country/Gear/IC         20177         INTERCEPT         0.866         0.166         655         65         50         0.191         0.584         1           Country/Gear/IC         20177         INTERCEPT         0.866         0.166         655         65         50         0.191         0.584         1           Country/Gear/IC         2125         1         0.105         0.197         10         70         54         1.074         0.285         5           Year         59         -         0.105         0.197         10         70         54         1.074         0.260         7           2155         2         0.110         0.266         5         71         55         0.684         0.210         14           3155         5         0.246         0.148         21         74         58         0.223         0.193         11           4157         7         0.204									61	. 45	0,760	0.326	4
CATEGORY         CODE         VARIABLE         COEFFICIENT         SID.         ERROR         MO.         065.         64         48         0.157         0.517         1           Countryl Gear /TC         20127         INTERCEPT         0.666         0.166         655         66         50         0.191         0.584         1           Nonth         4         67         51         10.127         0.583         1           Breach PCT         95         58         52         0.369         0.245         3           (1)         2125         1         70.105         0.197         10         70         54         1.074         0.260         7           2155         2         0.110         0.266         5         71         55         0.684         0.210         14           3155         5         0.246         0.148         21         74         59         0.0187         10           1127         5         0.666         0.207         8         73         57         0.067         0.442         8           3155         0.246         0.125         34         76         60         70.669         0.208		I	REGRESSION CO	DEFFICIENTS	•				62	46	0.426	0.326	4
CATEGORY         CODE         VARIABLE         COEFFICIENT         STD. ERROR         NO. 085.         64         48         0.157         0.577         1           Country/Gear/IC         20127         INTERCEPT         0.868         0.166         855         65         50         0.197         0.583         1           Nonth         4         67         51         0.127         0.583         1           War         59         68         52         0.369         0.295         5           Year         59         50         0.157         0.574         0.074         0.260         7           2155         2         0.110         0.266         5         71         55         0.684         0.210         14           3125         3         0.678         0.174         12         72         55         0.084         0.223         0.197         21           4127         5         0.246         0.125         34         76         60         70.067         0.424         8           11155         9         0.004         0.223         7         76         60         70.069         0.208         223         0.197									63	47	0.447	0.302	5
International construction         International constructinct construction         International construction <td>CATEGORY</td> <td>CODE</td> <td>VARTABLE</td> <td>COFFEICIENT</td> <td>STD.</td> <td>FRROR</td> <td>NO. 085.</td> <td></td> <td>64</td> <td>48</td> <td>0.157</td> <td>0.577</td> <td>1</td>	CATEGORY	CODE	VARTABLE	COFFEICIENT	STD.	FRROR	NO. 085.		64	48	0.157	0.577	1
Country/Sear/TC         20127         INTERCEPT         0.868         0.166         655         66         50         To.191         0.584         1           Wonth         4         67         51         To.127         0.583         1           Bycatch PCT         95         58         52         0.366         0.295         5           Year         59         53         0.152         0.346         3           (1)         2125         1         To.105         0.197         10         70         54         1.074         0.260         7           3155         2         0.110         0.266         5         71         55         0.684         0.210         8           3155         5         0.244         0.174         12         72         56         0.030         0.198         17           4127         6         To.204         0.182         21         74         56         0.223         0.187         21           4157         7         0.204         0.125         34         76         60         To.069         0.208         22           10127         8         To.066         0.273									65	49	0.283	0.296	5
North         4         67         51         0.127         0.583         1           Bycatch PCT         95         68         52         0.369         0.295         5           Year         59         69         53         0.152         0.346         3           (1)         2155         2         0.110         0.266         5         71         55         0.684         0.210         14           3125         3         0.678         0.174         12         72         56         0.093         0.198         17           3154         4         0.062         0.210         8         73         57         0.067         0.242         8           3155         5         0.264         0.148         21         74         58         0.223         0.197         21           4127         6         0.204         0.125         34         76         60         0.069         0.208         22           10127         8         0.666         0.207         8         77         1         0.145         0.148         43           14125         12         1.365         0.123         6         7	Country Gear 1TC	20127	INTERCEPT	0.868	N.	0.166	655		66	50	-0,191	0.584	1
Bycatch PCT         95         68         52         0.369         0.296         55           Year         59         69         53         0.152         0.346         33           (1)         2155         2         0.110         0.266         5         71         55         0.684         0.210         14           3152         3         0.678         0.174         12         72         56         0.093         0.198         17           3154         4         70.082         0.210         8         73         57         70.667         0.242         8           3155         5         0.246         0.146         21         74         58         0.223         0.197         21           4127         7         0.204         0.125         34         76         60         70.689         0.208         22           10127         8         70.656         0.207         8         77         61         0.145         0.182         32           11157         9         0.004         0.223         7         78         62         0.019         0.192         32           11155         9	Month	4							67	51	-0,127	0.583	1
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Sycatch PCT	95							68	52	0.369	0.296	5
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Year	59							69	53	0,152	0,346	3
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	(1)	2125	1	-0,105		0.197	tO		70	54	1.074	0.260	7
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	(.)	2155	2	0.110		0.265	5		71	55	0.684	0.210	14
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		3125	3	-0.878		0.174	12		72	56	0.093	0.198	17
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		3154	4	-0.082		0.210	8		73	57	-0.067	0.242	8
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		3155	5	0.248		0.148	21		74	58	0.223	0.197	21
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		4127	5	-0.231		0.164	14		75	59	0.018	0.195	21
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		4157	7	0.204		0.125	34	•	76	60	-0.069	0.208	22
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		10127	8	0.066		0.207	8		77	61	-0.145	0.196	27
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		11155	9	0.004		0.223	7		78	62	0.019	0.192	32
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		11157	10	0.070		0.236	6		- 79	63	-0.289	0.184	43
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		14124	11	-0,989		0.205	9	•	80	64	<sup>-</sup> 0,154	0.186	33
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		14125	12	-1,363		0.172	12		81	65	-0.052	0.189	29
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	•	14126	13	-1.165		0.134	24		82	66	-0.067	0.188	29
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		14127	14	0.826		0.108	46		83	67	- 184	0.190	31
16127       16       T0.867       0.189       13       85       69       T0.128       0.206       20         17116       17       T0.607       0.199       11       86       70       0.276       0.217       15         17126       18       T0.666       0.152       25       87       71       0.342       0.209       19         17127       19       T0.807       0.215       8       88       72       T0.135       0.209       18         20114       20       T1.928       0.160       35       89       73       T0.257       0.198       38         20116       21       T0.627       0.216       12       90       74       T0.389       0.181       70         20126       22       T0.428       0.254       5       91       75       T0.359       0.226       21         20156       23       T0.048       0.152       21       92       76       T0.440       0.225       27         20157       24       0.370       0.082       135       93       77       T0.540       0.229       13         25127       26       0.543       0.146		14156	15	-1, 181		0.235	6		84	58	-0.173	0.196	24
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		16127	16	-0.867		0.189	13		85	69	-0,128	0.206	20
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		17116	17	-0.607		0.199	11		- 86	70	0.276	0.217	15
17127       19       70.807       0.215       8       88       72       70.135       0.209       18         20114       20       71.928       0.160       35       89       73       70.257       0.198       38         20116       21       70.627       0.216       12       90       74       70.389       0.181       70         20126       22       70.428       0.254       5       91       75       70.359       0.226       21         20156       23       70.048       0.152       21       92       76       70.440       0.225       27         20157       24       0.370       0.082       135       93       77       70.540       0.229       13         25126       25       0.202       0.166       18       33       77       70.540       0.229       13		17126	18	-0.666		0.152	25		87	71	0.342	0.209	19
20114       20       ~1.928       0.160       35       89       73       ~0.257       0.198       38         20116       21       ~0.627       0.216       12       90       74       ~0.389       0.181       70         20126       22       ~0.428       0.254       5       91       75       ~0.359       0.226       21         20156       23       ~0.048       0.152       21       92       76       ~0.440       0.225       27         20157       24       0.370       0.082       135       93       77       ~0.540       0.229       13         25126       25       0.202       0.166       18       25127       26       0.543       0.145       33		17127	19	-0.807		0.215	8	,	88	72	10,135	0.209	18
20116       21       70.627       0.216       12       90       74       70.389       0.181       70         20126       22       70.426       0.254       5       91       75       70.359       0.226       21         20156       23       70.048       0.152       21       92       76       70.440       0.225       27         20157       24       0.370       0.082       135       93       77       70.540       0.229       13         25126       25       0.202       0.166       18       25127       26       0.543       0.146       33		20114	20	-1,928		0.160	35		89	73	-0.257	0.198	38
20126       22       0.428       0.254       5       91       75       0.359       0.226       21         20156       23       0.048       0.152       21       92       76       0.440       0.225       27         20157       24       0.370       0.082       135       93       77       0.540       0.229       13         25126       25       0.202       0.166       18       25127       26       0.543       0.146       33		20116	21	0.627		0.216	12		90	74	-0.389	0.181	70
20156         23         0.048         0.152         21         92         76         0.440         0.225         27           20157         24         0.370         0.082         135         93         77         0.540         0.229         13           25126         25         0.202         0.166         18         25127         26         0.543         0.146         33		20126	22	0.428		0.254	5		91	75	-0.359	0.226	21
20157 24 0.370 0.082 135 93 77 0.540 0.229 13 . 25126 25 0.202 0.166 18 25127 26 0.543 0.146 33		20158	23	0.048		0.152	21		92	76	-0,440	0.225	27
25126 25 0.202 0.166 18 25127 26 0.543 0.146 33		20157	24	0.370		0.082	135		93	77	10,540	0.229	13
25127 26 0.543 0.146 33		25126	25	0.202		0.166	18						
		25127	26	0.543		0.145	33						

# TABLE 3. ANOVA RESULTS AND REGRESSION COEFFICIENTS FROM A MULTIPLICATIVE MODEL UTILIZED TO DERIVE A STANDARDIZED CATCH RATE SERIES FOR REDFISH IN DIV. 3M. EFFORT IS MEASURED IN DAYS FISHED (1991-1993 BASED ON PRELIMINARY DATA).

REGRESSIO	ON OF MULI	IPLICATIVE M	IODEL			CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
NULTIPLE	R	0.	834			(2)	2	27		0.106	35
MULTIPLE	R SQUARED	) 0.	696				. 3	28	-0.159	0.091	54
	ANALYSIS	OF VARIANCE					5	29	-0.052	0.089	57
						• •	6	30	-0.103	0.092	55
SOURCE OF		SUMS OF	MEAN				7	31	10.085	0.095	54
VARIATION	DF	SQUARES	SQUARES	F-VALU	E		8	32	-0.054	0.093	57
<b></b>	- <del>-</del>			======	-		9	33	10.200	0.097	46
							10	34	TO.196	0.104	38
INTERCEPT	1	3.597E3	3.597E3				11	35	-0.053	0.105	34
							12	36	0.047	0.122	24
REGRESSION	74	2.547E2	3.442E0	14.72	6	(3)	55	37	-0.455	0.126	28
Country   Gear   TC	(1) 25	1.704E2	6.816E0	29.16	4		65	38	-0.447	0.090	42
Month	(2) 11	3.580E0	3.255E <sup>-</sup> 1	1,39	3		75	39	-0.307	0.090	45
Bycatch PCT	(3) 4	8.454E0	2.114E0	9.04	3		85	40	-0.098	0.068	87
Year	(4) 34	1.387E1	4.080E <sup>-1</sup>	1.74	6	(4)	60	41	- 0.024	0.401	2
	-						_ 61	42	-0.269	0.311	4
RESIDUALS	476	1.113E2	2.337E <sup>-1</sup>				. 62	43	0.680	0.566	1
TOTAL	551	3.963E3					63	44	0.216	0.310	4
							64	45	-0.497	0.541	1
	F	EGRESSION CO	EFFICIENTS				55	46	-0.322	0.280	5
	-						56	47	-0.273	0.569	1
CATEGORY	CODE	VARJABLE	COEFFICIENT	STD. ERROR	NO. OBS.		67	48	71.112	0.560	1
							68	49	-0.156	0.333	3
Country Gear TC	20127	INTERCEPT	3.302	0.164	551	•	69	50	-0.411	0.399	2
Month	4						70	51	-0.222	0.309	4
Bycatch PCT	95						71	52	-0.302	0.230	8
Year	59						72	53	-0.085	0.193	14
(1)	2125	1	0.172	0.194	9		73	54	-0.174	0.222	9
	3125	2	-0.796	0,185	9		74	55	-0.083	0.190	20
	3154	3	0.005	0.201	8		75	56	^0.205	0.192	18
	3155	. 4	0.334	0.157	17		76	57	-0.256	0.208	17
	4127	5	-0.362	0.162	13		11	58	-0.367	0.195	23
	4157	6	-0.062	0.129	34		78	59	-0.383	0.193	27
	10126	7	-0.313	0.217	8		79	60	-0.435	0.186	29
	10127	8	-0.127	0.198	8		80	61	<sup>-0.402</sup>	0.193	23
	10157	9	-0.076	0.228	9		81	62	~0.299	0.195	20
	11155	10	-0.138	0.213	7		82	53	<b>*0.45</b> 7	0.195	23
	14124	11	-1.027	0.207	8		83	64	-0.449	0.189	27
	14125	12	-1.343	0.175	11		84	65	-0.396	0.205	17
	14125	13	-1,393	0.149	18		85	65	⁻0.250	0.208	17
	14127	14	-1.189	0.124	31		86	67	0.086	0.223	12
	14156	15	-1.358	0.239	5		87	68	0.087	0.213	16
	16127	16	-0.766	0.244	8		88	69	-0.438	0.214	14
	17116	17	-0.453	0.203	9		89	70	-0.383	0.198	37
	17126	18	-0.529	0.154	21		90	71	-0.484	0.187	59
	20114	19	-1.586	0.181	31		91	72	-0.538	0.214	31
	20116	20	-0.887	0.208	11		92	73	-0.385	0.222	27
	20156	21	-0.337	0.168	16		93 -	74	-0.766	0.229	12
	20157	22	0,465	0.089	128						
	25126	23	-0.030	0.167	16						
	25127	24	0.565	0.149	28						
	31157	25	-0.295	0,239	8						
(2)	1	26	-0.277	0.115	27						

TABLE 4. STANDARDIZED CATCH RATE SERIES FOR DIV. 3M REDFISH FROM A MULTIPLICATIVE MODEL UTILIZING HOURS FISHED AS A MEASURE OF EFFORT.

# PREDICTED CATCH RATE

	LN TF	RANSFORM	RETRANSFORMED			
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT
1959	0 9692	0.0276	2 600	0.446		
1960	1 5050	0.0270	2.099	1 907	59	22
1900	1 6290	0.1740	4.742	1.897	60	13
1962	1 2044	0.0991	3.509	1.712	61	11
1062	1 2152	0.0973	3.992	1.217	62	16
1903	1.0150	0.0843	4.104	1.168	63	- 15
1065	1.0200	0.3220	2.725	1.431	64	23
1900	0 6760	0.0793	3.493	0.965	65	19
1900	0.0709	0.3296	1.917	1.016	66	34
1907	0.7407	0.3288	2.044	1.083	67	33
1900	1.2307	0.0800	3.802	1.055	68	18
1909	1.0201	0.1107	3.014	0.976	. 69	23
1970	1.9422	0.0575	7.785	1.842	70	9
1971	1.5520	0.0300	5.342	0.920	71	13
1972	0.9612	0.0217	2.972	0.436	72	24
1973	0.8016	0.0394	2.511	0.494	73	- 29
1974	1.0907	0.0217	3.383	0.496	74	22
1975	0.8865	0.0209	2.759	0.397	· 75	27
1976	0.7996	0.0249	2.524	0.396	76	30
1977	0.7232	0.0200	2.344	0.330	77	33
1978	0.8869	0.0193	2.762	0.382	78	28
1979	0.5788	0.0153	2.034	0.251	79	39
1980	0.7139	0.0162	2.327	0.296	80	34
1981	0.8164	0.0172	2.577	0.337	81	31
1982	0.8010	0.0170	2.538	0.330	82	32
1983	0.6842	0.0178	2.257	0.300	83	37
1984	0.6955	0.0213	2.279	0.331	84	37
1985	0.7397	0.0253	2.377	0.376	85	36
1986	1.1439	0.0318	3.549	0.629	86	24
1987	1.2104	.0.0270	3.802	0.621	87	23
1988	0.7336	0.0260	2.361	0.378	88	37
1989	0.6113	0.0220	2.094	0.309 /	. 89	43
1990	0.4791	0.0156	1.840	0.230	90	49
1991	0.5087	0.0330	1.879	0.339	91	48
1992	0.4284	0.0320	1.735	0.308	92 .	53
1993	0.3281	0.0329	1.569	0.283	93	59

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TABLE 5. STANDARDIZED CATCH RATE SERIES FOR DIV. 3M REDFISH FROM A MULTIPLICATIVE MODEL UTILIZING DAYS FISHED AS A MEASURE OF EFFORT.

# PREDICTED CATCH RATE

	LN TF	RANSFORM	NSFORM RETRANSFORMED				
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT	
1959	3.3021	0.0268	30.138	4.910	59	2	
1960	3.2781	0.1616	27.502	10.635	60	2	
1961	3.0332	0.0960	22.247	6.736	61	3	
1962	3.9818	0.3104	51.592	26.673	62	1	
1963	3.5177	0.0951	36.131	10.892	63	2	
1964	2.8051	0.2900	16,070	8.070	64	4	
1965	2.9799	0.0762	21.303	5.775	65	3	
1966	3.0291	0.3117	19.886	10.300	66	3	
1967	2.1902	0.3034	8.630	4.419	67	8	
1968	3.1458	0.1100	24.725	7.987	68	3	
1969	2.8910	0.1612	18.677	7.213	. 69	4	
1970	3.0797	0.0951	23.316	7.029	70	3	
1971	3.0005	0.0453	22.086	4.653	71	3	
1972	3.2169	0.0219	27.743	4.089	72	3	
1973	3.1286	0.0316	25.276	4.462	73	3	
1974	3.2191	0.0210	27.818	4.017	74	3	
1975	3.0976	0.0211	24.634	3.559	75	3	
1976	3.0459	0.0264	23.331	3.771	76	3	
1977	2.9353	0.0208	20.947	3.012	.77	4	
1978	2.9195	0.0210	20.618	2.974	78	4	
1979	2.8670	0.0175	19.597	2.580	79	4	
1980	2.9005	0.0193	20,245	2.801	80	4	
1981	3.0031	0.0209	22.415	3.230	81	4	
1982	2.8452	0.0212	19.137	2.778	82	4	
1983	2.8530	0.0190	19.309	2.655	83	4	
1984	2.9060	0.0260	20.289	3.255	84	4	
1985	3.0519	0.0279	23.454	3.897	85	4	
1986	3.3879	0.0357	32.694	6.126	86	3	
1987	3.3887	0.0297	32.817	5.620	87	3	
1988	2.8644	0.0299	19.423	3.339	88	5	
1989	2.9190	0.0232	20.583	3.119	89	4	
1990	2.8180	0.0182	18.653	2.511	90	5	
1991	2.7638	0.0296	17.568	3.002	91	5	
1992	2.9173	0.0308	20.471	3.570	、 92	4	
1993	2.5359	0.0334	13.961	2.533	93	7	

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.232



Fig. 1. Standardized CPUE and approximate 95% confidence interval for Div. 3M redfish based on effort in hours fished.



Fig. 2. Standardized CPUE and approximate 95% confidence interval for Div. 3M redfish based on effort in days fished.