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PRELIMINARY RESULTS OF STANDARDIZED CATCH RATES FOR SKIPJACK TUNA (*Katsuwonus pelamis*) FROM THE BRAZILIAN BAITBOAT FISHERY THROUGH 1998

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SUMMARY

Preliminary general linear modelling (GLM) analysis were used to attempt to standardize catch and effort data from the Brazilian baitboat fishery of skipjack in the soutwestern Atlantic. The basic data used were extracted from log-books and covered the period 1983-1998. The following main effects were incorporated into the models: fleet, year, region and quarter. Data on vessel type and vessel characteristics were also available but were not used in the analysis. It is expected that the incorporation of these addtional factors could improve the models fit.

RÉSUMÉ

Une analyse préliminaire par modélisation linéaire généralisée (GLM) a servi pour tenter de standardiser les données de capture et d'effort de la pêche de listao par les canneurs brésiliens dans l'Atlantique sud-ouest. Les données de base utilisées étaient extraites des carnets de pêche et couvraient la période 1983-1998. Les facteurs suivants ont été incorporés au modèle: flottille, année, région et trimestre. Des données étaient également disponibles sur les caractéristiques des bateaux, mais n'ont pas été utilisées dans les analyses. Il est escompté que l'incorporation de ces facteurs supplémentaires améliore l'ajustement du modèle.

RESUMEN

Se aplicó el análisis preliminar del modelo lineal generalizado (GLM) en un intento de estandarizar los datos de captura y esfuerzo de la pesquería brasileña de barcos de cebo para el listado en el Atlántico sudoeste. Los datos básicos usados se obtuvieron de los cuadernos de pesca y cubrían el periodo 1983-1998. A los modelos se incorporaron los siguientes elementos: flota, año, región y trimestre. Se disponía también de datos sobre tipo y características de los barcos, si bien no se usaron en el análisis. Se confía en que la incorporación de estos factores adicionales mejore el ajuste de los modelos.

1. INTRODUCTION

The western skipjack stock is primarily caught by baitboats fishing off the South and Southeast coast of Brazil. Venezuelan purse seiners and baitboats also catch important portions of this stock. Minor important fisheries for skipjack are also conducted by USA purse seiners and Cuban baitboats (ICCAT, 1998).

Up to the present the SCRS has not conducted any stock assessment analysis for the Western skipjack stock due to a lack of adequate catch and effort series of data to support such analysis.

During the ICCAT Data Preparatory Meeting for the South Atlantic Abundance Indices (ICCAT, 1995) it was tentatively decided to apply the GLM approach to develop standardized catch rates for the skipjack caught by the Brazilian baitboat fisheries. However, due to time constraints such analysis were not carried out and a recommendation was made for continued investigation in the near future.

Following this recommendation the available data from the Brazilian baitboat fishery were revised to create an appropriate data base on catch and effort covering the period from 1983 to 1998, to support the statistical analysis by the GLM procedure. The basic data consisted of information originated from mandatory submission of logbooks by fishermen of the baitboat fishery from the States of Rio de Janeiro, Santa Catarina and Rio Grande do Sul. The purpose of this paper is to present the preliminary results of the GLM analysis for standardization of skipjack catch rates, in an attempt to provide indices of abundance from the Brazilian baitboat fishery, for possible use by the SCRS to carry out stock assessment analysis for the Western skipjack stock.

2. MATERIAL AND METHODS

Basic catch and effort data used in the analysis were obtained from the baitboat fishery operating off the south and southeast coast of Brazil. Skipjack is the target species for this fishery comprising about 90% of the total weight of catches. Two source of data were used: the first was comprised of logbook data which were available either as records of catch and effort data for each fishing trip, aggregated by month and one degree statistical blocks, or as individual records of daily vessel activities conducted during each fishing trip (catching live bait, moving to the fishing grounds, facing bad weather conditions, searching fish schools, days fishing); the other source of data consisted of information on the main vessel characteristics: gross registered tonnage (GRT), total length, age of the vessels and carrying capacity.

All records of catch and effort data for each vessel were matched with its corresponding vessel characteristics and the resultant data base created included the following data: fleet, vessel identity, year, month, area, days spent at sea, days spent fishing live bait, searching days, effective fishing days, catch in weight by species (skipjack, yellowfin, albacore, blackfin tuna, frigate tuna, dolphin fish and other species), vessel characteristics (total length, gross registered tonnage) and vessel building date. Nominal CPUE values were calculated as catch in weight per fishing days(including unsuccessful searching days).

As for some years the original data set of catch and effort was consisted both of aggregated and disaggregated data, in order to have a database with a uniform format to carry out more consistent analysis, all the disaggregated data were processed for the purpose of having all data in aggregated format

Two types of GLM models were used to develop standardized catch rates of skipjack in the Brazilian baitboat fishery: the $\log(CPUE+1)$ and the delta-lognormal approach of Lo et al (1992), in which the log transformed positive catch rates and the proportion of observations for which there is a positive catch are modelled separately to produce an estimated abundance index. The analysis were conducted following the methodology applied at the ICCAT Data Preparatory Meeting for the South Atlantic Abundance Indices (ICCAT, 1995). Further details of this method are presented by Cramer and Scott (1993, 1997).

In order to allow the application of the GLM model based on the delta-lognormal assumption, each aggregated data record with both fishing days with positive catch and fishing days with zero catch were aggregated separately by all combination of categorical variables which were assumed to have influence on skipjack catch rates. Following this procedure , all observations in the original data set were aggregated by fleet, vessel identity, year, month, quarter, region, 1^o x 1^o area, GRT and vessel length classes.

For this fishery it was assumed that the main factors which influence CPUE are: year, season, area and vessel characteristics. Other factors with considerable influence on catch rates are the bait used, the type of schools from which the catches were made and the fishermen's skill (ICCAT, 1995). For the present analysis the main effects used in the GLM model were: year, fleet, quarter and area. The zero catch records were included in the model and observations with extremely small effort were excluded from the analysis.

3. RESULTS AND DISCUSSION

The original data set available for the analysis consisted of 12,455 observations. The nominal data were planned to be examined by plotting CPUE versus all the available variable which could influence CPUE to determine which variable should be considered as a factor in the model.. However, it was not possible to investigate the effect of all the possible variables on skipjack catch rates and it was decided to restrict the analysis to the following main effects: fleet, year, quarter and region. Tables 1 and 2 presents summaries of these observations by fleet, year, region and quarter, considering all two way combinations of these main effects.

Figures 1 through 6 show plots of CPUE versus year and area and CPUE versus year and season. Two geographical fishing areas were defined based on nominal catch distributions: north area, comprising all one degree blocks to the North of latitude 28^o S, and south area comprising all the blocks situated to the south of this latitudinal line. The main factors considered in defining these two regions were:(1) consistently higher skipjack CPUE in the south area than in the north area, as can be seen from figures 1 through 3; and (2) higher proportion of catches of yellowfin tuna in the North area in comparison with the south area. There are also indications that in the north area some baitboats use to operate around several oil rig platforms placed in the area. It is supposed that the higher proportion of yellowfin catches in this area results from the higher aggregation of yellowfin schools around the platforms. Fishing on this tuna aggregations is advantageous for the baitboat fishermen as they avoid spending time searching for tuna schools in the open sea.

The examination of plots of nominal CPUE for each fleet, by year and season, showed a consistent pattern of higher CPUE during the first quarter, for both leased fleet and Santa Catarina fleet, and smaller CPUE during the third quarter for all fleets (Fig. 4 and 6). For the Rio de Janeiro fleet, CPUE trends by season are not consistent from 1983 through 1998, however it is noted that the highest CPUE's have mainly occurred in the first and second quarters (fig. 5).

Although no consistent relationships could be observed between quarterly skipjack and yellowfin catch rates for leased baitboats and for national baitboats based at Santa Catarina, due to the low yellowfin catches obtained by these fleets, skipjack catch rates varied inversely with yellowfin catch rates for Rio de Janeiro fleet (figure 7).

Vessel characteristics were considered to be an important factor influencing skipjack catch rates. However, they were not included in the analysis because of some difficulties in defining a vessel characteristic strata to use as a categorical variable, in which vessels pertaining to each fleet could be included. This is the case of the leased baitboat fleet, in which all the vessels have homogeneous characteristics for length and GRT. In this way, to avoid the exclusion of a great portion of the available data in the analysis, no vessel characteristics factor were explicitly considered. Although, it can be considered that vessel characteristics could explain one part of fishing success, as a result of having higher bait capacity and autonomy at sea, with bigger vessels being expected to show better fishing performance, fishermen experience and their ability to locate and concentrate fish schools are possibly more important factors explaining fishing success for this fishery. For the purpose of the analysis it was assumed that all these factors were implicitly taken into account when the vessels were classified into three separate fleets. As each fleet show different vessel characteristics and it is supposed that the biggest vessels will have a more experienced crew, the application of fishermen's knowledge on the environmental factors which influence the distribution and concentration of fish schools, would allow them to choose the best area and season for fishing.

The better fishing performance of the leased fleet, comprised of the biggest vessels (over 150 GRT), in comparison with the national baitboats has been shown by IBAMA(1996) who reported that the mean annual skipjack catch rates for the leased vessels were consistently higher than for the national vessels, when fishing at the same areas and seasons.

Plots of nominal catch rates of skipjack by year and fleet showed a similar pattern of fluctuation in annual CPUE among fleets (fig. 8). For the leased fleet skipjack CPUE was consistently higher than CPUE for the other fleets. For the Brazilian fleet the examination of plots of nominal data also shown that CPUE for Santa Catarina fleet was always higher than CPUE for Rio de Janeiro fleet. It is also suggested that differences in skipjack CPUE between Rio de Janeiro and Santa Catarina fleets have increased since 1989.

Tables 3 and 4 present summaries of analysis of variance for each GLM model analysis as well as plots of histograms of the standardized residuals and the estimated skipjack abundance index with associated statistics. The plot of the fit residuals of both GLM analysis were approximately normally distributed, which suggest that both models fit could be considered acceptable. However, a poor fit (in terms of r^2) was presented by the lognormal model, and it is possible that improvements in r^2 would be expected by adding factors for vessel type and/or vessel characteristics and also for interaction terms.

The least square adjusted CPUE with its corresponding confidence limits are plotted in figures 9 and 10 and their estimated values are show in table 3 and 4. Although no consistent trends could be noted from standardized CPUE estimated by the lognormal model, when plotting the standardized CPUE estimated by the delta-lognormal model an apparent declining trend is observed from 1985 through 1995 and an increase is noted from 1996 through 1998.

Thanks are extended to Dr. Steven Turner for providing the SAS code used to develop the GLM analysis and for introducing us the basic principles of GLM analysis for development of standardized catch rates..

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Table 1. Number of observations by fleet, year, quarter and region used in the GLM analysis by the Lognormal model

TABLE OF YEAR BY REGION
(1= Leased baitboat fleet; 2= Rio Janeiro fleet; 3= Santa Catarina fleet)

YEAR FLEET

Frequency	1	2	3	Total
83	198	585	62	845
84	245	421	192	858
85	290	479	184	953
86	251	346	74	671
87	259	205	52	518
88	241	76	39	358
89	214	83	164	461
90	182	193	85	460
91	157	107	147	411
92	208	85	216	509
93	201	107	301	612
94	179	102	243	524
95	290	168	208	666
96	194	120	153	467
97	152	104	411	667
98	164	90	388	642
Total	3425	3271	2922	9618

TABLE OF YEAR BY QUATR

YEAR QUATR

Frequency	1	2	3	4	Total
83	235	223	166	221	845
84	248	236	171	203	858
85	258	305	169	221	953
86	196	212	122	141	671
87	110	168	106	132	518
88	113	136	46	59	358
89	129	151	63	118	461
90	120	142	93	105	460
91	168	130	35	78	411
92	153	214	57	85	509
93	233	173	99	107	612
94	183	164	54	98	524
95	216	206	108	136	666
96	188	149	80	70	467
97	252	245	76	94	667
98	211	247	85	99	642
Total	3031	3131	1512	1962	9618

TABLE OF YEAR BY QUATR
(1= Lesead baitboat fleet; 2= Rio Janeiro fleet; 3= Santa Catarina)

FLEET QUATR

Frequency	1	2	3	4	Total
1	1008	1169	430	818	3425
2	866	980	693	752	3271
3	1139	982	389	412	2922
Total	3013	3151	1512	1962	9518

TABLE OF YEAR BY REGION
FLEET (1= Leasea baitboat fleet; 2= Rio Janeiro fleet; 3= Santa Catarina fleet)
REGION (1= North of 28º S; 2=South 28º S)

FLEET REGION

Frequency	1	2	Total
1	1572	1853	3425
2	3245	26	3271
3	1959	963	2922
Total	6776	2482	9618

TABLE OF YEAR BY REGION
(1= North of 28º S; 2= South of 28º S)

YEAR Frequency	REGION 1	2	Total
83	766	79	845
84	654	204	858
85	695	257	953
86	497	174	671
87	333	163	516
88	228	128	356
89	295	166	461
90	338	122	460
91	237	174	411
92	320	189	509
93	365	247	612
94	323	201	524
95	427	239	666
96	340	127	467
97	511	156	667
98	446	196	642
Total	6776	2842	9618

TABLE OF YEAR BY REGION

QUATR Frequency	REGION 1	2	Total
1	1569	1444	3013
2	2441	690	3131
3	1397	115	1512
4	1369	593	1962
Total	6776	2842	9618

Table 2. Number of observations by fleet, year, quarter and region used in the GLM analysis by the Lognormal model

TABLE OF YEAR BY REGION
FLEET(1= Leased baitboat fleet; 2= Rio Janeiro fleet;
3= Santa Catarina Fleet).

YEAR FLEET Frequency	1	2	3	Total
83	242	877	78	1197
84	310	592	255	1157
85	366	679	265	1310
86	316	497	112	639
87	310	250	69	659
88	297	98	61	448
89	256	99	221	576
90	215	211	98	522
91	189	120	198	507
92	253	96	294	540
93	255	150	369	794
94	204	155	325	694
95	392	223	266	881
96	226	125	182	534
97	180	115	523	819
98	195	104	515	814
Total	4206	4410	3839	12455

TABLE OF YEAR BY QUATR

YEAR QUATR Frequency	1	2	3	4	Total
83	324	335	246	291	1197
84	335	325	235	261	1157
85	341	440	229	300	1310
86	268	309	168	180	639
87	136	207	188	158	659
88	143	105	62	76	448
89	153	191	85	147	576
90	133	165	99	125	522
91	199	168	46	94	507
92	198	272	71	99	540
93	301	235	126	132	794
94	324	262	79	119	694
95	283	286	149	163	881
96	212	178	67	77	534
97	313	294	97	115	819
98	255	326	112	121	814
Total	3829	4159	2009	2458	12455

TABLE OF YEAR BY QUATR
FLEET (1= Lesead baitboat fleet; 2= Rio Janeiro fleet;
3= Santa Catarina fleet).

FLEET QUATR Frequency	1	2	3	4	Total
1	1197	1482	554	983	4206
2	1176	1358	930	946	4410
3	1466	1319	525	529	3839
Total	3829	4159	2009	2458	12455

TABLE OF YEAR BY REGION
FLEET (1= Lesead baitboat fleet; 2= Rio Janeiro fleet;
3= Santa Catarina fleet).
REGION (1= North of 28º S; 2= South 28º S)

FLEET REGION Frequency	1	2	Total
1	1928	2276	4206
2	4372	38	4410
3	2553	1285	3839
Total	8853	3602	12455

TABLE OF YEAR BY REGION
(1= North of 28º S; 2= South of 28º S)

YEAR Frequency	REGION 1	2	Total
83	1102	95	1197
84	884	273	1157
85	967	343	1310
86	687	236	639
87	407	232	659
88	286	160	448
89	374	202	576
90	382	140	522
91	288	219	507
92	394	246	540
93	472	322	794
94	454	240	694
95	570	311	881
96	382	152	534
97	632	187	819
98	572	242	814
Total	8853	3602	12455

TABLE OF YEAR BY REGION
REGION: 1=North of 28º S;
2 = South of 28º S;

QUATR Frequency	REGION 1	2	Total
1	2049	1780	3829
2	3229	930	4159
3	1848	161	2009
4	1727	731	2458
Total	8853	3602	12455

Table 3. Analytical results from the GLM analysis (delta-log normal model) of skipjack catch rates in the Brazilian baitboat fishery.

GLM on proportion positives

```
General Linear Models Procedure
Class Level Information

Class    Levels    Values

YEAR        16    83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98
FLEET        3     1 2 3
QUATR        4     1 2 3 4
REGION       2     1 2
Number of observations in data set = 320

Dependent Variable: POS
                                  Sum of          Mean
Source                 DF        Squares        Square  F Value     Pr > F
Model                  23      1.1962570     0.0520112     4.65     0.0001
Error                 296      3.3114268     0.0111873

Corrected Total       319      4.5076838

                 R-Square          C.V.      Root MSE            POS Mean
                 0.265382      23.03619        0.1058              0.4591

Source                 DF    Type III SS   Mean Square  F Value     Pr > F
YEAR                   15      0.4140086     0.0276006     2.47     0.0020
FLEET                   2      0.0843129     0.0421565     3.77     0.0242
QUATR                   3      0.1970041     0.0656680     5.87     0.0007
REGION                  1      0.0676939     0.0676939     6.05     0.0145
FLEET*REGION            2      0.1901039     0.0950519     8.50     0.0003

STANDARDIZED RESIUALS
                       Histogram                          #  Boxplot
   3.25+*                                            1     0
       .*                                            2     0
       .***                                          5     0
       .****                                         8     |
       .**********                                  20     |
       .************************                    48  +-----+
       .******************************************  84  *--+--*
       .*************************************       74  +-----+
  -0.75+***********************                     46     |
       .*********                                   17     |
       .****                                         8     |
       .*                                            1     0
       .
       .*                                            1     0
       .
       .**                                           4     *
  -4.75+*                                            1     *
        ----+----+----+----+----+----+----+----+--
         * may represent up to 2 counts
```

GLM on positive catches

```
General Linear Models Procedure
Class Level Information

Class    Levels    Values
YEAR        16    83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98
FLEET        3     1 2 3
QUATR        4     1 2 3 4
REGION       2     1 2
Number of observations in data set = 7522

Dependent Variable: LSKJCR
                                  Sum of          Mean
Source                 DF        Squares        Square  F Value     Pr > F
Model                  21      3096.2119      147.4387    99.50     0.0001
Error                7500     11113.4198        1.4818

Corrected Total      7521     14209.6317

                 R-Square          C.V.      Root MSE         LSKJCR Mean
                 0.217895      86.51012        1.2173              1.4071

Source                 DF    Type III SS   Mean Square  F Value     Pr > F
YEAR                   15       413.1000       27.5400    18.59     0.0001
FLEET                   2      1261.4910      630.7455   425.66     0.0001
QUATR                   3       391.0955      130.3652    87.98     0.0001
REGION                  1        30.3135       30.3135    20.46     0.0001

standardized residuals

Variable=SRESID
                        Histogram                           #  Boxplot
   2.75+*                                             5     0
       .**                                           45     0
```

```
      .******                                       225     |
      .*******************                          703     |
      .***************************************     1469  +-----+
      .************************************************  1789  *-----*
      .**************************************      1414  +--+--+
      .**********************                       800     |
      .*************                                459     |
      .********                                     291     |
      .****                                         151     0
      .***                                           87     0
      .**                                            47     0
      .*                                             21     0
      .*                                             10     *
      .*                                              2     *
      .*                                              3     *
 -5.75+*                                              1     *
       ----+----+----+----+----+----+----+----+----+---
        * may represent up to 38 counts
```

cpue is uncorrected model cpue from glm on positive catches. ppos is the model estimated proportion positive.INDEX is the annual, standardized CPUE via the Lo method with a standard error of SE_I and CV of CV_I.

YEAR	CPUE	PPOS	INDEX	SE_I	CV_I	L80%	U80%
83	5.12639	0.55968	6.04474	1.43663	0.23767	4.49891	8.12173
84	2.81340	0.44861	2.68421	0.23189	0.08639	2.40785	2.99229
85	5.52343	0.58639	6.87439	0.51511	0.07493	6.25588	7.55405
86	6.03268	0.50732	6.49833	0.55924	0.08606	5.83172	7.24114
87	4.69033	0.59044	5.86612	0.51658	0.08806	5.25117	6.55309
88	4.09586	0.56664	4.90482	0.51904	0.10582	4.29415	5.60233
89	4.32227	0.58191	5.32516	0.49342	0.09266	4.73955	5.98313
90	3.59857	0.63846	4.85972	0.44167	0.09088	4.33491	5.44806
91	3.17426	0.63010	4.23053	0.39593	0.09359	3.76091	4.75878
92	3.30523	0.61743	4.31887	0.39452	0.09135	3.85023	4.84454
93	3.01721	0.61439	3.92745	0.33291	0.08477	3.53028	4.36930
94	3.52553	0.57476	4.29456	0.37800	0.08802	3.84456	4.79723
95	3.00152	0.56967	3.62530	0.31222	0.08612	3.25315	4.04002
96	3.62274	0.64467	4.93949	0.45683	0.09249	4.39724	5.54860
97	4.52210	0.60594	5.80700	0.48963	0.08432	5.22269	6.45668
98	3.86355	0.69715	5.70163	0.46518	0.08159	5.14550	6.31786

Index with 80% CI

Table 4. Analytical results from the GLM analysis (delta-log normal model) of skipjack catch rates in the Brazilian baitboat fishery.

GLM on proportion positives

General Linear Models Procedure
Class Level Information

Class	Levels	Values
YEAR	16	83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98
FLEET	3	1 2 3
QUATR	4	1 2 3 4
REGION	2	1 2

Number of observations in data set = 320

Dependent Variable: POS

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	23	1.1962570	0.0520112	4.65	0.0001
Error	296	3.3114268	0.0111873		
Corrected Total	319	4.5076838			

R-Square	C.V.	Root MSE	POS Mean
0.265382	23.03619	0.1058	0.4591

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	15	0.4140086	0.0276006	2.47	0.0020
FLEET	2	0.0843129	0.0421565	3.77	0.0242
QUATR	3	0.1970041	0.0656680	5.87	0.0007
REGION	1	0.0676939	0.0676939	6.05	0.0145
FLEET*REGION	2	0.1901039	0.0950519	8.50	0.0003

STANDARDIZED RESIUALS

```
                   Histogram                        #  Boxplot
  3.25+*                                            1     0
      .*                                            2     0
      .***                                          5     0
      .****                                         8     |
      .**********                                  20     |
      .************************                    48  +-----+
      .******************************************  84  *--+--*
      .*************************************       74  +-----+
 -0.75+***********************                     46     |
      .*********                                   17     |
      .****                                         8     |
      .*                                            1     0
      .
      .*                                            1     0
      .
      .**                                           4     *
 -4.75+*                                            1     *
       ----+----+----+----+----+----+----+----+--
        * may represent up to 2 counts
```

GLM on positive catches

General Linear Models Procedure
Class Level Information

Class	Levels	Values
YEAR	16	83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98
FLEET	3	1 2 3
QUATR	4	1 2 3 4
REGION	2	1 2

Number of observations in data set = 7522

Dependent Variable: LSKJCR

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	21	3096.2119	147.4387	99.50	0.0001
Error	7500	11113.4198	1.4818		
Corrected Total	7521	14209.6317			

R-Square	C.V.	Root MSE	LSKJCR Mean
0.217895	86.51012	1.2173	1.4071

Source	DF	Type III SS	Mean Square	F Value	Pr > F

YEAR	15	413.1000	27.5400	18.59	0.0001
FLEET	2	1261.4910	630.7455	425.66	0.0001
QUATR	3	391.0955	130.3652	87.98	0.0001
REGION	1	30.3135	30.3135	20.46	0.0001

standardized residuals

Variable=SRESID

```
                        Histogram                          #  Boxplot
   2.75+*                                                  5     0
       .**                                                45     0
       .******                                           225     |
       .*******************                              703     |
       .***************************************         1469  +-----+
       .************************************************ 1789  *-----*
       .**************************************          1414  +--+--+
       .**********************                           800     |
       .*************                                    459     |
       .********                                         291     |
       .****                                             151     0
       .***                                               87     0
       .**                                                47     0
       .*                                                 21     0
       .*                                                 10     *
       .*                                                  2     *
       .*                                                  3     *
  -5.75+*                                                  1     *
        ----+----+----+----+----+----+----+----+----+---
         * may represent up to 38 counts
```

cpue is uncorrected model cpue from glm on positive catches. ppos is the model estimated proportion positive.INDEX is the annual, standardized CPUE via the Lo method with a standard error of SE_I and CV of CV_I.

YEAR	CPUE	PPOS	INDEX	SE_I	CV_I	L80%	U80%
83	5.12639	0.55968	6.04474	1.43663	0.23767	4.49891	8.12173
84	2.81340	0.44861	2.68421	0.23189	0.08639	2.40785	2.99229
85	5.52343	0.58639	6.87439	0.51511	0.07493	6.25588	7.55405
86	6.03268	0.50732	6.49833	0.55924	0.08606	5.83172	7.24114
87	4.69033	0.59044	5.86612	0.51658	0.08806	5.25117	6.55309
88	4.09586	0.56664	4.90482	0.51904	0.10582	4.29415	5.60233
89	4.32227	0.58191	5.32516	0.49342	0.09266	4.73955	5.98313
90	3.59857	0.63846	4.85972	0.44167	0.09088	4.33491	5.44806
91	3.17426	0.63010	4.23053	0.39593	0.09359	3.76091	4.75878
92	3.30523	0.61743	4.31887	0.39452	0.09135	3.85023	4.84454
93	3.01721	0.61439	3.92745	0.33291	0.08477	3.53028	4.36930
94	3.52553	0.57476	4.29456	0.37800	0.08802	3.84456	4.79723
95	3.00152	0.56967	3.62530	0.31222	0.08612	3.25315	4.04002
96	3.62274	0.64467	4.93949	0.45683	0.09249	4.39724	5.54860
97	4.52210	0.60594	5.80700	0.48963	0.08432	5.22269	6.45668
98	3.86355	0.69715	5.70163	0.46518	0.08159	5.14550	6.31786

Index with 80% CI

FIG1

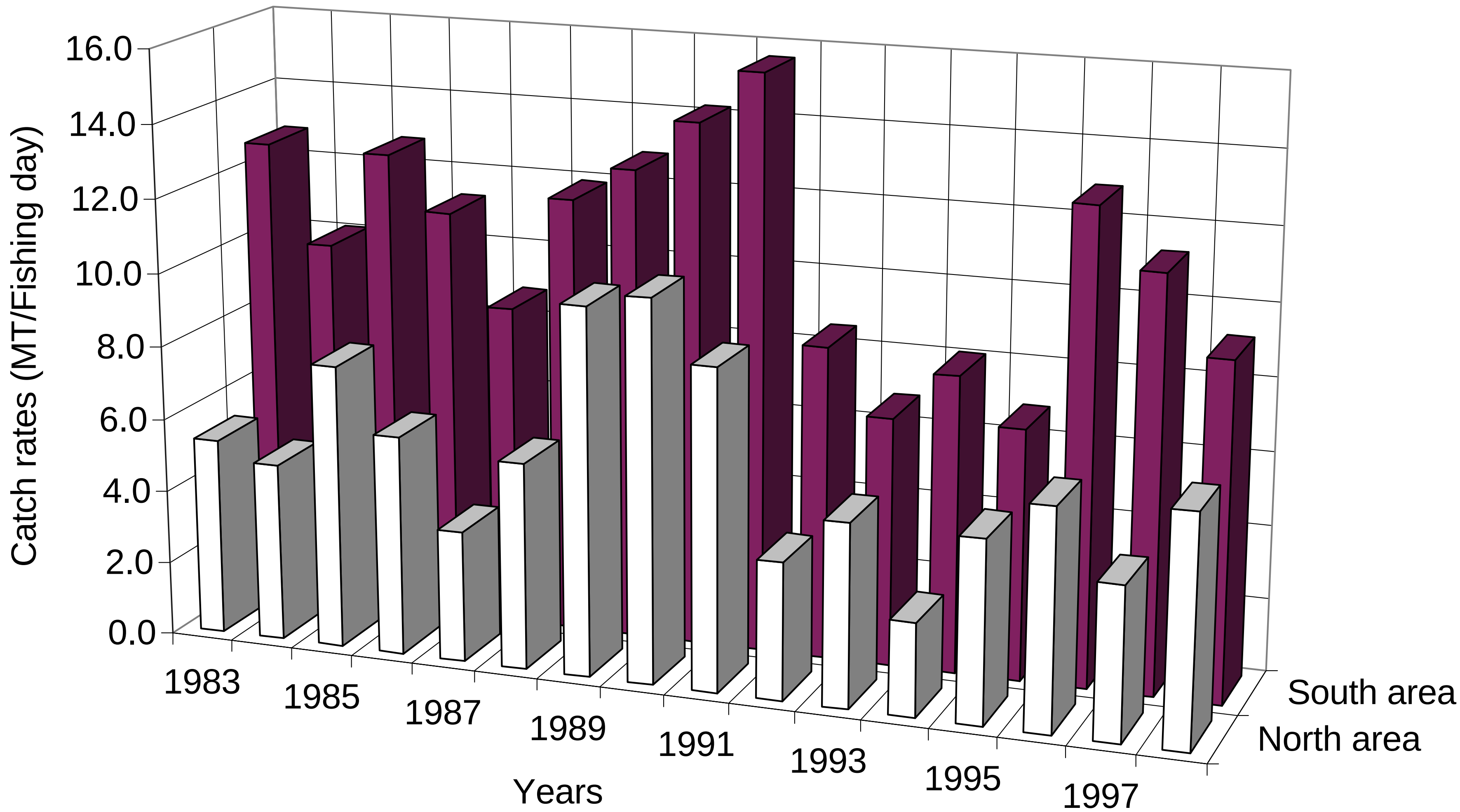

Fig. 1 - Skipjack catch rates by year and area, Japanese leased baitboat fleet

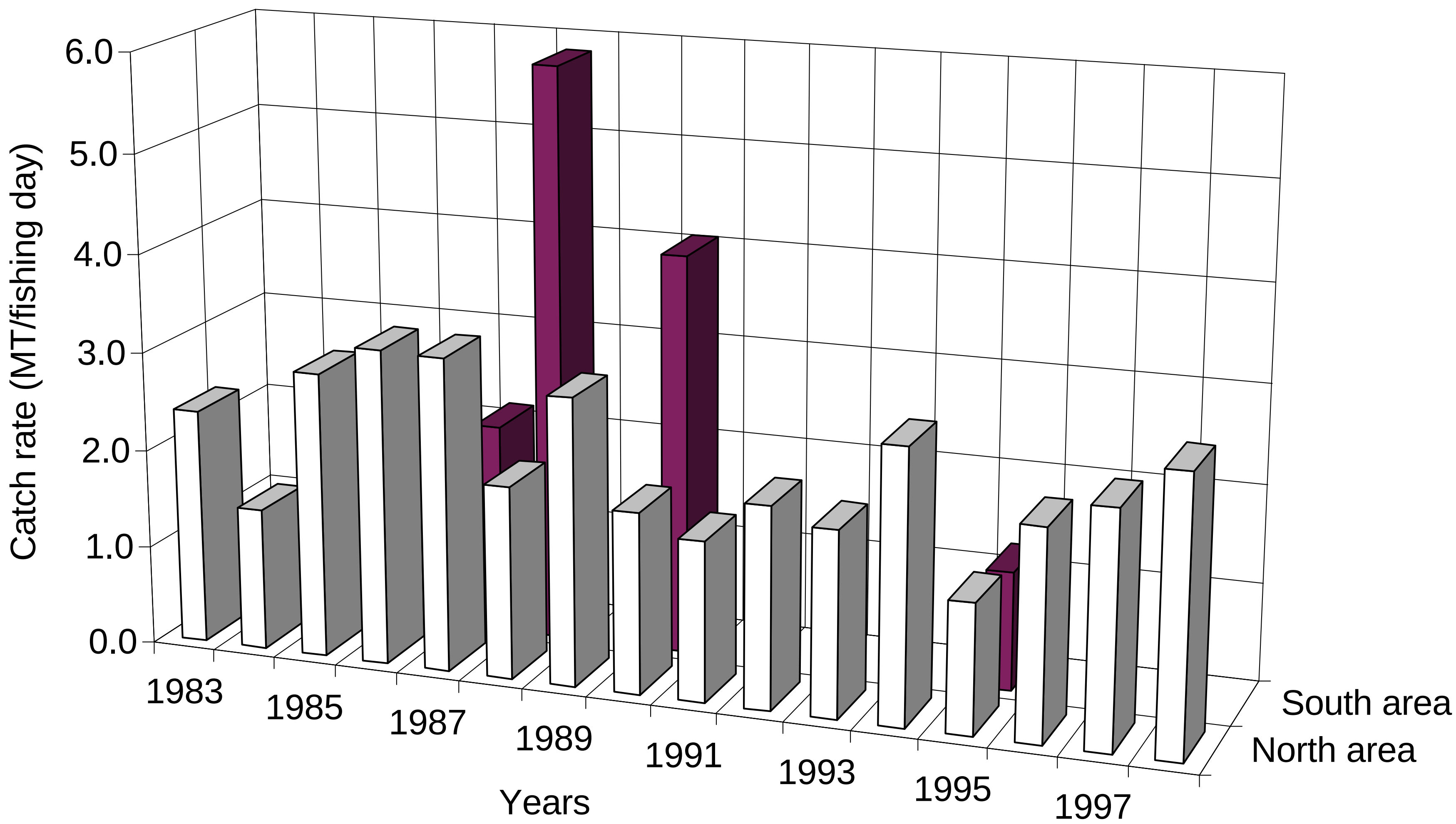

Fig. 2 - Skipjack catch rates by year and area, Rio de Janeiro-based baitboats

FIG3

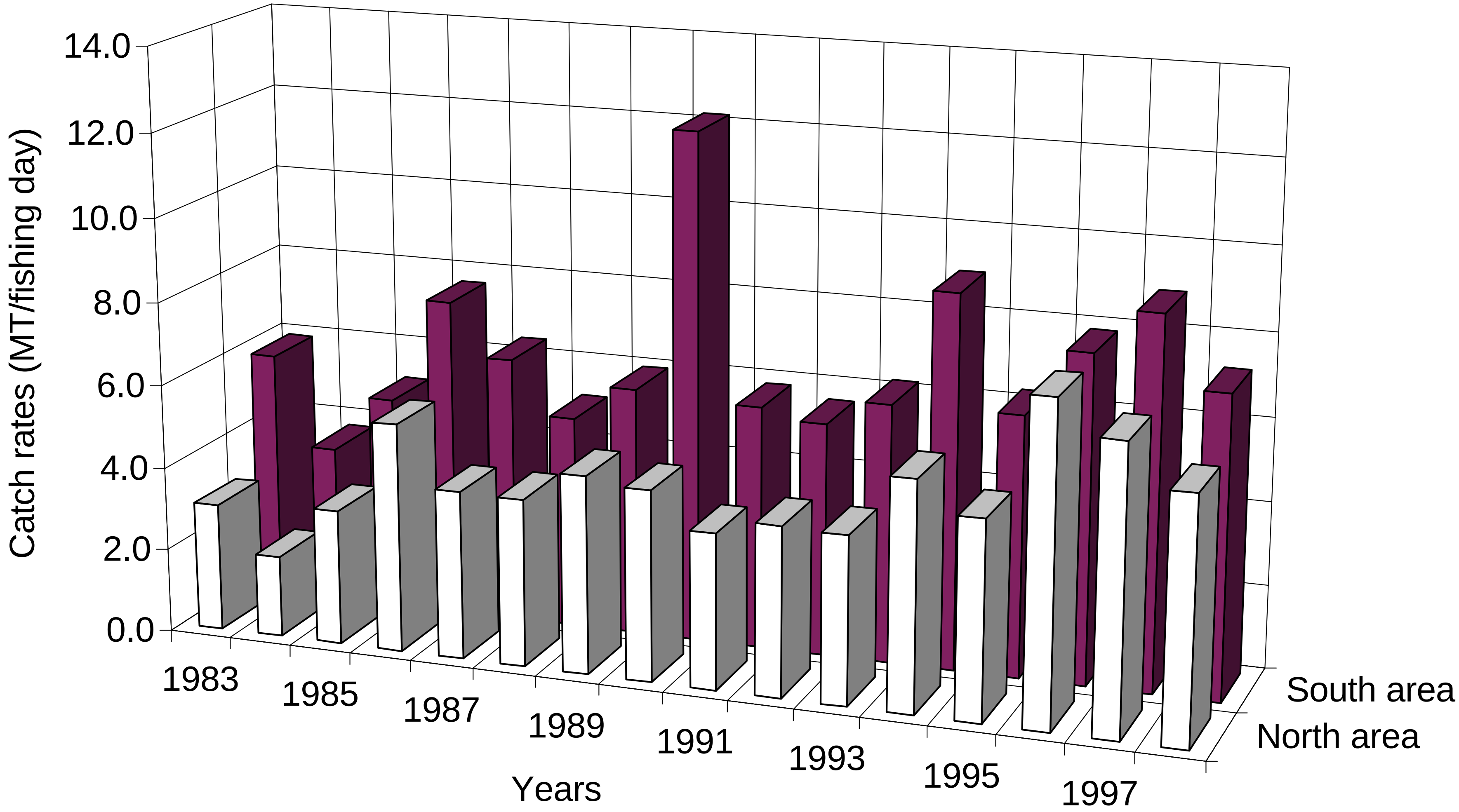

Fig. 3 - Skipjack catch rates by year and area, Santa Catarina-based baitboats

fig4

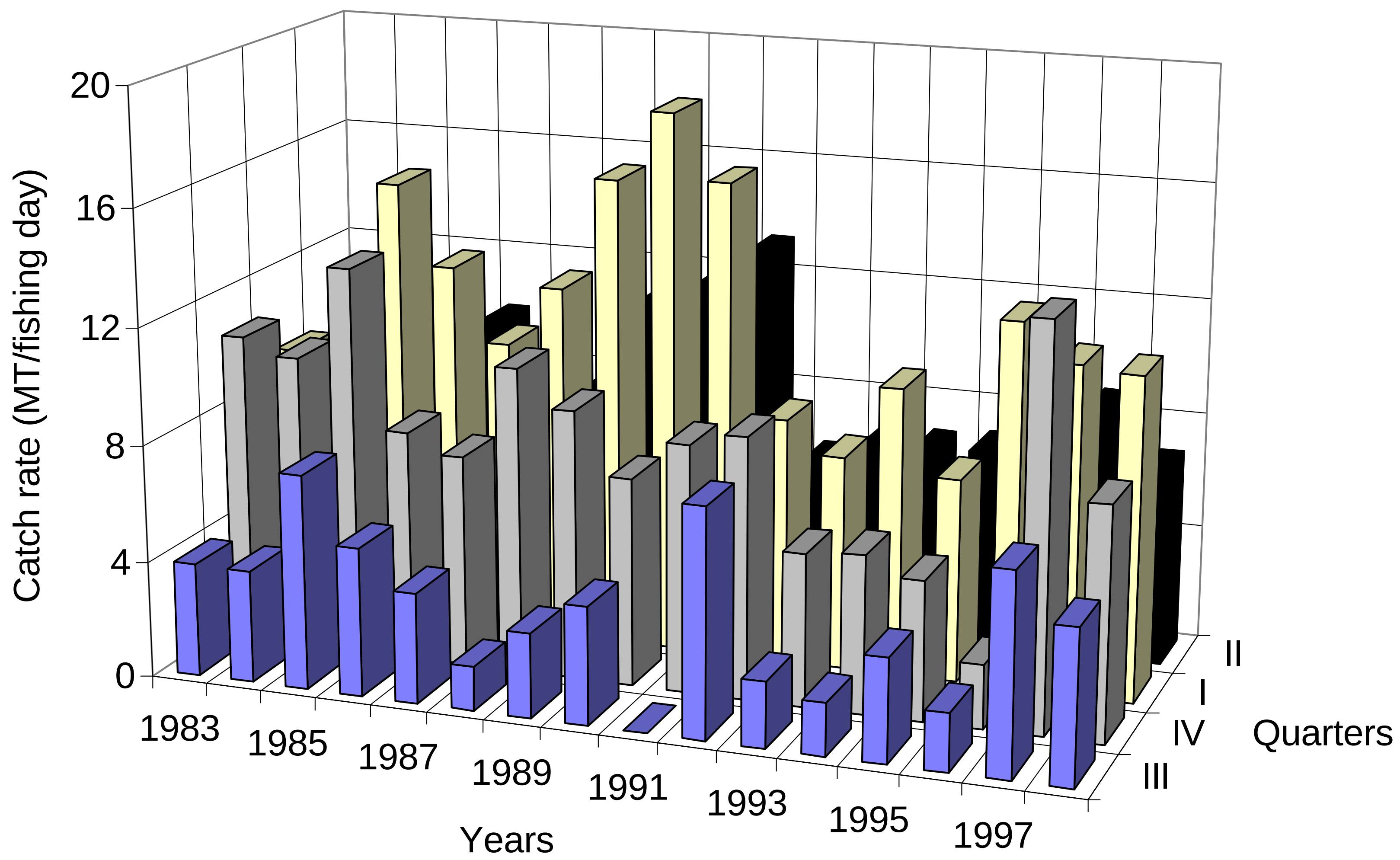

Fig. 4 - Skipjack catch rates by year and quarter, leased baitboats

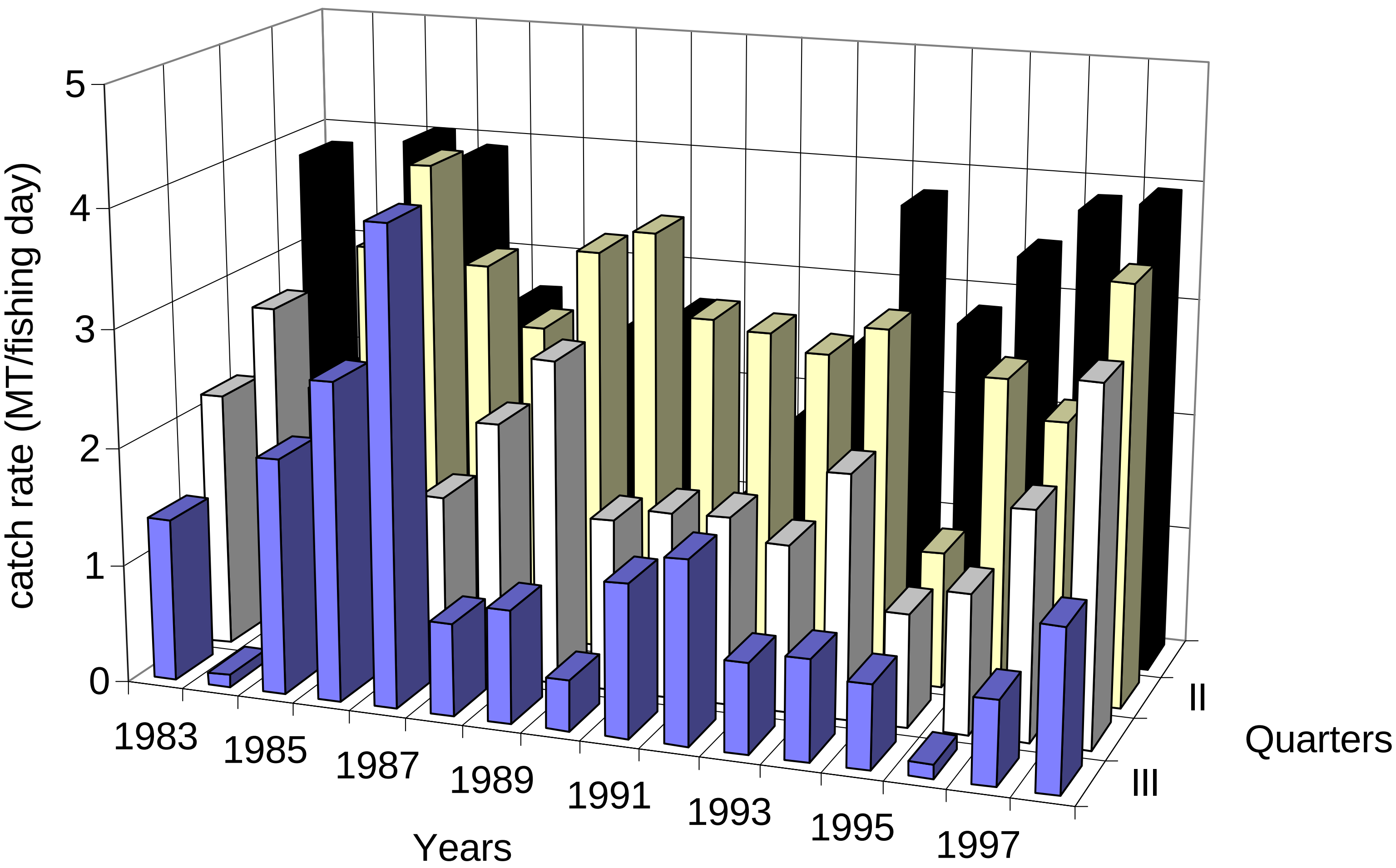

Fig. 5 - Skipjack catch rates by year and quarter, baitboat fleet based at Rio de Janeiro

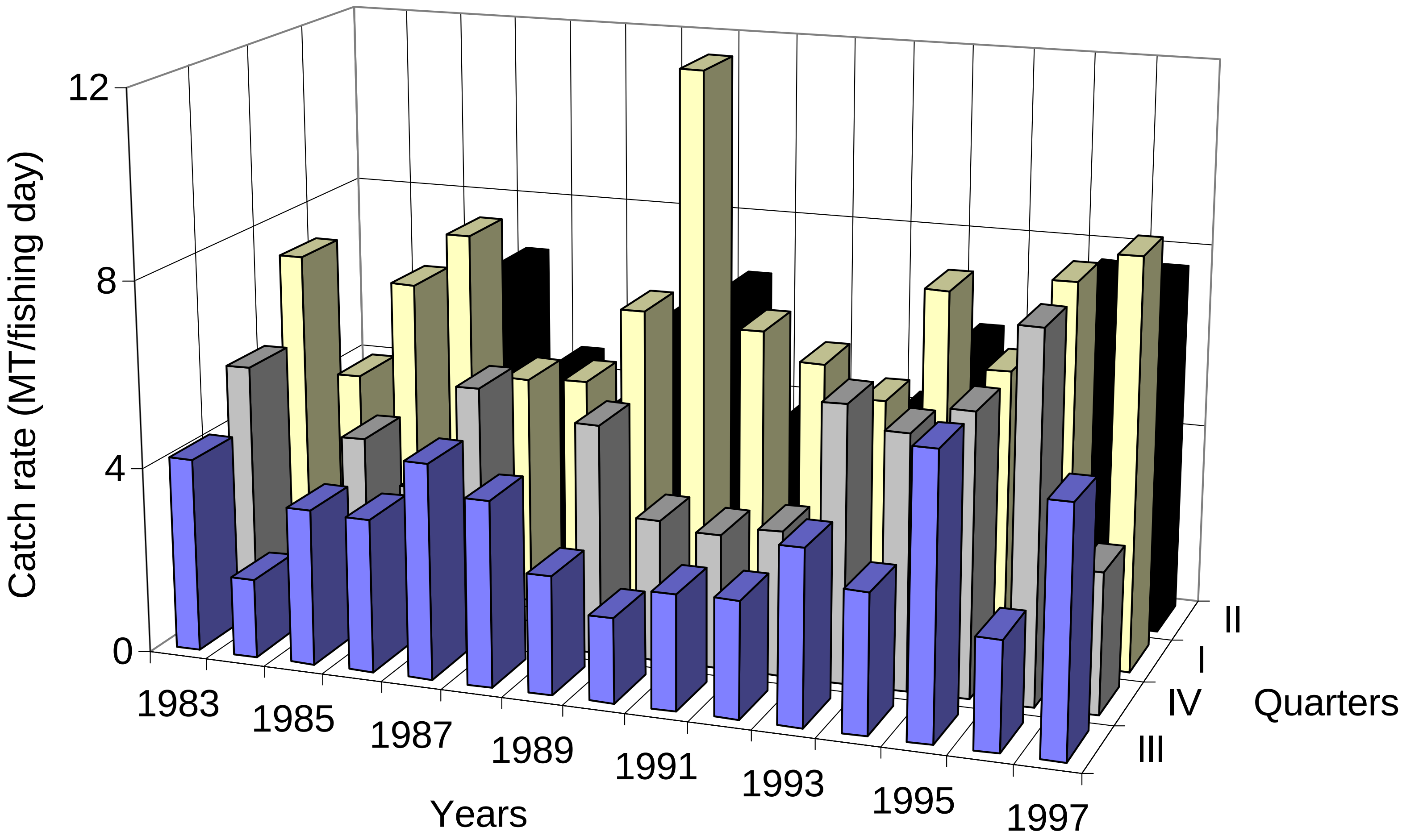

Fig. 6 - Skipjack catch rates by year and quarters, baitboat fleet based at Santa Catarina

Fig. 7 Catch rates of skipjack and yellowfin by quarters from baitboats based at Rio de Janeiro, during the period 1983-98

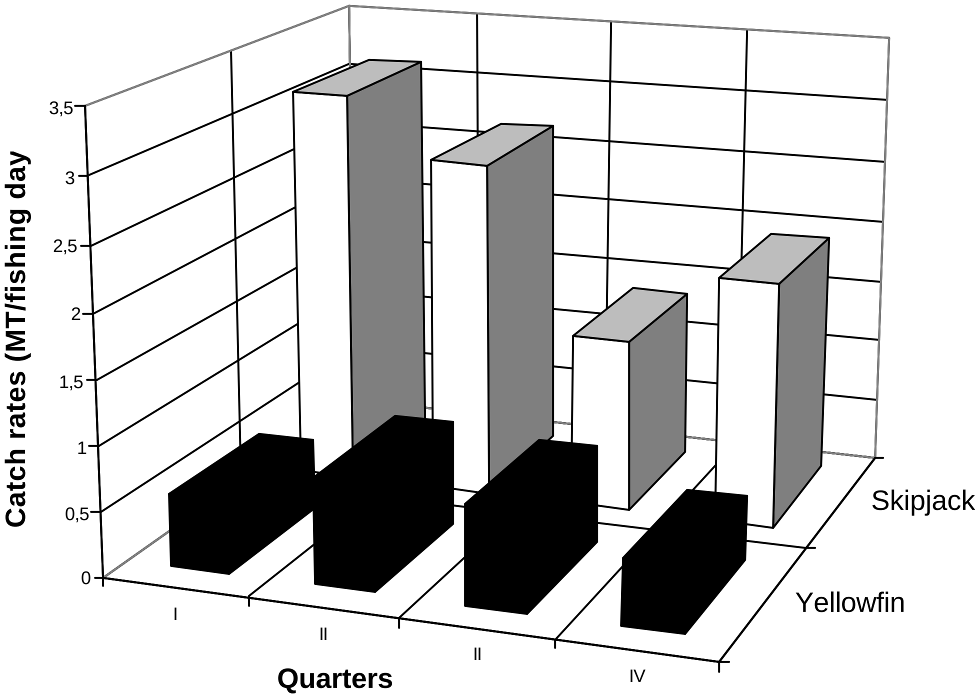

Fig. 8. Nominal CPUE trends for skipjack, by each baitboat fleet, during the period 1983 - 1998.

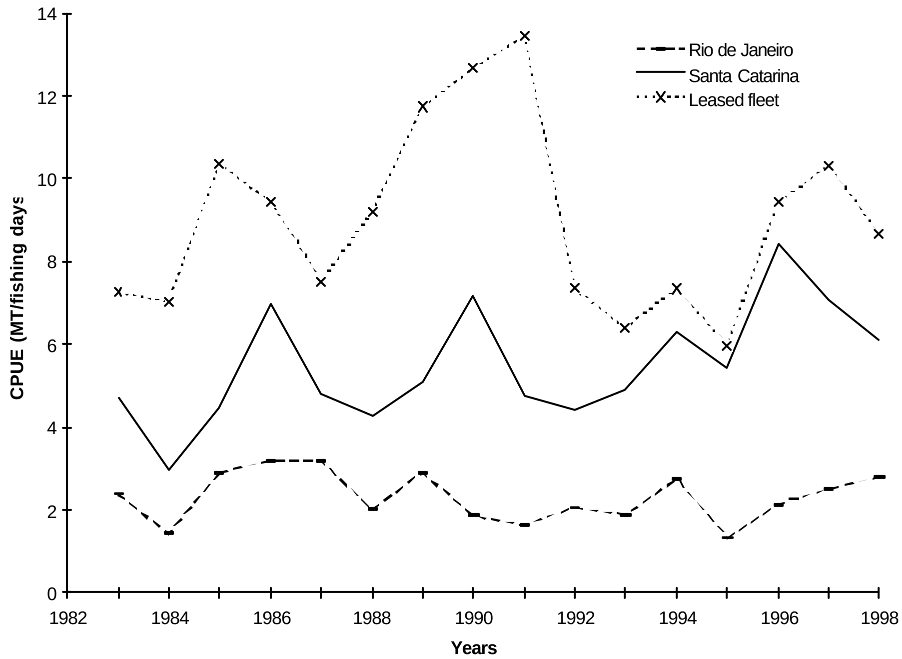

Fig. 9 Annual change of skipjack standardized CPUE and estimated 80% confidence intervals, by GLM (delta-log normal) in the Brazilian baitboat fishery

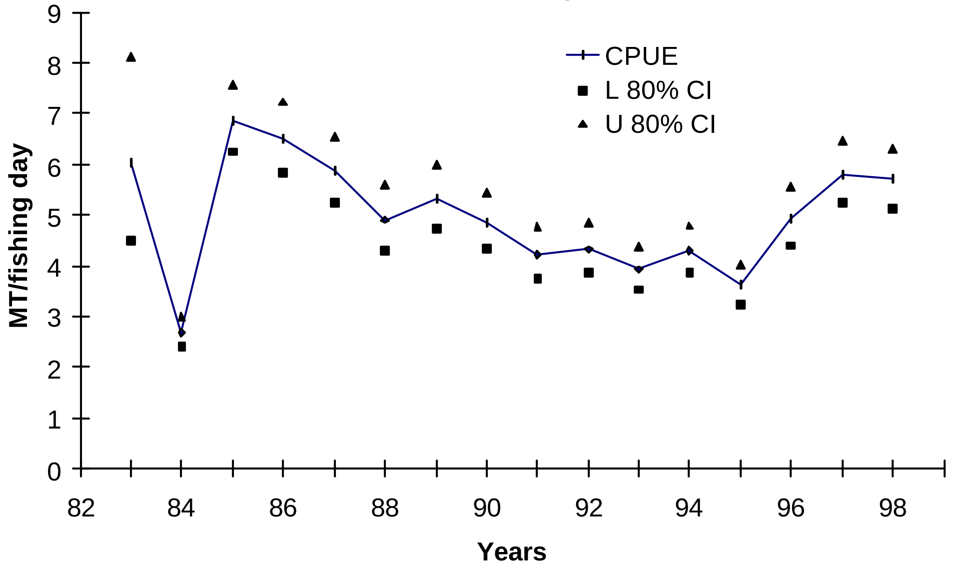

Fig. 10 Annual Change of standardized CPUE and estimated 95% confidence intervals, by GLM (log normal), for skipjack in the Brazilian baitboat fishery