

## REVIEW OF WHITE MARLIN (*TETRAPTURUS ALBIDUS*) FISHERY BIOLOGY OFF THE SOUTHERN BRAZILIAN COAST (1971-2001)

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### SUMMARY

The historical series of white marlin caught by national and leased longliners based in Santos City, Sao Paulo State, Brazil, have been reviewed and the fishery biology has been studied. White marlin represented less than 4% of the catch from the leased and national fleet. In the 1971-84 period the annual average weight of white marlin caught fluctuated from 33.2 to 28.8 kg until 1983, decreasing to 25.3 kg in 1984. For the 1992-95 period it fluctuated from 26.6 to 22.3 kg. This species' annual CPUE (kg per thousand hooks) for the national fleet shows a decreasing trend from 1972 (77.2) to 1982 (12.2), followed by an increasing trend until 1991 (73.6), and then decreasing until 1994 (21.4). From 1995 to 1999, the CPUE of this species ranged from 23 to 57 kg per thousand hooks. The leased fleet exhibited two high peaks, in 1978 (100.1) and in 1979 (94.8). After these peaks, the CPUE fluctuated from 33.6 (1985) to 3.3 (1994). In the study area, white marlin occurs mainly in the fourth and first quarters, especially from October to January. The analysis of annual size-frequency data, show that the largest proportion of the species was concentrated from 135-140 cm to 145-150 cm, in the 1972-83 period, but from 120-125 cm to 125-130 cm in 1971 and 1984. In the period 1971-84, the caught specimens were distributed in the 85-90 cm to 200-205 cm classes. Considering that white marlin attains sexual maturity at around 130 cm (EFL), only 11% of the caught fish by national Santos longliners were of immature size. South and southeast of Brazil is the only area in the South Atlantic with a concentration of maturing white marlin (20°S and 30°S along 20°W). It was observed that white marlin spawns from December to March at 18°-26°20'S and 40°-46°W.

### RÉSUMÉ

Les séries historiques du makaire blanc capturé par des palangriers nationaux et affrétés dont le port d'attache est à Santos City, Etat de Sao Paulo, Brésil, ont été examinées et la biologie halieutique a été étudiée. Le makaire blanc a représenté moins de 4% de la capture de la flottille nationale et affrétée. Durant la période 1971-84, le poids moyen annuel du makaire blanc capturé a fluctué entre 33,2kg et 28,8 kg jusqu'à 1983, puis a été ramené à 25,3 kg en 1984. Pour la période 1992-95, il a fluctué entre 26,6 kg et 22,3 kg. La CPUE annuelle de cette espèce (kg pour mille hameçons) pour la flottille nationale indique une tendance à la baisse de 1972 (77,2) à 1982 (12,2), suivie par une tendance ascendante jusqu'à 1991 (73,6), puis descendante jusqu'à 1994 (21,4). De 1995 à 1999, la CPUE de cette espèce s'est située entre 23 et 57 kg pour mille hameçons. La flottille affrétée a connu deux maximums accusés, en 1978 (100,1) et en 1979 (94,8). Après quoi, la CPUE a fluctué de 33,6 (1985) à 3,3 (1994). Dans la zone sous étude, on rencontre le makaire blanc principalement au cours des quatrième et premier trimestres, notamment d'octobre à janvier. L'analyse des données annuelles de fréquence des tailles indique que la plus forte proportion de l'espèce a été concentrée de 135-140 cm à 145-150 cm, dans la période 1972-83, mais de 120-125 cm à 125-130 cm en 1971 et 1984. Dans la période 1971-84, les spécimens capturés ont été distribués dans les classes allant de 85-90 cm à 200-205 cm. Sachant que le makaire blanc atteint la maturité sexuelle à environ 130 cm (EFL), 11% seulement des poissons capturés par les palangriers nationaux de Santos étaient de taille immature. Le sud et le sud-est du Brésil sont les seules zones dans l'Atlantique sud qui connaissent des concentrations de makaire blanc en voie de maturité (20°S et 30°S le

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long de 20°W). Il a été observé que le makaira blanc fraie de décembre à mars à 18°-26° 20'S et 40°-46°W.

## RESUMEN

Se han revisado series históricas de la aguja blanca capturada por palangreros nacionales y fletados con base en Santos City, estado de Sao Paulo, Brasil, y se ha estudiado la biología de la pesquería. La aguja blanca representaba menos del 4% de la captura de la flota nacional y fletada. En el período de 1971 a 1984, el peso medio anual del atún blanco capturado osciló entre 33,2 y 28,8 kg hasta 1983, descendiendo hasta 25,3 kg en 1984. Para el período 1992-1995 osciló entre 26,6 y 22,3 kg. La CPUE anual de esta especie (kg por mil anzuelos) para la flota nacional muestra una tendencia decreciente desde 1972 (77,2) hasta 1982 (12,2), seguida por una tendencia al alza hasta 1991 (73,6), y después por una decreciente hasta 1994 (21,4). Desde 1995 hasta 1999, la CPUE de esta especie osciló entre 23 y 57 kg por mil anzuelos. La flota fletada tuvo dos puntos máximos en 1978 (100,1) y en 1979 (94,8). Tras estos puntos máximos, la CPUE fluctuó entre 33,6 (1985) y 3,3 (1994). En la zona estudiada, la aguja blanca aparece sobre todo en el cuarto y primer trimestre, sobre todo de octubre a enero. El análisis de los datos anuales de frecuencia de tallas muestra que la mayor proporción de la especie se concentraba entre 135-140 cm y 145-150 cm, en el período de 1972-83, y entre 120-125 cm y 125-130 cm en 1971 y 1984. En el período 1971-84, los especímenes capturados se distribuían en clases de 85-90 cm a 200-205 cm. Considerando que la aguja blanca alcanza su madurez sexual con aproximadamente 130 cm (EFL), sólo el 11% de los peces capturados por los palangreros nacionales de Santos tenían una talla inmadura. Al Sur y al Sureste de Brasil se encuentra la única zona del Atlántico Sur con una concentración de aguja blanca en proceso de maduración (20°S y 30°S, a 20°W). Se observó que la aguja blanca desova desde diciembre a marzo a 18° - 26° 20'S y 40 -46°W.

## KEY WORDS

*Longline fishery; Santos longliner; longliners based in Santos City, Sao Paulo State, Brazil; white marlin (Tetrapturus albidus); white marlin yield, fishing effort, reproduction and biological aspects.*

## 1. INTRODUCTION

The longline fishery in Brazil started with Japanese longliners settled in Recife city, Pernambuco State, in 1956, and operated until 1964. This fleet consisted of 12 boats in 1959 (Paiva and Le Gall, 1975) and although quite good catches were achieved, fishing operations were suspended in 1964 owing to economic and political reasons. During 1976 and 1977, the fishery experienced a brief revival through the leasing of two Korean longliners (Hazin *et al.* 1994).

A Japanese leased fleet based in Santos city, Sao Paulo State, operated with three boats from 1958 to 1961 (Morales, 1962; Morais, 1963), and in 1965/66 a Brazilian company started to operate with two boats in the same port (ARFELLI and AMORIM, 1988). The national longliner fishery in Santos, begun with two boats, increasing gradually until a maximum of 20 boats in 1998 and decreasing again to 14 in 2000. These longliners ranging from 192–25 TB and 52-22 TL (34 to 16 meters long), presented great variation, in its fishing goals. Some leased longliners (with flags of Barbados, Honduras and Panama), have been operating since 1992, also in the South and Southeast off Brazil, and unload in Santos Fishing Terminal (Amorim and Arfelli, 2000).

Some leased boats (with Honduras, Panama and Barbados flags) have been operating since 1992, also in Santos. Based in Rio Grande city, Rio Grande do Sul State, the tuna longline fishery operated from 1977 to 1995 with leased Japanese boats, and from 1982 to 1992 with

national boats. A Taiwanese leased fleet settled in Rio Grande, operated from 1991 to 1994, and a Korean leased fleet during 1994-1995. In Belem city, Para State, a Taiwanese leased fleet started operating in 1992.

In Santos, according to Arfelli *et al.* (1997) the first ten years the main target of the Santos longliners was the tunas. After 1974 shark catch gradually increased, with a minimum of 11% of Santos longliners catch in 1974 to 59% in 1993. Also these longliners brought large amount of sailfish, white and blue marlin, mari mari, different sharks species and swordfish.

According to Ueyanagi *et al.* (1970) and Mather *et al.* (1972), the major concentration of white marlin in the Atlantic Ocean, based on records of the Japanese longline fishery (1956-67), occurred off the northeast to southeast Brazilian coast, from September to January.

In the 1970s and 1980s, white marlin caught by Japanese longliners showed a strong decline. The main area of concentration was in the northwest Atlantic. In the south Atlantic a small concentration of white marlin was observed in southeast of Brazil (Uozumi and Nakano, 1994).

Off the Brazilian coast, the white marlin, called agulhao-branco, is caught by longliners, all year round (ANTERO SILVA *et al.* 1994). According to Arfelli *et al.* (1994), this species is also caught by sport fishing tournaments conducted by yacht clubs, mainly off Vitoria city (18° to 21°S) but also caught in Rio de Janeiro (22° to 23°S) and Ilhabela (24°S) cities, from October to February (spring/summer).

Ueyanagi *et al.* (1970) cited that the area off southeast Brazil (20°-30°S and 20°-50°W) was a major spawning area for white marlin in the Atlantic.

According Arfelli *et al.* (1986) white marlin spawn at least from November to March in the area 18°-26°S and 40°-46°W.

The present report contains analyses of yield, CPUE and biological information of white marlin caught by the Santos fleet, as well as data of these boats.

## **2. MATERIAL AND METHODS**

The methodology used basically follows that presented in Amorim and Arfelli (1984).

The data and material utilized in this study were mostly obtained from Santos longliners at the Fishing Terminal in Santos City, Sao Paulo State. Also the researchers from "Instituto de Pesca" took 23 research trips on these longliners from 1974 to 1994.

According to the commercial companies most of the fish were sold and recorded by individual fish carcass weight and converted to total weight.

The fishing effort was obtained of the captains' logbooks and of interview in the Fishing Terminal of Santos, while the weight was obtained from the log commercial sheets of the fishing companies and also from the Fishing Terminal.

The dressed weight is obtained from the carcass (without bill, gill, gut and caudal fins), as the fish is commercialized with 1 kg of approximation (Amorim, 1992).

The fishing area is 20°-33°S and 39°-50°W and extended to 15°-35°S and 30°-50°W. Nevertheless it was considered the area 20°-30°S and 40°-50°W.

The 2000 and 2001 data comes from “Relatório Interno sobre os Desembarques da Frota de Espinheil-de-superfície nos Municípios de Santos e Guarujá, Núcleo de Economia e Estatística Pesqueira of “Instituto de Pesca”.

In the 1971-92 period the number of longliners increased from 3 to 13 in 1991. It increased again to 20 in 1998 and decreased to 14 in 2000 (**Table 1**). Basic characteristics of these longliners in 2000, is presented in **Table 2**.

A statistical revision of Santos national longliners, including annual and monthly yield (in total weight) and fishing effort of all Santos fleet of white marlin and other species or group of species caught off south and southeast of Brazil, from 1971-1997. Including annual and monthly yield and fishing effort by species or group of species from 1992-1997 of leased. Also annual yield and effort for 1998 of national Santos fleet and 1999 to 2000 of leased and national grouped.

### 3. RESULTS AND DISCUSSION

In the Brazilian coast, morphological differences were observed in some specimens that presented pectoral, dorsal and anal fins, likely *Tetrapturus audax*, but the anus position similar to *T. albidus*. The existence of some morphological differences in white marlin was also mentioned by Dr. Robins during the Billfish Workshop (ICCAT, 1981). Graves and McDowell (1998) studying the mitochondrial DNA of fish hearts, believe that white marlin off Brazil and the U.S. Atlantic coast belongs to the same population.

According to Ueyanagi *et al.* (1970) the only area in the South Atlantic with a concentration of maturing white marlin is the one between 20°S and 30°S along 20°W. These authors also found one white marlin larvae off Rio de Janeiro State (22°S-32°W).

In the south and southeast Brazilian coast, 52 females were observed. From April to August all gonads were in the early development stages (II and III); the developing and running ripe gonads (stage IV and V) were collected from December to March (Arfelli *et al.* 1986). Off Vitoria from November/December, 1988 to 1992, 84 females were studied, 28% of them were in the II and III stages, 61% in IV and V, and 1% VI (CEPEMAR, 1988, 1990, 1991 and 1992). Probably white marlin spawns from December to March at 18°-26°20'S and 40°-46°W.

Iso in the southern Brazil, white marlin, sailfish, swordfish, dolphin and others were spawning in Santa Martha Cape (25°55'-26°20'S and 45°10'-45°50'W), in February 1977. Large yellow-orange spots probably containing eggs and seaweed's were observed in this area during a research trip. Probably these eggs are moved away from this area by some current, because juveniles were not found in the stomach contents of the tunas and related species caught by Santos longliners (Arfelli *et al.* 1986). Stomachs of these species were also analyzed from 1972 to 1980 by Zavala-Camin (1982) and no white marlin was found. It suggests that the south and southeast of Brazil is not a growing area for white marlin. This is reinforced by the absence of young (less than 85 cm) specimens in the catch of longliners and the sport fishing boats (Amorim *et al.* 1998).

This species represented about 3% of the catch (in weight) from the leased Japanese fleet, 0.4% of the national fleet from Rio Grande (Brazil), 2% of Santos longliners and 4.2% (number of fish) from national based Natal city (Antero-Silva *et al.*, 1994).

According to Arfelli *et al.* (1986), in the 1971-84 period the annual average weight of white marlin caught by Santos longliners fluctuated from 33.2 to 28.8 kg until 1983, decreasing to 25.3 kg in 1984. For the 1992-95 period it fluctuated from 26.6 to 22.3 kg.

The white marlin annual CPUE (kg per thousand hooks) for national fleet shows a decreasing trend from 1972 (77.2) to 1982 (12.2), followed by an increasing trend until 1991 (73.6), and then decreased until 1994 (21.4). The leased fleet exhibited two high peaks, in 1978 (100.1) and in 1979 (94.8). After these peaks, the CPUE fluctuated from 33.6 (1985) to 3.3 (1994). Analyzing the annual white marlin CPUE in the Brazilian coast, it is observed that the leased Japanese fleet obtained the highest values in all Brazilian coast: 843 (1979) and 715 (1982) in the Area B (10° to 20°S and 30°W to coast); 120 (1982) in the Area A (0° to 10°S and 30° to 40°W); and 115 (1978) in Area C (20° to 35°S and 25°W to coast). The CPUs of the leased Taiwanese fleet were always lower than 37 (1991, Area B) and the leased Korean fleet never exceeded 0.9 (1995, Area C). The CPUE of Natal longliners (Area A) presented values around 20 in the first three years (1983-1985), and around 7 in the subsequent years (Antero-Silva *et al.*, 1994).

Since 1971 and after 1991 the annual white marlin CPUE presented a decreasing trend along the Brazilian coast. The highest abundance of this species was verified in Area B and A. In Area C white marlin occurs mainly in the fourth and first quarters, especially from October to January (Amorim *et al.*, 1998). From 1995 to 1999, white marlin yield showed small fluctuations, ranging from 47 t in 1999 to 63 t in 1995. From 1995 to 1999, the CPUE of this species ranged from 23 to 57 kg per thousand hooks.

The analysis of annual size-frequency presented by Arefelli *et al.* (1986), shows that the largest proportion of the species was concentrated from the 135-140 cm to 145-150 cm classes, in the 1972-83 period, but from 120-125 cm to 125-130 cm in 1971 and 1984. In the period 1971-84, the caught specimens were distributed from 85-90 cm to 200-205 cm classes. Considering that white marlin attains sexual maturity at around 130 cm (EFL), only 11% of the caught fish by national Santos longliners were in immature size.

In this meeting, the represent of Brazil presented a table with revised data from Santos and Natal, but did not incorporated at ICCAT database. Nevertheless, they will be incorporated as soon as officially submitted.

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**Table 1.** Number of longliners based in the Santos Fishing Terminal

<i>Year</i>	<i>Longliner</i>	<i>Year</i>	<i>Longliner</i>
<b>1971</b>	3	<b>1986</b>	6
<b>72</b>	3	<b>87</b>	6
<b>73</b>	4	<b>88</b>	9
<b>74</b>	5	<b>89</b>	10
<b>75</b>	5	<b>90</b>	11
<b>76</b>	4	<b>91</b>	13
<b>77</b>	5	<b>92</b>	15 (1 leased)
<b>78</b>	5	<b>93</b>	16 (3 leased)
<b>79</b>	5	<b>94</b>	15 (2 leased)
<b>80</b>	5	<b>95</b>	16 (3 leased)
<b>81</b>	6	<b>96</b>	18 (4 leased)
<b>82</b>	6	<b>97</b>	17 (2 leased)
<b>83</b>	9	<b>98</b>	20 (5 leased)
<b>84</b>	8	<b>99</b>	19 (3 leased)
<b>85</b>	7	<b>2000</b>	14 (1 leased)

**Table 2.** Basic characteristics of the longliners based in Santos (SP) in 2000.

<i>SANTOS 2000</i>	<i>BOAT LENGTH</i> <i>(meters)</i>	<i>TB</i>	<i>TL</i>
Taihey Maru 3	33	149	45
Sea Wolf (leased)	29	136	65
Kaiko Maru 16	27	100	48
Itapuí I	27	121	34
Comandante Danil	27	---	---
Imaipesca	24	107	72
Progressão	24	105	70
Argonauta	24	110	37
Camburi	22	88	26
Oceano Brasil	22	88	26
Falcon I	22	81	24
Andréas	22	----	----
Elisabeth Vitória I	19	44	13
Jonas	16	26	22