A REVIEW OF THE RECREATIONAL FISHERY FOR THE ATLANTIC SAILFISH *ISTIOPHORUS ALBICANS* IN COZUMEL ISLAND, QUINTANA ROO, MEXICO.

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SUMMARY

The waters surrounding Cozumel Island in the Mexican Caribbean support a very important recreational fishing for billfish. However biological and fishery studies in this area and in particular for the Atlantic sailfish Istiophorus albicans are scarce. The information used in this paper comes from the catch reports of the marina of Club Nautico of Cozumel during the period 1971-1992. The historical catches of sailfish were analyzed in the spring season, which coincide with the seasonal migration of the species and the presence of foreign sportfishing boats in the area. Generally, it is observed that the CPUEs of sailfish remained between 2 and 3 sailfish /boat / day over the last years. It was determined that the moon period does not affect the catch rate of the sailfish. Additionally, information about the movements of sailfish tagged and released is presented for the period 1963-1992 to establish possible migratory patterns.

RESUME

Les eaux qui entourent l'île de Cozumel dans la partie mexicaine de la mer des Antilles subissent une pêche sportive très importante d'istiophoridés. Par ailleurs, les études biologiques et halieutiques sont rares dans ce secteur, en particulier en ce qui concerne le voilier de l'Atlantique Istiophorus albicans. L'information rassemblée dans le présent document provient des registres de capture du port de plaisance du Club Nautico de Cozumel pendant la période 1971-92. Les prises historiques de voilier ont été analysées au printemps, qui coïncide avec la migration saisonnière de l'espèce et la présence de bateaux étrangers de pêche sportive dans la région. On observe en général que la CPUE du voilier est restée ces dernières années entre 2 et 3 voiliers /bateau /jour. Il a été déterminé que les phases de la Lune n'affectent pas le taux de capture du voilier. En outre, une information est présentée pour la période 1963-92 sur les déplacements de voiliers marqués et relâchés, afin de définir d'éventuels modes migratoires.

RESUMEN

En las aguas que rodean la isla de Cozumel en el Caribe mexicano, existe una pesquería recreativa de marlines que es muy importante. Sin embargo, los estudios biológicos y de pesquería de esta zona, y en particular respecto al pez vela atlántico (Istiophorus albicans) son escasos. La información usada en este documento procede de registros de captura del Club Náutico de Cozumel, del período 1971-92. Se analizaron las capturas históricas de pez vela en primavera, estación que coincide con la migración estacional de la especie y con la presencia en la zona de barcos extranjeros de pesca deportiva. En general, se observa que las CPUEs del pez vela permanecieron en los últimos años entre 2 y 3 peces vela /barco por día. Se determinó que las fases de la luna no afectaban a la tasa de captura del pez vela. Además, se presenta información sobre los movimientos de los peces vela marcados y liberados en el período 1963-1992, para establecer posibles pautas migratorias.

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1. INTRODUCTION

In the Mexican Caribbean in the southeast part of the Yucatan Peninsula, the waters adjacent to Cozumel Island show a series of oceanic-biological characteristics that promote the occurrence of the 5 billfish species (Istiophoridae and Xiphiidae) known to inhabit the Atlantic ocean. The development of a recreational fishery for billfish in this area generates considerable income at the regional and national level.

The sportfishing for billfish of the families Istiophoridae and Xiphiidae has been practiced in Cozumel waters for a long time. This fishery has as a main target the Atlantic sailfish, *Istiophorus albicans*, and to a lesser extent the white marlin, *Tetrapturus albidus*, blue marlin, *Makaira nigricans*, swordfish, *Xiphias gladius* and the longbill spearfish, *Tetrapturus pfluegeri*.

The abundance of these fish in the Cozumel waters is seasonal, during the spring season (March, April, May and late June) . The sportfishing season is defined in part by the large concentration of foreign boats in the area during this period. It is important to note that the only fishing pressure on the billfish in the zone is recreational, because the commercial and artisanal fisheries are not well developed. This is due in part to a lack of interest concerning the resource and inadequate fishing technology (Compean,1987).

The Atlantic sailfish is the most sought species by the recreational fishermen in Cozumel, because its coastal behavior and relative availability in comparison with the marlins. The fishing is practiced along the southeast coast of the Yucatan Peninsula and the trolling patterns of the boats are normally from north to south or in zig-zag pattern for up to 8 hours per day using dead bait (Hemiramphus spp.).

Numerous previous studies have been made in the Mexican Caribbean concerning billfish (Lesser,1989; Lozano,1989 and Gonzalez,1992). However, a study specifically for Cozumel has only been done once. This study (Martinez 1992) analyzes catches from the sport fishery for sailfish during the period 1989-1991.

Therefore, the objectives of this paper are to supplement a general overview of the recreational fishery for the Atlantic sailfish in Cozumel during the period 1971-1992, with some observations on the fishing areas, migratory movements, and some biological observations.

2. METHODS

The catch (number of sailfish) and effort (number boats/day) was gathered by means of daily interviews with recreational fishermen at the end of the fishing trip, using a sampling format (bitacora) for sportfishing boats during the sportfishing seasons 1988-1992 (Fig.1). Additionally, available data on the period 1971-1987 reported by the marina was used in the analysis. With this data, relative abundance index for the sailfish was obtained (catch per unit effort, CPUE) . Analysis of these data were conducted in order to illustrate the historical trend in the availability of the resource.

In addition to CPUE, hook per unit of effort (HPUE, Browder and Prince 1990) was used to gain better insight into the fishery for the spring seasons 1991 and 1992.

An analysis of variance was made to compare the average catch rates by quarter and show the possible relationship between the sailfish catches and the moon phase during the seasons 1989-1991 (Martinez,1992).

In order to illustrate some of the movement patterns for sailfish tagged and released off the Mexican Caribbean, we present a map which indicates the locations of release and recapture. These data will provide insight into possible migratory routes of the species in this location.

Finally, biological information of the sailfish landings, including food habits studies, during the 1990 season were conducted (Gonzalez,1992). It is important to note that because of the frequent practice of hooking and releasing of the fish, it is difficult to obtain a representative sample of specimens for biological studies.

3. RESULTS AND DISCUSSION

3.1 Historical CPUEs

The percentage of catches during the period 1971-1992 is presented in figure 2, where it is shown that the sailfish was the main species in the catches (88%) followed by the white marlin (11%) and the blue marlin (2%). These proportions are the normal trend considering that the fishing effort is concentrated in a large way to trolling in coastal places with shallow waters where there is a greater chance to hook a sailfish, rather than a white or blue marlin.

The catch and effort data for sailfish are presented in table 1. In figure 3, it is observed that for the years 1973 to 1986, the CPUE remained at about 3 sailfish caught/boat/day. In 1987, the average decreased and then remained stable at a minimum level of 2 sailfish caught/boat/day in the last years, even though fishing effort increased substantially during 1991-1992. This indicates that in Cozumel, catch rates have remained stable even in the presence of increased effort. In comparison with other places, for example in South Florida for the period 1968-1971 where the CPUE was 1. 31 sailfish caught/boat/day (Jolley, 1974), higher catch rates for sailfish are found in Cozumel.

On the other hand, the fishing effort remained stable from 1971 to 1990. There were between 400 and 600 fishing trips/season. For 1991 the fishing effort doubled to 1200 fishing trips as a result of the extension of the fishing season until early July (Fig. 4).

In figure 5, the historical sailfish total catch is shown for 22 seasons; catches increased from about 1500 fish in 1971 to a high of 2500 fish by 1979, catches steadily decreased to an historical low of about 1000 fish by 1990, and then increased sharply in 1991 and 1992, with a historical high of almost 3000 fish.

Regarding the hook per unit of effort, for 1991, a total of 5799 sailfish were hooked (strikes), 6032.6 fishing hours were reported and the HPUE was 0.96 (Table 1). This suggests that a sailfish was hooked for every 1.04 hours of fishing. For 1992, a total of 6939 hooks, 7775.6 fishing hours and a HPUE of 0.89. Both indices (199192) can be considered high for Cozumel. In comparison, for South Florida in 1987, an HPUE of 0.017 was reported (Fedler y Ditton, 1990).

3.2 CPUEs and Moon phases

Table 2 presents the analysis of variance (ANOVA) made by Martinez (1992) for the CPUE data of the sportfishing seasons 1989, 1990 and 1991. Lesser (1989) established for the Mexican Caribbean that the best catches were obtained during the dark phases of the moon and this might be explained by reproductive or feeding behavior. However, the study was based on the average catches obtained for all species of billfish combined (sailfish, white marlin, blue marlin), with no distinguishing between species. The results obtained by Martinez (1992) indicate no significative differences in the average catches for sailfish between moon quarters ($F = 0.5\ 1.89 < 2.60$), so it is concluded with 95% confidence that the moon period does not affect the sailfish catches in the sportfishing of f Cozumel. Similar results have been reported f or the commercial catches of the tuna fleet in Spain (Pallares and Garcia,1985).

3.3 Fishing Grounds

The large quantities of sailfish are often taken along the mainland coast (Fig. 6) . Martinez (1992) reported that the best fishing grounds are in the north and south of Playa del Carmen, in front of Puerto Aventuras and Akumal. There is no information concerning the physical, chemical and biological parameters in these places. It may be that these areas have better conditions for sailfish in terms of temperature, depth, dissolved oxygen, visibility of the water and availability of food important to the basic needs of the sailfish. These factors are often reported to have resulted in large concentrations of billfish in other areas of the Atlantic ocean (Nakamura and Rivas,1972; Jolley,1974; Roffer,1986).

It is important to note that for the 1991 season, the fishing effort expanded to the south, where sportfishing was not practiced previously. This could be because a new marina was opened in Puerto Aventuras in the mainland, and the number of boats fishing in the same area increased substantially. As

a result, the boats from Cozumel searched for new fishing areas in the south and this is reflected in the number of hook ups for 1991.

3.4 Migratory Movements

A total of 11325 sailfish were tagged and released in the Cancun-Cozumel area since the start of the tagging program in 1963, but the rates of recovery are very low. Sailfish tagged in Cozumel have been recovered in places like the island of Grenada and the Venezuelan coast in the South Atlantic (Fig. 7). This suggests that the fish move south as a result of aspects related with spawning, variation of the oceanic conditions associated with the temperature or availability of food (Greenough and Rothschild, 1989). However, other sailfish released in Cozumel have been recovered in the North Atlantic, in Texas, Louisiana and South Florida (Pompano beach), (Bayley and Prince,1992), which suggests that at least some part of the population travels north with the current. With two patterns of movements totally different and the low recovery rates, it is very difficult to establish a general scheme of the routes followed for the sailfish tagged and released in Cozumel.

On the other hand, during 1992 a male sailfish was recaptured in the same place tagged in Cozumel waters one year before (1991), which suggests that maybe some fish return the same place after some time or they could be permanent residents in the area. only by the continuing practice of tagging and releasing there will be the opportunity to obtain recoveries and to know more of the migratory routes of the species.

3.5 Reproductive Aspects

Preliminary results show that the average weight of sailfish sampled off Cozumel were in the range of 14-38 kg., and generally the females were bigger than the males. The average lengths obtained were 167.25 cm. LJFL for females and 162.5 cm. LJFL for males (Gonzalez, 1992) . Since Beardsley et al. (1975) reported that female western Atlantic sailfish reach sexual maturity at about 158 cm LJFL and a weight of 13.6 kg, the average size of female sailfish caught off Cozumel suggests that the female component of this fishery probably consists mature size fish.

Regarding the observations made on the gonadal maturity of the sailfish landed during the 1990 sportfishing season, a final conclusion can not be made due to the small number of samples obtained. However, it is believed that this zone can be a spawning and nursery ground for the sailfish in the spring season, because the majority of the gonad females sampled were in stage III (ripe) and also some juveniles have been collected with dip nets at night and some juveniles have been observed in the stomach contents of the dorado *Coryphaena hippurus* (Gonzalez,1992). These observations coincide with Gaertner et. al.,(1991) that the sailfish reproduce near the Venezuelan coast from February to May and from August to November, and with Beardsley et. al.,(1975) who reported that the reproduction period for the sailfish in the Caribbean is from April to September.

The increase in the size of the samples in the adults, the sampling in different times throughout the year, and the realization of an ichthyoplankton survey will provide a better understanding of the reproductive aspects of this species off Cozumel.

4. CONCLUSIONS

The catch composition of billfish from the sport fishery in Cozumel reveals that the sailfish is the main target, with 88% of the catches. This species is most abundant from March to July.

The sailfish catches have remained relatively stable during the period 1971-1989 but did decline in the last few years to an average of 2 sailfish caught/boat/day. The fishing effort has doubled since 1991 with 1000 fishing trips/season as a result of the extension of the recreational fishery until early July.

The moon period does not appear to have a significant effect ($P > 0.05$) on the sailfish sportfishing in Cozumel.

The distribution of sailfish catches indicates that specific areas in front of the mainland where possibly favorable oceanographic and biological conditions exist for the species. The fishing areas have expanded to the south since 1991, as a result of the increase of boats fishing in the same area.

The migratory patterns of the sailfish tagged and released in Cozumel area are not well defined due in part to the low rate of recoveries.

5. ACKNOWLEDGEMENTS

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Table 1 **Catch, effort, CPUE (# sailfish caught/boat/day) and HPUE (# sailfish hooked/hour trolling) in Cozumel island during the period 1971-1992.**

YEAR	Boat Fishing Days	Sailfish Caught	CPUE	Strikes	Hours Trolling	HPUE
1971	509	1421	2.79			
1972	520	1308	2.51			
1973	561	1563	2.78			
1974	543	1788	3.29			
1975	574	1916	3.33			
1976	602	1989	3.30			
1977	611	2214	3.62			
1978	640	2108	3.29			
1979	681	2460	3.61			
1980	656	2050	3.12			
1981	632	1916	3.03			
1982	517	1842	3.56			
1983	593	1771	2.98			
1984	571	1736	3.04			
1985	548	1623	2.96			
1986	528	1591	3.01			
1987	527	1487	2.82			
1988	494	1430	2.89			
1989	464	1120	2.41			
1990	390	835	2.14			
1991	954	2420	2.53	5799	6032.6	0.96
1992	1188	2987	2.51	6939	7775.6	0.89
TOTAL	13303	3957S				

Table 2 **Analysis of variance for the sailfish CPUEs during the period 1989-1991 (from Martinez,1992).**

ANALYSIS OF VARIANCE

Source of Variation	D.F.	Sum Squares	Medium Squares	F	
Moon phases	3	5.81	1.93	1.89	NS
Years	2	34.21	17.10	16.76	**
Error	189	194.06	1.02		
	F 0.5 (3,189) = 2.60		F 0.5 (2,189) = 3		

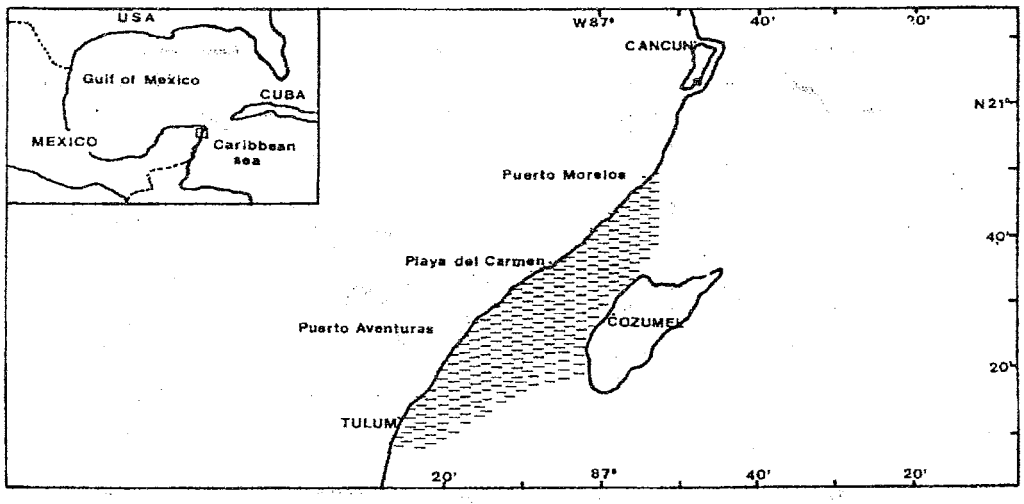

Figure 1. Operation area of the sport fishing fleet of Cozumel.

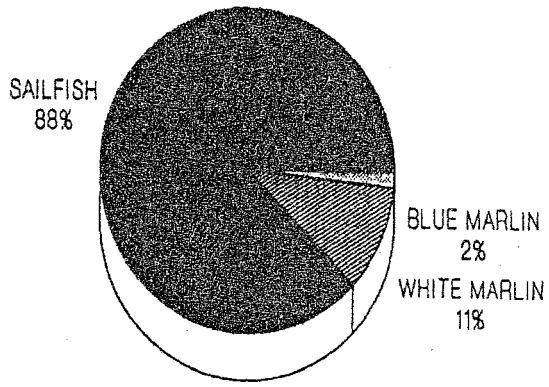

Figure 2. Total percent of billfish catches since 1991-1992 in Cozumel Island, Mexico.

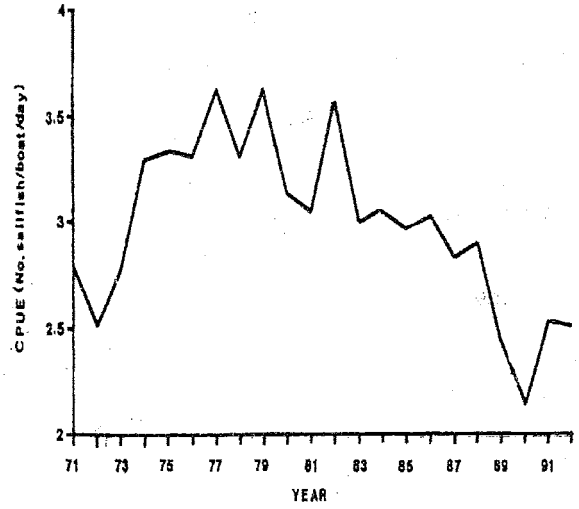

Figure 3. Historical CPUE for the sailfish in the spring season in Cozumel Island, Mexico.

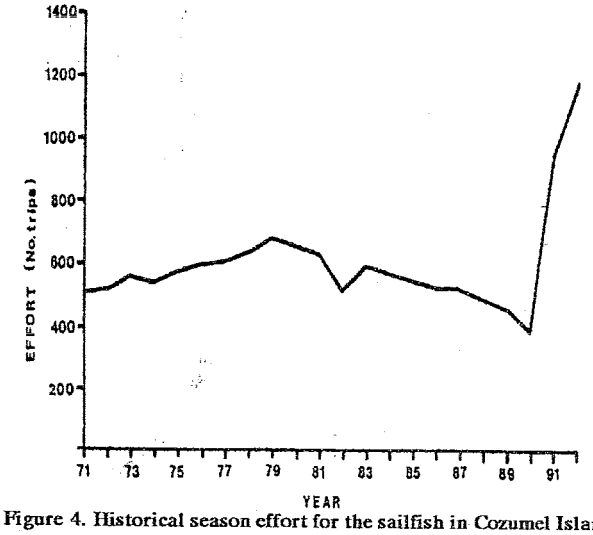

Figure 4. Historical season effort for the sailfish in Cozumel Island, Mexico.

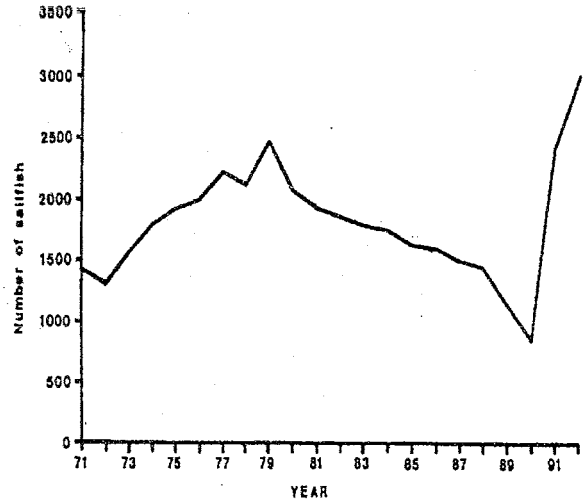

Figure 5. Total catch of sailfish in the spring season in Cozumel Island, Mexico.

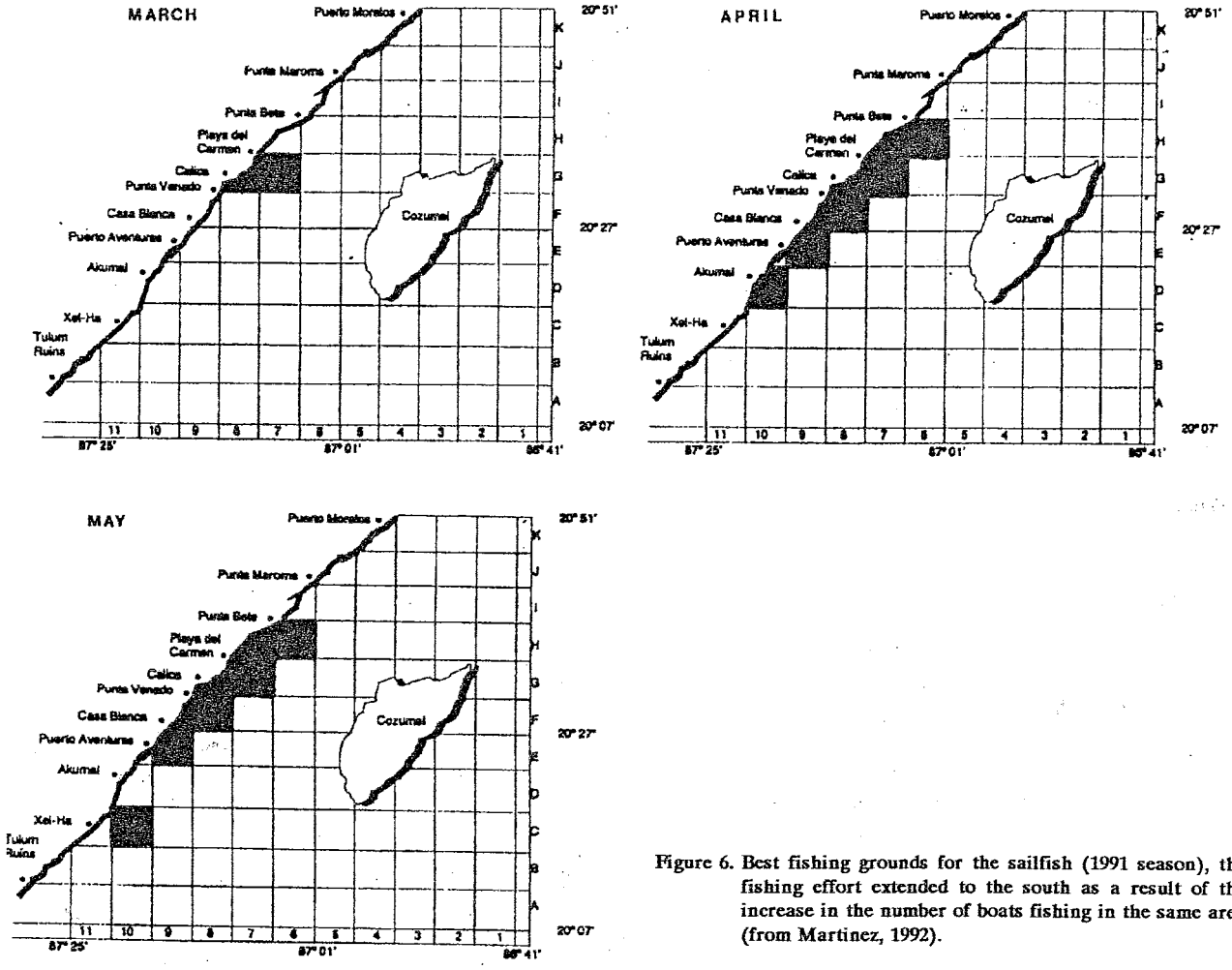

Figure 6. Best fishing grounds for the sailfish (1991 season), the fishing effort extended to the south as a result of the increase in the number of boats fishing in the same area (from Martinez, 1992).

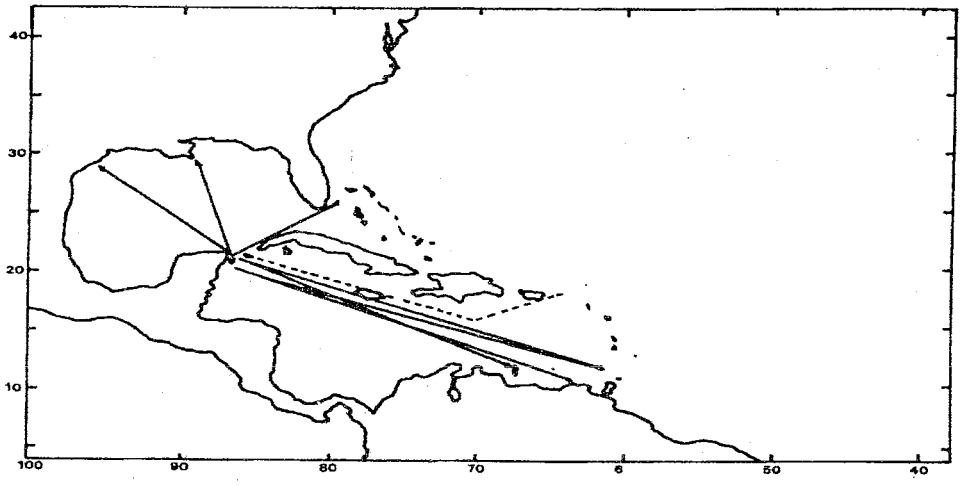

Figure 7. Some movement registered of sailfish tagged and released in Cozumel. Note: Arrows are not intended to indicate routes taken by tagged fish, but only as a visual aid to differentiate tagging and recaptures sites.