The Biology and Ecology of the Silky Shark, Carcharhinus Falciformis

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Chapter 10

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Abstract

The silky shark (*Carcharhinus falciformis*), an inhabitant of coastal and oceanic waters in tropical regions, is among the world's most abundant and cosmopolitan shark species. It is caught in signi cant numbers in directed shark sheries throughout its range and is an important bycatch in tropical tuna sheries. On the basis of differences in life-history parameters, it is possible to identify at least three distinct populations inhabiting the Northwest Atlantic, the western-central Paci c, and the eastern Paci c. Data from the Indian Ocean are too sketchy to derive conclusions about a distinct population in this area. Silky sharks grow larger and mature at larger sizes in the Northwest Atlantic than in the western-central and eastern Paci c. Many populations mate and give birth during late spring and summer, but others do not have a well-de ned reproductive season. Silky sharks are born after a 9- to 12-month gestation period and are thought to have 1 year of rest between pregnancies. Litter sizes range from 1 to 16 young, but are more commonly of 6–12 young. Estimates of age at maturity range from 4 to 10 years for males and from 7 to 12+ years for females; maximum estimated age is 22+ years. Given their importance for shing communities worldwide and the increasing trend in shark catches, silky shark populations should be constantly monitored to assure their conservation and wise management.

Key words: silky shark, *Carcharhinus falciformis*, Carcharhinidae, age and growth, distribution, sheries, movements, reproduction, stock status.

Introduction

The silky shark, *Carcharhinus falciformis* (Bibron, 1839), is a member of the requiem or gray sharks of the family Carcharhinidae and is one of the largest members of its genus, reaching up to 330 cm total length (TL). According to Garrick (1982), the species was originally described from the island of Cuba, but the adults and the juveniles were mistakenly classi ed as two separate species (with the adults attributed to *C. oridanus*) until both were synonymized by Garrick *et al.* (1964).

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Silky sharks get their common name from the distinctive smooth texture of their skin, which is covered with very fine and minute dermal denticles, making it softer to the touch than the considerably rougher skin of most other sharks. Apart from this peculiar skin texture, the silky shark can be recognized from similar members of *Carcharhinus* by (1) its falcate first dorsal and pectoral fins (thus its Latin name *falciformis*, meaning sickle shaped); (2) its relatively small first dorsal fin – whose origin is behind the free rear tips of the pectoral fins – with a rounded apex and a posterior margin slightly convex from the apex down, then slightly concave toward the posterior tip; (3) a very small and low second dorsal fin with a very long trailing tip that almost reaches the precaudal pit; and (4) the particular shape of its upper teeth. Young silky sharks have shorter pectoral fins and shorter heads than adults.

The silky shark is one of the most frequently caught sharks in many tropical fisheries either as a target or as a bycatch species. But despite its commercial importance, our understanding of its biology and ecology is limited, and there is a genuine need for increased research, management, and perhaps even conservation work on silky sharks. This chapter presents a critical review of current knowledge about the biology, ecology, exploitation, and conservation of the silky shark.

Distribution, movements, and stock structure

Geographic, depth, and age-related distribution

The silky shark is one of the most common semipelagic sharks found in coastal and oceanic waters of all tropical oceans (Fig. 10.1). Its distribution seems to be limited to waters above 23°C (Last and Stevens, 1994). Many of the apparent gaps in distribution in tropical seas may be due to limited records or misidentification with other species. Commercial fisheries throughout the world usually do not record catch by species, and silky sharks can be difficult to recognize from other members of *Carcharhinus* when one is not familiar with their identification.

Silky sharks inhabit continental and insular shelves, slopes, and even offshore waters from the surface down to at least 500 m of depth, and have been occasionally recorded in water as shallow as 18 m (Compagno, 1984). They are more abundant along the edge of continental and insular shelves, although they can be found far offshore, especially adjacent to regions with deepwater reefs, in association with floating objects, and offshore island slopes. Strasburg (1958) noted that silky sharks were more abundant in the tropical Pacific as one approached the outer continental shelf, and Garrick (1982) pointed out that this species seems to have a wider latitudinal distribution along the continental margins than in open ocean or insular shelves.

In the western Atlantic, and probably elsewhere, newborns have a more demersal lifestyle and, together with some of the early juveniles, occupy nursery grounds in shelf waters (Springer, 1967; Branstetter, 1987; Bonfil, 1997), while some juveniles and the subadults and adults occupy more oceanic habitats in slope waters (Bonfil, 1997). No strong evidence for sexual segregation in the silky shark has been reported, except by Strasburg (1958) for the Pacific Ocean populations.

Fig. 10.1 Global distribution of silky sharks. The dark shading shows well-established distribution areas, while the light shading shows uncertain distribution (expected or possible presence, or records in need of confirmation).

Movements and migrations

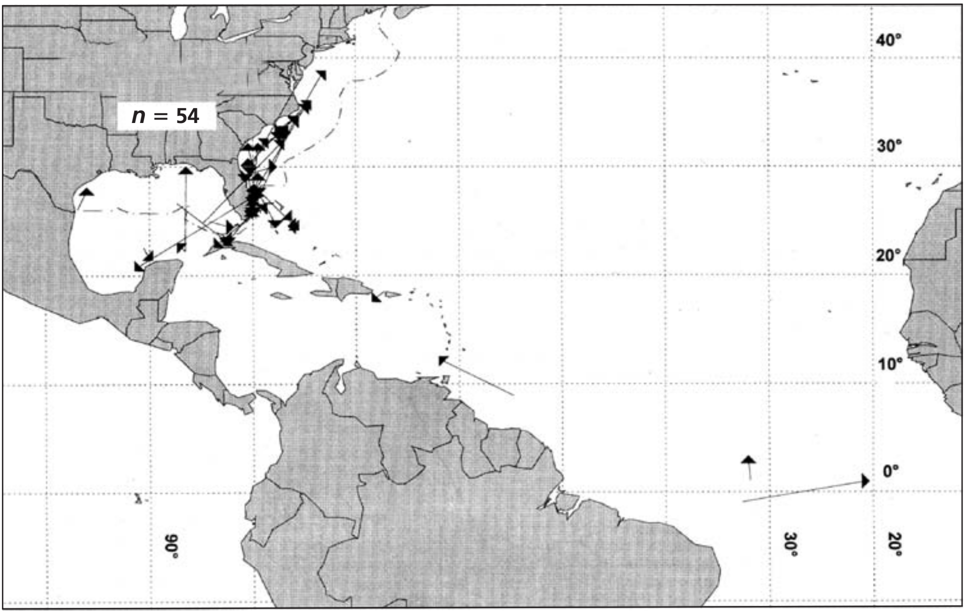
Relatively little is known about the migrations and movements of the silky shark. Most of the available data come from the Northwest Atlantic, where more than 820 silky sharks have been tagged since 1963 under the National Marine Fisheries Service (NMFS) Cooperative Shark Tagging Program. The 54 recaptures to date (6.6% return rate) show that this species can migrate long distances quickly, with estimated maximum speeds of up to 60 km/day, ranking it fourth in speed after the blue shark (*Prionace glauca*, Carcharhinidae), the shortfin mako (*Isurus oxyrinchus*, Lamnidae), and the tiger shark (*Galeocerdo cuvier*, Carcharhinidae; Kohler *et al.*, 1998). The majority of the sharks were tagged along the eastern coast of Florida and the northern Gulf of Mexico. The recaptures show that most silky sharks move northward along the East Coast, probably following the Gulf Stream, and only a few move southward into the Caribbean and even into the Gulf of Mexico (Fig. 10.2). At least one silky shark tagged off the Mexican coast had crossed the Gulf of Mexico from Yucatán to the northwestern coast of Florida (Bonfil, 1997). Silky sharks are commonly associated with schools of tuna and probably undertake long trips throughout their life, but this aspect of their ecology is poorly documented. The known maximum distance traveled by a silky shark is 1,339 km (Kohler *et al.*, 1998).

In the Pacific, silky sharks seem to move from the equator toward slightly higher latitudes during summer (Strasburg, 1958), and it is possible that this pattern of movement also occurs in other silky populations. In the Indian Ocean, adult silky sharks (including pregnant females) concentrate in the Gulf of Aden during the late spring and summer, but decrease in numbers during the rest of the year (Bonfil, 2003).

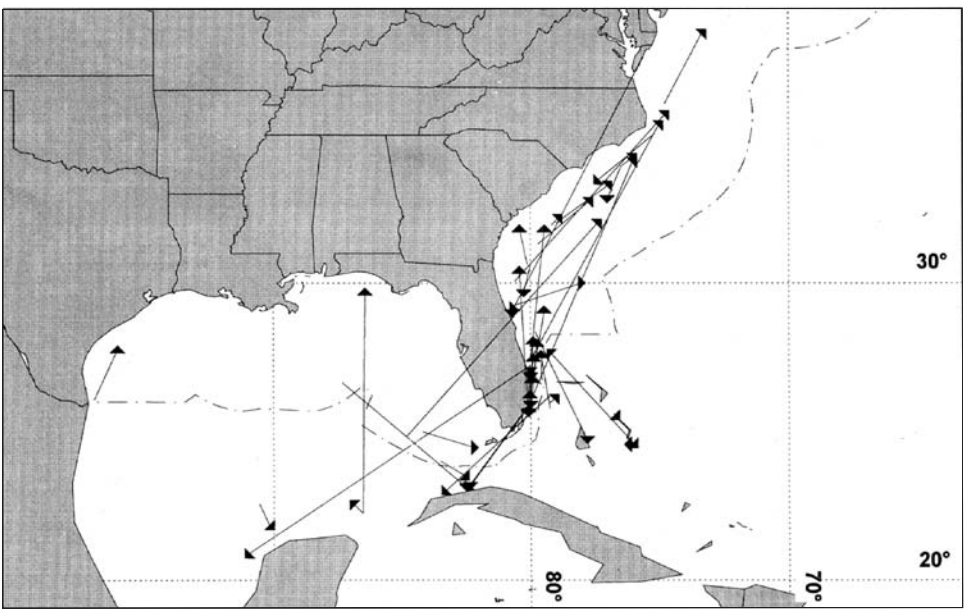
Despite the fragmentary information, it is possible to reconstruct the patterns of distribution and movements of silky sharks in relation to age, based on the available literature (Strasburg, 1958; Springer, 1967; Branstetter, 1987; Bonfil *et al.*, 1990, 1993; Bonfil, 1997) and personal observations of the author. In the Gulf of Mexico, silky sharks are born in the deeper parts of the continental shelf (such as the Campeche Bank). During the first few years of their life, neonates and young juveniles live in nursery grounds that appear to be associated with snapper reef areas. There, they lead a demersal/semipelagic lifestyle (they are known to be taken on both bottom and pelagic longlines), but soon move to a more offshore and pelagic existence. As they grow and approach about 130 cm TL, silky sharks switch to a more oceanic habitat, moving offshore and often joining schools of large pelagic fish such as tuna, probably traveling long distances with them. Adult silky sharks return seasonally to feed and reproduce in shelf waters, but they can also be found in oceanic areas. This general pattern of life-stage-related movement seems to be followed in other regions of the world (Cadena-Cárdenas, 2001) and is probably valid for the species as a whole. A more detailed understanding of the seasonal movements of silky sharks will require further studies using conventional and electronic tagging methodologies (i.e., archival and satellite tags).

Stock structure and genetic studies

There is almost no information about the stock structure of silky sharks. Nevertheless, on the basis of variations in life-history parameters in different parts of the world, it appears



(a)



(b)

Fig. 10.2 Maps showing tag and recapture locations of silky sharks tagged under the NMFS Cooperative Shark Tagging Program during 1962–1993. Arrowheads mark the recapture sites. (a) Map of movement in the Atlantic and Gulf of Mexico. (b) Close-up view of the US Atlantic and Gulf of Mexico. *Source*: Used with permission from Kohler *et al*. (1998).

that there are several distinct populations (see Reproduction): One in the Northwest Atlantic Ocean, at least two in the Paci c Ocean (a western-central and an eastern population), and one in the Indian Ocean. Given the size of these ocean basins and the physical barriers between them, it is not surprising that genetic exchange between populations is restricted or even precluded. Whether there are more discrete populations within any of these oceans (e.g., western versus eastern Atlantic Ocean) and how much exchange and divergence there is between stocks are unknown, as no population genetic studies have been conducted for silky sharks. The chain of islands across the tropical Paci c may serve as a link for the apparently distinct eastern and western-central Paci c silky shark populations, but the population structure within the Paci c is as yet unknown. Conventional and electronic tagging programs implemented through observer programs onboard commercial shing vessels, as well as genetic and biological studies, must be conducted for these questions to be answered.

Biology and ecology

Reproduction

The reproduction of the silky shark is probably the best known aspect of its biology. Except for studies on the morphology of the placentation (Gilbert and Schlernitzauer, 1965, 1966), only scattered observations of reproduction were made until the 1980s. More detailed studies in the Gulf of Mexico (Branstetter, 1987; Bon l *et al*., 1993) and the Gulf of California (Cadena-Cárdenas, 2001) have improved our understanding of the reproductive cycle of this species.

Silky sharks have one of the most evolved types of reproduction among the elasmobranchs: placental viviparity. In silky sharks, internal fertilization is followed by an approximately 12-month gestation period, after which up to 16 (more commonly 6–12) fully functional 65- to 80-cm-TL sharks are born. Maternal size is positively correlated to litter size (Cadena-Cárdenas, 2001), and miscellaneous observations suggest that the entire reproductive cycle spans 2 years, with a 1-year pregnancy followed by a "resting" year (Branstetter, 1987; Cadena-Cárdenas, 2001). Many silky shark populations do not show seasonality in the reproductive cycle (Strasburg, 1958; Bass *et al*., 1973; Cadenat and Blanche, 1981; Stevens, 1984a, b), but in some cases this could be an artifact of limited data (in time, space, or number of observations) rather than the existence of year-round reproduction.

Branstetter (1987) and Bon l *et al.* (1993) found a clear parturition and mating period from late spring to summer for Gulf of Mexico silky sharks. In other areas there is no obvious season for reproduction: Central Paci c populations have a parturition period spanning from February to August (S. Oshitani and H. Nakano, National Research Institute of Far Seas Fisheries, Japan, personal communication), and pregnant females from the eastern Atlantic (Cadenat and Blanche, 1981), the Gulf of Aden (Bon l, 2003), and the Gulf of California (Cadena-Cárdenas, 2001) carry embryos of very different stages of development in the same month, indicating protracted mating/parturition. The role of environmental conditions in determining a well-de ned reproductive season for this species in some regions warrants investigation.

Table 10.1 Life-history parameters for silky sharks.[a]

Region	Male TL maturity	Female TL maturity	TL at birth	Maximum TL	Reference
Northwest Atlantic					
Florida coast	ca. 221	ca. 233	ca. 68–84	307	Springer (1960)
Northern Gulf of Mexico	215–220	232	–	–	Branstetter (1987)[b]
Campeche Bank	225	232–246	76	314	Bon l *et al.* (1993)
Eastern Atlantic					
Unspeci ed	220	250	–	–	Cadenat and Blanche (1981)
Gulf of Guinea	–	238	–	300	Bane (1966)[b]
Indian					
Southeastern Africa	240	248–260	78–87	–	Bass *et al.* (1973)[b]
Aldabra Atoll	239	216	–	–	Stevens (1984a)[b]
Maldives	–	–	56–63	–	Anderson and Ahmed (1993)
Western Paci c					
Northern Australia	210	215	–	243	Stevens and McLoughlin (1991) (females)[b]
Eastern Australia	214	202–208	–	–	Stevens (1984b)[b]
Central Paci c	–	213–218	>66	236	Strasburg (1958)
	–	–	65–81	245	S. Oshitani and H. Nakano (personal communication)
Eastern Paci c	180	180	70	279	Cadena-Cárdenas (2001)

[a]TL: total length in cm.
[b]Studies with fewer than 10 observations for size at maturity for either or both sexes, in which case the size given is usually the smallest mature specimen found.

Reproductive parameters for silky sharks show relatively large geographic variability, but a clear analysis is obscured by the limited number of observations in some studies and to a lesser extent by the different methods used for the measurement of length (Table 10.1). Nevertheless, three groups, likely constituting distinct populations, are identi able based on the consistency (coincidence of results between different studies for a given region) and robustness (number of sharks analyzed per study) of the data: A distinct group in the Northwest Atlantic, another in the west and central Paci c, and a third in the eastern Paci c. Northwestern Atlantic silky sharks reach sexual maturity and are born at considerably larger sizes (male sexual maturity at 215–225 cm TL, female sexual maturity at 232–246 cm TL, birth at 76 cm TL) than those in the western-central Paci c (male sexual maturity at 210–214 cm TL, female sexual maturity at 202–218 cm TL, birth at >66 cm TL). In contrast, eastern Paci c silky sharks show the smallest reported sizes at maturity (180 cm TL for both sexes). In addition, maximum sizes recorded for these areas follow the same trend (Table 10.1). Data from the eastern Atlantic are limited, but sizes at maturity appear to be within the range of those for the northwestern Atlantic. Available data from Indian Ocean silky sharks are con icting, with a wide range of size at maturity for females, and males with larger sizes at maturity than females, probably due to the overall small number of specimens analyzed. However, except for the size at maturity for females reported by Stevens (1984a), it would appear that Indian Ocean silky sharks attain the

Table 10.2 Von Bertalanffy growth model parameters for silky sharks.*

Region	Sex	k	L_{inf} (cm)	t_0 (years)	Maximum age (years)
Northwestern Gulf of Mexico	Both	0.153	291	−2.2	13+
Southeastern Gulf of Mexico	Both	0.101	311	−2.78	22+
Central Paci c	Males	0.08	304.3	−2.29	–
Central Paci c	Females	0.19	198.1	−1.73	–

*L_{inf} is given in TL for the Gulf of Mexico, and in precaudal length for the central Paci c. Northwestern Gulf of Mexico data are from Branstetter (1987), southeastern Gulf data are from Bon l *et al.* (1993), and central Paci c data are from S. Oshitani and H. Nakano (personal communication).

largest sizes at maturity. More precise estimates of size at maturity and birth are needed for the eastern Atlantic, Indian, and western-central Paci c Oceans.

Age and growth

There are two published studies on the age and growth of silky sharks (Branstetter, 1987; Bon l *et al*., 1993), plus one unpublished study (S. Oshitani and H. Nakano, personal communication). The rst two are for populations in the northwestern and southeastern Gulf of Mexico, respectively, and the third study is for a central Paci c population. All used direct readings on thin sections of vertebral centra for age determination. Branstetter (1987) used unstained centra sections, whereas Bon l *et al.* (1993) and Oshitani and Nakano (personal communication) used sections stained with alizarin-red-S. The two studies in the Gulf of Mexico found that silky sharks are born in late spring and summer, that growth is similar in both sexes, that a pair of growth bands is formed in the vertebrae every year (one translucent and one opaque), and that silky sharks are long-lived and have medium growth rates relative to other sharks, achieving sexual maturity at 6–10 years (males) and 7–12+ years (females). Estimates of the von Bertalanffy growth model parameters derived by Branstetter (1987) and Bon l *et al.* (1993) were slightly different (Table 10.2 and Fig. 10.3), but it is not known if this re ects true differences in growth or is due to differences in methodology or sample bias. Oshitani and Nakano found differences in growth between the sexes (Table 10.2), and estimated ages at rst maturity of 4+ years for males and 7–9 years for females. Their results are unique in nding signi cant growth differences between the sexes and fall outside the known pattern for most shark species in which females grow larger than males. It is possible that a lack of large females in their samples biased the growth model estimates toward a smaller asymptotic length for females, and also likely that an incomplete size range of male samples caused the model to overestimate the asymptotic length for males (Bon l *et al*., 1993).

Although none of these studies provided validation on the periodicity of ring formation, it appears from the veri cation methods used that the growth estimates are suf ciently accurate. However, to different extents the samples used for age determination in these studies did not include the full size structure of the population. Thus, at least some of the observed differences in growth parameters can be attributed to biases introduced by the size structure of the samples. Our knowledge of age and growth of silky sharks is still incomplete, especially considering that several populations of this species in other parts of the world remain unstudied.

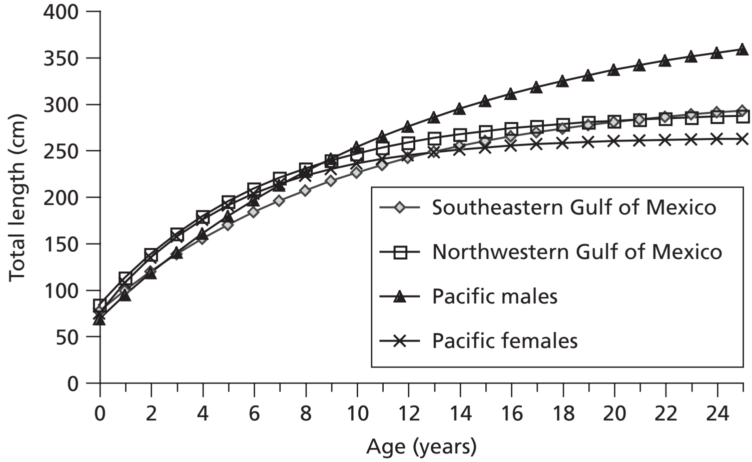


Fig. 10.3 Von Bertalanffy growth curves for silky sharks from three different studies (Branstetter, 1987, for the northwestern Gulf of Mexico; Bon l *et al*., 1993, for the southeastern Gulf of Mexico; and S. Oshitani and H. Nakano, personal communication, for the Paci c Ocean, after conversion of measurements in Table 10.2 from precaudal length to total length).

Diet

Silky sharks are opportunistic feeders, feeding near the bottom as well as in the water column, and according to Springer (1979), adults are known to form large feeding aggregations when food is available. Compagno (1984) de nes silky sharks as primarily piscivorous, a fact supported by the few detailed reports of stomach contents (Yoshimura and Kawasaki, 1985), but they also eat molluscs and crustaceans. No in-depth studies of their feeding habits exist, but the following list of prey is drawn from stomach analyses (Springer, 1979; Yoshimura and Kawasaki, 1985; Branstetter, 1987; Stevens and McLoughlin, 1991; Bon l *et al*., 1993) – sh: sea cat sh, yellow n tuna, albacore, porcupine sh, monacanthids, balistids, groupers, snappers, ophichthid eels, *Mugil* spp., *Katsuomus pelamis*, *Thunnus* spp., *Euthynnus* spp., *Scomber* spp., *Scomberomorus* spp.; molluscs: squid, *Octopus maya*, *Sepia* spp., *Argonauta* spp.; crustaceans: pelagic crabs, *Portunus* spp., *Kyphosus cinerascens*, *Myctophum* spp., *Elagatis bipinnulata*, *Decapterus macrosoma*.

Recent open-water video footage has provided probably the rst direct record of silky shark feeding behavior in the wild. A group of silky sharks in the Paci c was lmed herding a shoal of clupeoid shes, slowly scaring the sh into a more and more compact mass while driving them toward the surface. Once the shoal was suf ciently compact and practically trapped between the circling sharks and the air–water interface, the sharks proceeded to attack until not a single sh was left in the water.

Threats and status

Silky sharks in tropical sheries

The preponderance of silky shark in shery catches throughout tropical waters makes it a signi cant source of income for shing communities around the world. Like other elasmobranchs, the silky shark is fished either directly or as bycatch. There are a few intense multispecies shark fisheries that catch large numbers of silky sharks, mainly in Mexico, Guatemala, El Salvador, Costa Rica, Sri Lanka, the Maldives, Yemen, and apparently Ivory Coast, and it may be a target species elsewhere as well (Anderson and Ahmed, 1993; Bonfil, 1994, 1997, 2003; Bonfil and Abdallah, 2004; R. Bonfil, unpublished data). It is probably caught in even greater quantities as bycatch in tropical tuna longline and purse-seine fisheries, especially when the gear is set near continental or insular shelves. Silky sharks are the most common shark bycatch of the eastern tropical Pacific (Kato, 1964; R. Bonfil, unpublished data) and the Gulf of Mexico (Russell, 1993) tuna fisheries, and are also frequently caught by tuna fleets in the Atlantic and Indian Oceans, as well as in tropical Australian waters (Cramer *et al.*, 1997; Santana *et al.*, 1997; Amorim *et al.*, 1998; Marín *et al.*, 1998; Stevens and Wayte, 1999). In many cases, most of the sharks are thrown overboard dead or alive, the fins being the only part that is utilized.

There is a lack of accurate information about the actual quantity of silky sharks (and any other shark for that matter) being killed worldwide and within each region. However, given the size of the fishing operations in the Pacific Ocean, it is likely that the largest numbers of silky sharks are caught there. A rough estimate of the silky sharks taken as bycatch in tuna longline fisheries of the southern and central Pacific Ocean indicated that up to 900,000 individuals were caught during 1989 (Bonfil, 1994). Yet there is great uncertainty surrounding these calculations, and there are no estimates of numbers discarded alive and numbers actually killed, although given the common practice of finning among tuna fishermen it is likely that most sharks caught eventually die. Indeed, Clarke (2003) estimated that silky sharks are probably the second most important species (after blue sharks) supporting the Hong Kong fin trade. Furthermore, suspected misidentification between silky and blacktip (*C. limbatus*, Carcharhinidae) sharks in some Pacific tuna fisheries suggests that silky bycatch might be higher (S. Smith, NMFS, personal communication; C. Lennert, Inter-American Tropical Tuna Commission (IATTC), personal communication).

Inadequate data obscure the quantity of silky sharks that are landed by the various shark-fishing fleets of the world. FAO catches of silky sharks in Sri Lankan fisheries for the period 1960–1998 averaged 11,000 metric tons (t)/year and oscillated around 20,000 t/year over the last 6 years. However, according to Bonfil (1994), only about 75% of these catches are actually attributable to silky sharks; Sri Lankan scientists report (information courtesy of the Fishery Information Data and Statistics Unit, FAO) that only about 13,000 t/year of silky sharks were landed in the mid-1990s. In the Gulf of Mexico, silky sharks are regularly caught as part of Mexican multispecies shark fisheries, and to a lesser extent in US shark and tuna/swordfish fisheries, but in most cases the catch is not recorded at the species level. Recently instituted observer programs have partially alleviated this problem, at least in the Gulf of Mexico (Cramer *et al.*, 1997; Gonzalez-Ania *et al.*, 1997). Landings of silky shark by US commercial fisheries off the East Coast were estimated at 14.5 and 6.5 t (dressed weight) for 2000 and 2001, respectively (Cortés and Neer, 2002).

Stock assessment and fisheries management

There have been only a few attempts to conduct stock assessment of silky sharks because of limited landings data and the absence of estimates of population sizes or indices of abundance for most populations. Bonfil (1990) detected growth overfishing of silky sharks in the Yucatán fishery by applying Beverton and Holt's yield per recruit analysis. Subsequent research using a simulation model of the population dynamics of silky sharks in this fishery indicated that banning the catch of juveniles was the best alternative for management of this stock, considering fishery conditions in the late 1980s (Bonfil, 1996). For the Pacific Ocean, Oshitani and Nakano (personal communication) characterized the silky shark stock as stable. Their study, using generalized linear model–standardized catch-per-unit-effort (CPUE) data and separable virtual population analysis, estimated a total catch of 13,000–20,000 t against a biomass of 170,000–240,000 t, with a resulting fishing mortality level of $F = 0.061$–0.096 and a stable CPUE trend for 1992–1998, which was higher than that found in 1967–1970.

In the Gulf of Mexico, Baum and Myers (2004) compared the catch rates of silky sharks from tuna surveys in the 1950s against catch rates from the commercial pelagic longline fishery in the 1990s (targeting tunas, swordfish, and sharks) and found a drop of nearly 91% in silky shark abundance. While the exact magnitude of this decline is subject to debate owing to differences in the mode of fishing between the two data sets, there is little doubt that silky shark populations have undergone significant declines in the Gulf of Mexico over the last 40 years of fishing.

Given their life-history characteristics, silky sharks have a moderate capacity to recover from overexploitation. Smith *et al.* (1998, 2008), in a quantitative analysis of the intrinsic rebound potential for 26 different shark species, listed the silky shark in the middle of the range (intrinsic rebound potential of 0.043, within a range of 0.017–0.136). Similar results, confirming the moderate capacity of silky sharks for population growth, were obtained through additional demographic modeling (Cortés, 2002, 2008; Beerkircher *et al.*, 2003).

Conservation of silky sharks

During preparation of the 2000 IUCN Red List of Endangered Species, the silky shark was assessed as a Lower Risk, Least Concern species (thus it does not appear on the Red List). This classification was based on the lack of evidence for strong declines in abundance, the generally high abundance of the silky shark where it occurs, and its wide distribution in all tropical oceans; these last two characteristics make it likely to be one of the five most abundant shark species in the world. Populations of the northern Indian Ocean, tropical Pacific Ocean, and Northwest Atlantic Ocean were classified as Data Deficient because of the lack of information on the number of sharks dying in relation to the abundance of the species (it is known that silky sharks are exploited in these areas, but there are no statistics of these catches nor indices of abundance for the stocks). In light of the findings outlined earlier, it is likely that this species will be assigned threatened status, at least for the Northwest Atlantic population, in the next publication of the Red List.

Several international fishery organizations have recently initiated specific actions to lower shark bycatch in pelagic (tuna and billfish) fisheries. The IATTC is determining the extent of shark identification problems in the eastern tropical Pacific tuna purse-seine fishery (C. Lennert, personal communication). The International Commission for the Conservation of Atlantic Tunas (ICCAT) has enhanced its data recording system to include detailed shark bycatch by species since 1996, which resulted in a stock assessment for shortfin mako and blue sharks in the Atlantic (Babcock and Nakano, 2008). Unfortunately, lack of adequate data precludes a similar assessment for silky sharks in the immediate future.

With renewed commitment and effort, stock assessment and management of the sh-eries that affect silky and other sharks can be dramatically improved within a few years. However, comprehensive plans for shark management in international waters, perhaps through suitable agreements among shery organizations, are also needed to establish informed and sustainable management of the world's diverse shark populations.

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