Conservation and Management Status of Spiny Dogfish Sharks (*Squalus acanthias)*:

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Overview

The Spiny Dogfish, *Squalus acanthias,* is a small shark found in temperate waters worldwide, where it is or has been important in commercial fisheries. It is exceptionally slow-growing and long-lived and therefore especially prone to rapid over-exploitation and long-lasting depletion. The sustainability of Spiny Dogfish fisheries is further hampered by the tendency for directed fisheries to target large, mature females. Reproductive biomass in the Northwest has declined by 75% in the past 15 years and total biomass has fallen by 95% in the Northeast Atlantic since fisheries began over one hundred years ago. Demand for Spiny Dogfish meat, primarily from Europe where depleted stocks may no longer meet market demand, is driving targeted fisheries around the world, none of which are effectively managed. Spiny Dogfish fins also enter international trade for use in shark fin soup. There are no regional or international management measures in place for Spiny Dogfish.

Biology

The Spiny Dogfish is a temperate, cosmopolitan species with principal populations found in the North Atlantic, the eastern South Pacific, the South Atlantic off South America, the Cape coast of South Africa, the southern coasts of Australia and New Zealand, and the North Pacific. Although they are highly migratory, little mixing occurs among populations. Spiny Dogfish travel in large schools, segregated by size and sex. They are found from the intertidal zone to depths of 900m. Usually coastal and demersal, they migrate north and south as well as nearshore and offshore in 7–15^{o}C water (Compagno 1984).

Spiny Dogfish are very long-lived. Individuals in the Pacific are thought to grow more slowly and larger than those in the Atlantic (Nammack *et al*. 1985). Life history characteristics are summarized below. Smith *et al*. (1998) found Spiny Dogfish to have the lowest intrinsic rebound potential of 26 shark species analyzed. These factors, combined with the tendency of fisheries to target the reproductive females (due to their large size), make the species particularly prone to depletion.

Table 1. Spiny Dogfish *Squalus acanthias* estimated life history parameters

Age/ size at maturity	Females - NW Atl.: 12 yrs/ 75 cm; NE Pac.: 23 yrs/93.5 cm; NE Atl:15 yrs/ 83 cm Males - NW Atl.:6 yrs/60 cm; NE Pac.:14 yrs; Australia: 59 cm
Longevity/maximum size	Females - NW Atl.: 40 yrs/124 cm; N. Pac. 160 cm Males - NW Atl.: 35 yrs/100 cm
Gestation time	18–24 months
Reproductive periodicity	2 years (no resting stage)
Average litter size	1–20 pups; 2–15 (NW Atl)
Rate of population increase	2.3 % (N. Pacific)
Natural mortality	0.092 (NW Atl)

Threats

The principal threat to Spiny Dogfish throughout the world is overfishing from commercial fisheries, most of which are fuelled by European demand for meat. The species is also exploited worldwide for fins, cartilage, liver oil, and hides (Compagno 1984). Discarded bycatch may be significant if market demand is low, but survival of Spiny Dogfish returned to the water may be high, as evidenced by dramatic increases in dogfish populations during periods of heavy indirect but little direct fishing (such as the Northwest Atlantic stock during the 1980s). Bycatch is therefore not necessarily a significant source of mortality.

Spiny Dogfish were once considered to be the most abundant living shark. They are caught in bottom trawls, gillnets, line gear, and by rod and reel. Locally high biomass initially supports large catches (Compagno 1984). However, most large-scale Spiny Dogfish fisheries have depleted populations and collapsed (Ocean Wildlife Campaign 1996).

In the late 1980s, falling yields from severely depleted stocks of Spiny Dogfish off Europe led to increased levels of frozen imports from 25 countries, principally the U.S. and Argentina (Rose 1996). In recent years, as the U.S. Atlantic population declined and came under management, fisheries and trade increased in Atlantic Canada and several countries in the Southern Hemisphere.

According to the Food and Agricultural Organization (FAO), dogfish catches reached a peak in 1972 (73,500 metric tonnes (metric tonnes, or t, =1000kg) then declined and stabilized in a range between 36,000–51,000t in the 1990s. Most of the catch reported to FAO comes from the North Atlantic with minor amounts reported from the Northeast Pacific (maximum 5,314t in 1988) and the Mediterranean and Black Seas. Eighty-nine percent of the world spiny dogfish landings reported to FAO from 1950 to 2001 (excluding miscellaneous sharks, etc.) were taken from the Northeast Atlantic. Over this period, landings were sustained at levels of 30–50,000t per year for most of the 1960s, 70s and 80s. Since the mid 1980s, Spiny Dogfish reported landings in this region have declined sharply while those from elsewhere have mostly increased. By 2001, Northeast Atlantic reported landings had dropped to 27% of their historical FAO-reported peak of nearly 50,000t, taken in 1972. FAO data are often incomplete: more detailed Northeast Atlantic data from the International Council for the Exploration of the Sea record a peak of over 58,000t reached in 1963, followed by a 89% decline through to 2002. Other discrepancies between records include U.S. landings in 1999 of nearly 15,000t of Spiny Dogfish, while FAO reports 1999 global catch at 22,756t with the largest catches coming from Canada (5,536t) and Norway (1461t).

U.S. catch statistics show that catches from the Northwest Atlantic stock were primarily from foreign vessels from 1966–1977 with a peak of 25,000t in 1974. U.S. vessels then dominated the fishery until 2000 with peak catches in 1996 at 28,000t. Canadian catches (primarily from Nova Scotia) rose nearly six times from 1997–2001. In the last two years, they have represented the largest proportion of the landings from the stock (NEFSC 2003).

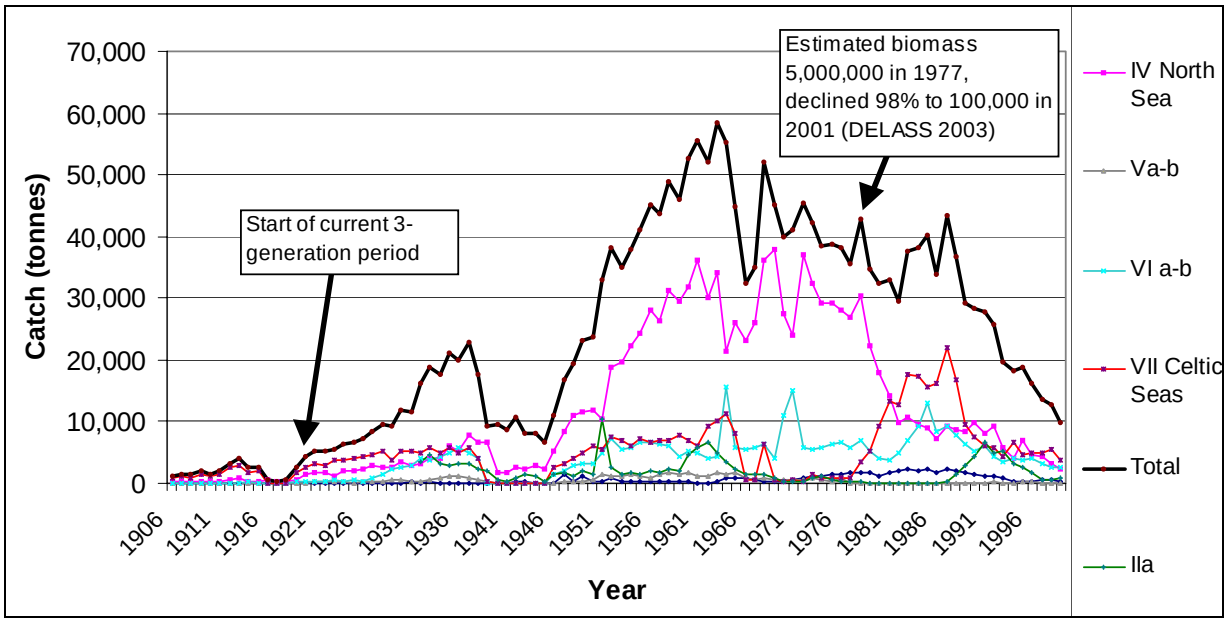
Other stocks yielding significant landings are in the Northeast Pacific (off western North America), the Southwest Pacific (mainly New Zealand) and Northwest Pacific (Japan), but the high landings reported in Japanese documents are apparently not included in FAO statistics. Reported catches from Japanese coastal and offshore fisheries dropped from more than 50,000t in 1952 to only 10,000t in 1965 (Taniuchi 1990). Japanese offshore trawler catches from the Pacific North Area declined to below 200t after 1996 and a record low of 115t in 1999 with catches increasing slightly in 2000 and 2001 (232t and 203t respectively). From 2000–2001, catches from the Shiriyazaki Area rose from 56t to 86t while catches from the Kinkazan Area dropped from 95t to 53t and those from the Joban Area declined from 55t to 41t. In this time period, fishing effort is reported to have increased considerably (Government of Japan 2003). Reported catches of Spiny Dogfish in New Zealand have more than doubled over the past decade, from 2500–5000t in the last 1980s to 5000–10,000t in the 1990s (MFish 2003).

Population Trends and Conservation Status

The 2003 IUCN Red List assessment for Spiny Dogfish is “Near Threatened” on a global basis. Populations in the Northwest and Northeast Atlantic, however, are currently assessed as “Vulnerable” and “Endangered” respectively, based on past fisheries records, stock assessments, and continued unsustainable exploitation. Assessment and review of these and other regional stocks and of global status are underway. The most heavily fished populations of Spiny Dogfish (Northwest and Northeast Atlantic stocks) were both recently subject to peer-reviewed assessments conducted by international panels of experts.

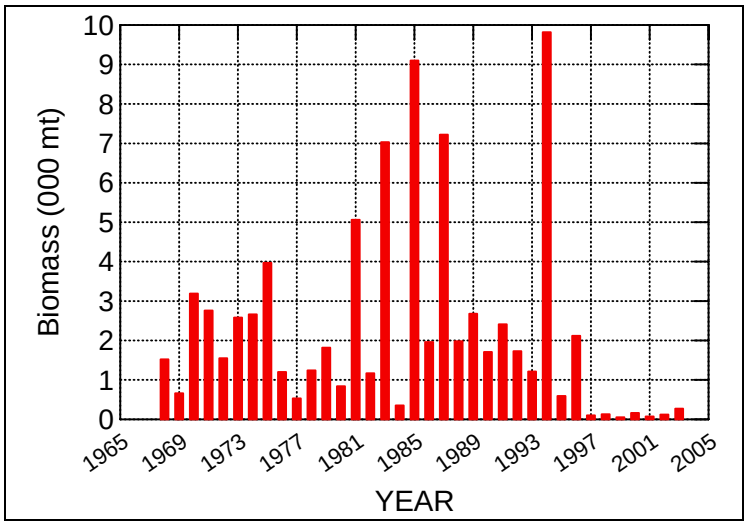
The 2003 assessment report from EU-based Development of Elasmobranch (DELASS) Project characterized the Northeast Atlantic Spiny Dogfish population as “severely depleted” and suggests stock depletion to below 5% of carrying capacity (K) in 2001 (Heessen 2003). Other scenarios carried out in this assessment revealed population status as low as 2% of K.

Figure 1. *Squalus acanthias* catches in ICES areas, Northeast Atlantic



Also in 2003, the Regional Stock Assessment Review Committee (SARC) of the U.S. Northeast Fisheries Science Center (NEFSC) assessed the Northwest Atlantic Spiny Dogfish population. Their advisory report documents a 75% decline in reproductive female dogfish since the U.S. fishery began in 1988 (NEFSC 2003). Consequently, the number of dogfish pups has been at record low levels for seven consecutive years (1997-2003); this recruitment failure (see Figure 2) is expected to persist for at least the next several years. The SARC also reports recent declines in survivorship of pups, due likely to smaller mothers producing smaller, weaker young. Projections that take into account the resulting lower reproductive potential coupled with current fishing mortality (estimated at three times the accepted rebuilding level) forecast stock collapse. Recovery, even under optimistic assumptions for recruitment and unrealistically minimal fishing mortality, is estimated to take two to three decades (NEFSC 2003).

Figure 2. Biomass estimates of *Squalus acanthias* pups, Northwest Atlantic (source: National Marine Fisheries Service, Northeast Fisheries Science Center)



The Spiny Dogfish stock in the Sea of Japan is estimated to have been extremely low in recent years, and the stock in the Pacific North Area off Japan is considered to be at a low level (Government of Japan 2003).

Management status

There are no truly effective Spiny Dogfish fishery management programs in place anywhere in the world. Only Canada, the U.S., the EC and Norway currently impose any species-specific measures for Spiny Dogfish (New Zealand has proposed precautionary limits on emerging fisheries beginning in October 2004 in order to prevent stock depletion as a result of international trade demand). To date, none of these restrictions has led to rebuilding of depleted populations. Of these, the management plan for the U.S. Northwest Atlantic population most closely reflects scientific advice. The U.S. federal measures, however, are inconsistent with Canadian restrictions for the same Atlantic population and their effectiveness is regularly undermined by non-compliance of U.S. states in state waters. There are no bilateral or international management measures to protect Spiny Dogfish, although the highly migratory nature of this species means that collaborative management is essential for fisheries targeting shared stocks.

Europe

Prior to 1998, a Norwegian minimum size was the only regulation imposed for Northeast Atlantic Spiny Dogfish (ICES 1997) despite warnings that part of the Northeast Atlantic stock was already over-exploited in the 1960s (Holden 1968). In 1998, the European Commission (EC) enacted the first commercial quotas for the stock. However, limits were based on historical landings, not scientific advice and are unlikely to provide conservation benefit (Federal Republic of Germany 2004). Since 1999, annual catch quotas for the EC North Sea waters have consistently been set far in excess of North Sea landings and the recommendations of the European Commission's STECF (Scientific, Technical and Economic Committee for Fisheries). For example, the 1999 total allowable catch (TAC) was set at 8870t, more than twice the total reported landings for the ICES North Sea area for the year prior (3288t were taken in 1998). In 2002, the TAC was reduced by 36% to 5640t, yet was still nearly five times higher than the total North Sea and UK reported landings for the previous year (1795t and 1006t for 2001 respectively).

United States Atlantic

The U.S. rebuilding plan for Northwest Atlantic Spiny Dogfish has yet to reverse population decline. Due to implementation delays, loopholes and state non-compliance, detailed below, the plan's mortality targets have yet to be achieved and have been grossly exceeded in some years. Whereas significant rebuilding was anticipated by now, the stock is instead poised for collapse.

Federal Fishery Management Councils in the eastern U.S. developed a Spiny Dogfish rebuilding plan in the late 1990s coincident with the stock being officially declared overfished (MAFMC 2000). Low priority and controversy over quota cuts led to serious delays. Implemented in mid 2000, the plan aimed to rebuild the population through a low fishing mortality target (F=0.03) and corresponding quota (1800t) and trip limits (135 – 270kg for two periods) to discourage targeted fishing, yet allow some landing of incidental catch. Now that the ten-year legal limit for population recovery is no longer possible, federal law allows the rebuilding period to be extended, opening the plan up for relaxation of measures.

As Federal measures developed, the dogfish fishery shifted into state waters (within three miles from shore), with state fisheries undermining the federal management plan. Most notably, Massachusetts, the Atlantic state with the largest directed dogfish fishery, adopted a state quota in 2000 at nearly twice the Federal allotment for the entire Atlantic, and excessive possession limits that allowed for continued directed dogfish fishing. Under the federal plan, overages are not deducted from the subsequent year's quota.

In late 2002, the Atlantic States Marine Fisheries Commission (ASMFC), which regulates state water fisheries for shared stocks, adopted a federally compatible dogfish rebuilding plan for state waters (ASMFC 2002). In early 2003, however, the ASMFC rejected scientific advice and accepted a Massachusetts proposal to more than double the quota (to 8.8 million lbs) and increase trip limits by an order of magnitude (to 7,000 lbs) to allow directed dogfish fishing. The ASMFC plans to impose scientifically defensible limits for the 2004 fishing year (beginning in May), but that decision can be overturned by a two-thirds majority vote.

Canadian Atlantic

As U.S. restrictions for the Northwest Atlantic Spiny Dogfish came into effect, a directed Canadian fishery on the same stock began to develop and expand. Canada began restricting dogfish catch in May of 2002, following a significant increase in landings in years just prior. The government capped 2002 commercial landings at 2500t for the fixed-gear groundfish sector off Nova Scotia and in the Bay of Fundy, based on landings history at the time. In addition, bycatch caps for other fisheries consistent with historical landings and an additional 700t for a cooperative industry sampling program were granted. The Canadian government has stated that the caps are aimed to limit exploitation while future sustainable catch levels are investigated.

In April 2003, Canadian officials reported that the 2002 quota was exceeded by 1000t (40%) and noted that the quota caps were being opposed by industry. The Canadian government has announced their intention to collect dogfish data for another five years in preparation for their own assessment and their expectation that current fishing effort, deemed unsustainable in U.S. assessments, would be maintained in the meantime.

Canadian Pacific

British Columbia spiny dogfish have been managed only broadly through groundfish regulations since 1978. Dogfish are subject to Total Allowable Catches (TACs) that have not yet been reached (Bonfil 1999). These stocks are protected more by lack of market than by current regulations.

United States Pacific

Dogfish fisheries in the U.S. North Pacific are subject to minimal management. Off Alaska, they are the predominant shark regulated under an "other species" bycatch TAC (Alaska NMFS report 2000). The state prohibited commercial shark fishing in 1998, however, proposals for a 2002 directed fishery in Prince William Sound were only narrowly defeated (Goldman, pers. comm.). Washington State has recently imposed closed areas and seasons intended to protect Spiny Dogfish during pupping in Puget Sound, however, these measures are based more on anecdotal information than on science (Cindy Tribuzio, University of Washington, pers. comm.).

New Zealand

Citing increased catches, rising demand as overseas stocks collapse, poor records for sustainability and knowledge of the target species' vulnerability, the New Zealand Minister of Fisheries has announced intention to bring Spiny Dogfish fisheries under the country's quota management system in October 2004 (MFish 2003).

International Trade

Meat

Special codes are used by customs services of the main importing countries to record international trade in meat of Spiny Dogfish at the species level. These codes are part of the customs Harmonised System, called Combined Nomenclature in the European Union (EU). FAO and customs data (Eurostat import data and U.S. customs export data) indicate that in 2001 the EU represented the world's largest market for Spiny Dogfish meat, consuming at least 65% of world reported landings. Volumes rose from 450t in 1995 -1500t in 2002. France has been historically the largest consumer of spiny dogfish meat, importing an annual average of 5000t (98% Spiny Dogfish) from 1990 - 1994, with the UK as its top European supplier. At that time (1988 - 1994), Norway was the largest of nine non-EU suppliers of fresh or chilled Spiny Dogfish to the EU, followed by the U.S. In 2001, in addition to their 11,700t reported landings (wet weight), EU Member States imported 7100t Spiny Dogfish. From the total (18,800t), less than 1% was exported or re-exported. The largest proportion of 'fresh or chilled' and 'frozen' Spiny Dogfish imported into the EU in 2001 was destined to France (1500t), Germany (1400t), Denmark (1300t), the UK (1000t) and Italy (700t). USA (2700t representing 92% of U.S. reported landings), Canada (1950t – 23% of Canada's reported landings) and Norway (1400t – 98% of reported landings) supplied 75% of EU imports in 2001. As North Atlantic Spiny Dogfish stocks decline, demand is being met by imports from 25 countries, including emerging South American, African and Pacific suppliers such as Argentina, Mauritania and New Zealand, which exported to the EU only 5% of its 2001 reported landings (4200t). Discrepancies appeared between Argentina's landings reported to FAO and EU imports recorded in Eurostat for 2001 (Federal Republic of Germany 2004). Due to the depletion of the U.S. Atlantic stock, catches, port prices and market demand for Spiny Dogfish off New Zealand have increased in recent years (MFish 2003).

Fins

Despite their low quality, dogfish fins are available in high volume from fisheries and have been routinely traded (for shark fin soup) for more than a decade (Rose 1996). Among the 20 nations recorded by FAO as trading in Spiny Dogfish products, only Japan, New Zealand, South Africa and the United Kingdom reported exports of fins of this species (Vannuccini 1999). However, volumes of shark fins in international trade are generally lumped under a custom code that does not allow for recording at species level. As such, data on global imports of Spiny Dogfish fins are not readily available.

Conclusions

The Spiny Dogfish *Squalus acanthias* has been a valuable species in target and multi-species commercial fisheries for more than 100 years. Its products (primarily meat, but also fins and liver oil) enter international trade in very large quantities. International trade demand (the European market for meat) is driving existing and new fisheries around the world.

Virtually all Spiny Dogfish stocks are depleted, some of them seriously so, but the majority of fisheries are unmanaged or inadequately managed by range states. Collaborative management of shared stocks is also lacking. Stock rebuilding programs are rare, and where they do exist, suffer from lack of cooperation or compliance.

Monitoring and reporting of Spiny Dogfish fisheries (target catch, bycatch, discards, and landings) is inadequate in most range states. Monitoring and reporting of international trade is also insufficient. There are frequently discrepancies between FAO data and data recorded by national or regional fisheries bodies.

Improvements in the monitoring, management and stock status of Spiny Dogfish are urgently needed, but are not being delivered under the great majority of existing monitoring and management regimes.

Spiny Dogfish require immediate attention under Resolution Conf. 12.6 on the Conservation and Management of Sharks. This species also warrants urgent attention based on the Guiding Principles and Objectives of the UN FAO International Plan of Action for the Conservation and Management of Sharks, largely unimplemented in most Spiny Dogfish range states.

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