PROPOSAL FOR INCLUSION OF SPECIES ON THE APPENDICES OF THE CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS

A. PROPOSAL: Inclusion of *Cetorhinus maximus* on Appendices I and II.

B. PROPONENTS: The Government of the United Kingdom of Great Britain and Northern Ireland, and the Government of Australia.

C. SUPPORTING STATEMENT:

1. Taxon

1.1	**Kingdom**:	Animalia
1.2	**Phylum**:	Chordata
1.3	**Class**:	Chondrichthyes, subclass Elasmobranchii
1.4	**Order**:	Lamniformes
1.5	**Family**:	Cetorhinidae
1.6	**Genus/species/subspecies**:	*Cetorhinus maximus* (Gunnerus (1765))
1.7	**Common Name**:	English: Basking shark, (traditionally sunfish or sailfish, hoe mother). Gaelic: Cearban (Scotland), liabhán mór, liabhán chor gréine (Ireland). Manx Gaelic: sharkagh-souree (summer shark) or gobbag vooar (big mouth) French: Pélerin Spanish: Peregrino German: Riesenhai, Italian: Squalo elefante, Greek: Sapounas

2. Biological data

The basking shark (*Cetorhinus maximus*) is clearly a K-strategist species, with low fecundity, gives birth to fully developed young, attains a late age and size at sexual maturity, and has a long gestation period. They are ovoviviparous (producing eggs which hatch within the uterus). They are RAM-filter feeders[1], principally feeding on zooplankton. It is calculated that they may filter up to 2000 cubic metres of seawater per hour.

Table 1: Some biological characteristics of the basking shark (*C. maximus*).

Category	**Statistic**
Maximum length	10m (33ft)
Age/size at sexual maturity	Males: 12-16 years / 5-7m Females: 18 years / 8-9m
Gestation period	18 months – 3 years (Pauly, 2002)
Litter size	5-6 pups (Pauly, 2002)
Size at birth	1.6m (FAO, 2004)
Population productivity	0.013-0.023 (Musick *et al*, 2000)
Minimum population doubling time	14 years (Musick *et al*, 2000)
Temperature range	8-14 degrees C
Depth range	0-2000m

[1] Sharks must swim in order to pass the food into their mouths. They have no musculature in the mandibles to 'vacuum' food into their mouths.

Little is known about the maximum age of basking sharks. Sabine Wintner of the Natal Sharks Board in South Africa is undertaking a project to age basking sharks using vertebral samples obtained from around the world. The National Marine Fisheries Service (US) APP is contributing ten samples from eight animals towards this effort. Other samples were x-rayed at a number of different locations, including Sweden, Algeria, Italy and South Africa, and the resulting x-rays are being forwarded to Dr Wintner for analysis. Vertebrae are being x-rayed at the CA Pound Human Identification Laboratory of the University of Florida.

2.1 Distribution

Basking sharks occur mainly in the temperate waters of continental and insular shelves and shelf slopes of the Atlantic and Indo-Pacific Oceans and Mediterranean Sea. They are occasionally recorded well offshore in oceanic waters and spend a large amount of time feeding in deeper water on the edge of continental and insular shelves (Sims *et al.*, 2005), but are most commonly seen on the surface close to the coast (Doyle *et al.*, in press). They have only rarely been recorded in the tropics, but this may be because they are restricted to deep cold water in these areas and are therefore not seen or captured – a basking shark tagged with an archival satellite tag off the temperate coast of North America migrated to a deep trench between Jamaica and Haiti the following winter (Skomal, 2005). Records from the warmest areas are otherwise of dead, stranded or moribund specimens. Although widely distributed, they are frequently observed from a few favoured coastal temperate areas, where they are usually seen in relatively large numbers for only part of the year.

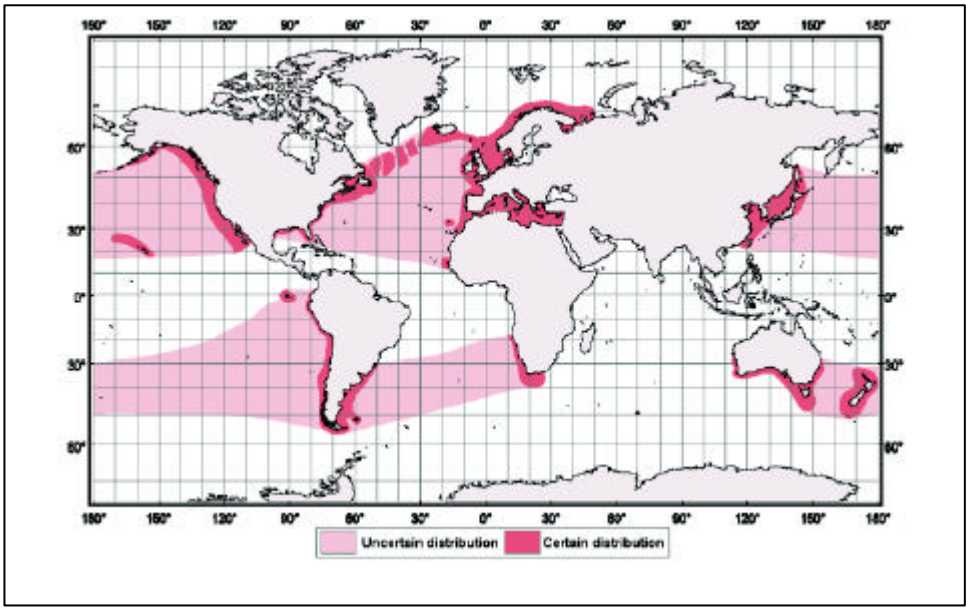


Figure 1. Basking shark distribution in international waters. (Data source FAO: 2004).

2.2 Population (estimates and trends)

No firm estimates are available for the total global population or regional populations of this species. Owen (1984) suggested that the unexploited population in the Gulf of Maine and off the New England coast (USA) during the summer months may number as many as 6,700 - 14,300 sharks. He compared this with an estimated population of 2,000 sharks in the Monterey Bay area of the US west coast (Squire 1967). As pointed out by Compagno (1984), it should be noted that basking shark populations are probably very small compared with most other sharks. Most recorded fisheries have taken only hundreds or about one thousand individuals annually for a few years before collapsing (see Annex 1). Where observations of basking sharks have been recorded, the total annual number of records is usually in the tens, hundreds, or at most low thousands, including repeat sightings. The total number removed from the whole of the Northeast Atlantic during the past 50 years is probably between 80,000 and 106,000 animals (Annex 2; Sims & Reid, 2002).

There is pronounced spatial and seasonal population segregation where groups of animals of similar sizes and the same sex may be sighted together. Most basking sharks caught in surface fisheries in Scottish waters were recently mated females (F:M ratio of 18:1), (Watkins, 1958), and 65-70% of sharks taken in Japan were

also female. Conversely, catches in sub-surface gill nets off Newfoundland included twice as many male as female sharks (Lien & Fawcett, 1986). Segregation by sex was also evident in bycatch from different regions of the waters around New Zealand (Francis & Duffy, 2002). Despite the large numbers of mature females taken in fisheries, there is only one known record of a pregnant female (with a litter of six). Newborns and juveniles are also only rarely seen (comprising 2.6-2.8% of sightings by Sims *et al*. 1997 and Lien & Fawcett, 1986), perhaps suggesting that their populations occur elsewhere, or that recruitment rates are very low.

The global status of the basking shark is assessed as **Vulnerable** (A1a,d, A2d, using the 1994 Red List criteria) in the 2004 *IUCN Red List*, with the North Pacific and Northeast Atlantic stocks both assessed as **Endangered** (A1ad). These IUCN assessments are based primarily on past records of rapidly declining local populations of basking sharks as a result of short-term fisheries exploitation and very slow population recovery rates recorded (see fisheries accounts in the following pages). The global assessment also takes into account the likely potential for similar population declines to occur in the future from directed fisheries, driven at least in part by the demand for fins in international trade, and from continued global by-catch. An updated assessment currently under consideration by the IUCN Shark Specialist Group utilising the 2001 criteria retains the same global and regional assessments, but applies criterion A2bd only.

Compagno (1984) considers the basking shark "to be extremely vulnerable to overfishing, perhaps more so than most sharks ascribed to its slow growth rate, lengthy maturation time, long gestation period, probably low fecundity and probable small size of existing populations (belied by the immense size of individuals in their small schools)." The best estimates of age at maturity for basking sharks are 12-16 years for males, up to 20 years for females, with a litter size of six, and gestation period from 12 to 36 months. Longevity is likely to be 50 years. The interval between litters may be two to four years (Pauly 1978, in press; Compagno, 1984; Fowler, in press).

Siccardi (1971; 1960) suggested that there are four species of *Cetorhinus*, two in the North Atlantic and Mediterranean (*C. maximus* and *C. rostratus*), one from southern Australia (*C. maccoyi*), and one from the South Atlantic (*C. normani*). Compagno (1984) and Springer and Gilbert (1976) consider there is insufficient evidence to separate these species, although there are apparently clear morphological differences between some populations (e.g. Tomás and Gomez, 1989). Genetic research currently underway (e.g. Hoelzel, 2001) may help to clarify the status of populations in different oceans and/or hemispheres.

There is only very limited information available on wider population trends; data indicating changes in catch per unit effort or annual variation in numbers of sightings are only obtainable on a local, or at most regional, scale. Some evidence exists for unpredictable cycles in the numbers of basking sharks entering coastal waters. Certain years have seen very large influxes of sharks to some UK areas, while in others the numbers recorded are low (Kunzlik, 1988; Speedie, 1998; Fairfax, 1998). Landings throughout the Northeast Atlantic have also fluctuated, but with a continued downwards trend evident over the past few decades. Annual variations in sightings and catch records may be strongly influenced by weather conditions, water temperature and cyclical fluctuations in the distribution and abundance of zooplankton. For example, some of the fluctuations in north-east Atlantic catches could be linked to broad-scale oceanic changes controlled by factors such as summer stratification, the North Atlantic Oscillation or climate (Sims and Reid, 2002). Associated changing patterns of basking shark activity may make populations more or less vulnerable to fisheries in some years than in others. The life history of the basking shark, with late maturity, low natural mortality and low birth rate probably means that any short-term fluctuations in sightings or catches are not reflections of natural fluctuations in total abundance, but of variations in distribution and/or vulnerability to surface fisheries.

2.3 Habitat (short description and trends)

The basking shark inhabits waters close to the continental shelf of nation states, migrating from deeper offshore waters closer in to coastal areas in the spring and summer months in order to follow and feed on the bloom of copepods that occur in shallow waters in summer months (Figs. 2-11). Surface waters preferred for feeding, and possibly for mating activity in the UK [northern Europe], appear to be ocean fronts, close inshore off headlands and islands, and in bays where 'tide lines' (tidal slacks) are formed in areas of strong tidal flow and where zooplankton aggregate (Earll, 1990; Sims *et al.*, 1997; Sims and Quayle, 1998). Tagging

studies have shown that sharks migrate considerable horizontal and vertical distances throughout the year in order to locate dense food patches (Sims *et al*., 2005; Skomal, 2005), although the tagging studies of Dr David Sims and colleagues at the Marine Biological Association, UK have shown that sharks in the NE Atlantic remain on or near to the edge of continental shelf waters generally at depths of less than 200m.

2.4 Migrations (kinds of movement, distance, proportion of the population migrating)

Distribution records are characterised by seasonal appearances, and the species is highly migratory, undertaking extensive horizontal (of >3000km) and vertical movements (Sims *et al*., 2005; Skomal, 2005) in a single year. Records in higher latitudes are most common during the spring and summer months, with migrations taking place from deep offshore to shallow inshore waters and between warm lower and cold higher latitudes, depending upon the seasonal distribution of the plankton on which basking sharks feed. Recent UK satellite tagging work has shown that basking sharks remain in continental shelf edges during winter spending more of their time at greater depths and less near the surface (Sims *et al*., 2005). Some individuals move into shallower shelf waters in higher latitudes as the summer season progresses, with a greater proportion of time spent feeding at the surface, particularly after the thermocline has developed and zooplankton densities are at their height. In contrast, a basking shark tagged off the Atlantic coast of North America during the summer migrated south into the very deep water (Skomal, 2005). Basking sharks are caught from near to well beyond the edge of the continental shelf off the west coast of New Zealand in winter, both in mid water and on or near the bottom (Francis and Duffy, 2002).

The UK has recently funded a large-scale scientific project to survey the critical habitat and vertical and horizontal migrations of the basking shark in and around the waters of the United Kingdom, and the associated areas of contiguous Northeast Atlantic continental shelf (Sims *et al*., 2005). This has clarified long-distance vertical and horizontal shark movements, demonstrating that the basking shark population that occurs in the UK is shared with neighbouring Northeast Atlantic states and that individual sharks were sometimes seen in more than one state over the course of a single year.

Archival pop-up tags were attached to 20 sharks over the course of the project. Horizontal tracking showed considerable movement of sharks that were tagged in the Plymouth (UK) area around the NE Atlantic continental shelf area into EEZ waters of France, Ireland, Wales and England, and northwards into Scottish waters (Figs 2 – 9).

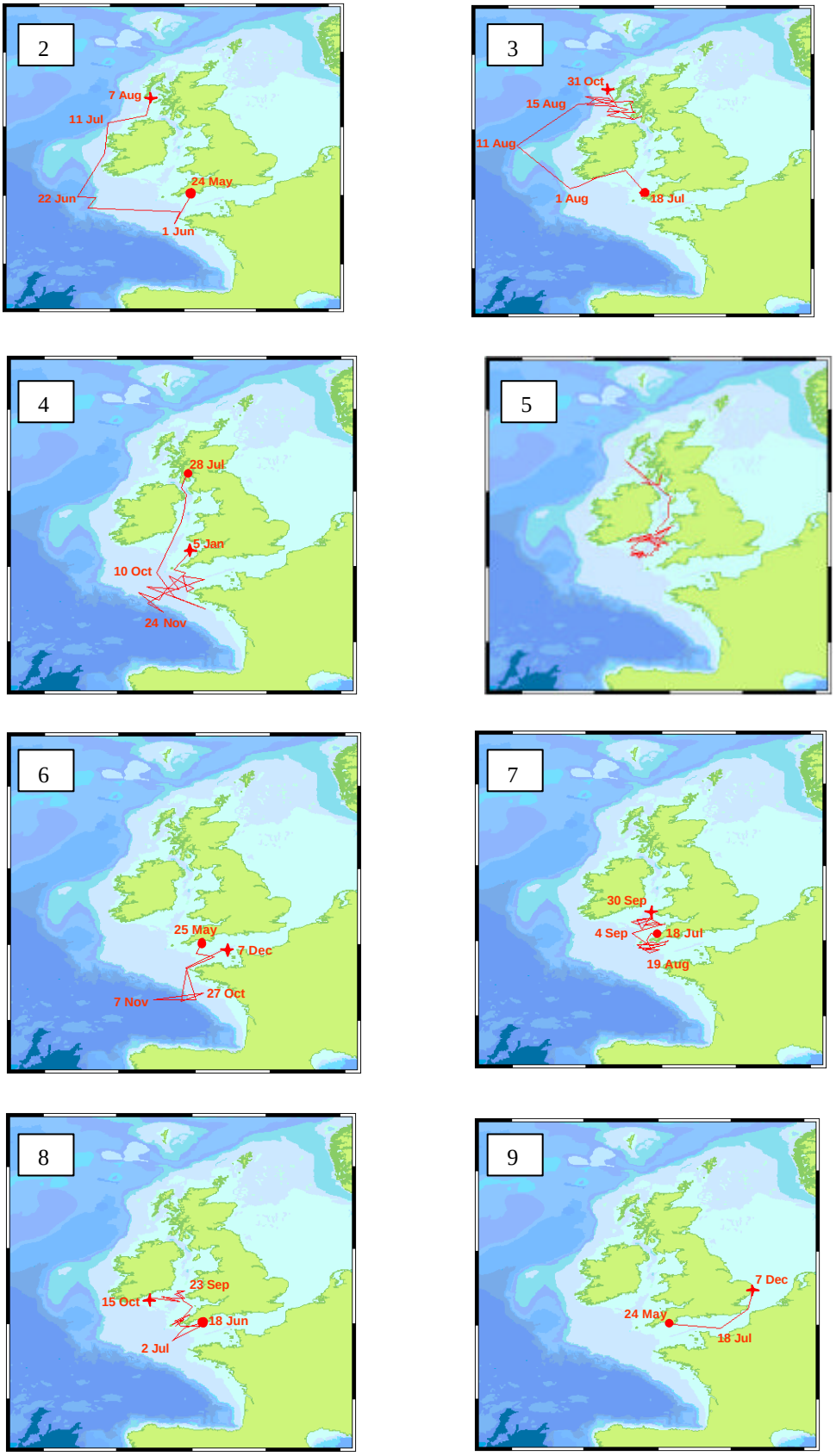


Figure 2–9. Horizontal movement of 8 tracked sharks between 2001 and 2003 (Sims *et al*., 2005). Circles are locations of tagging. Crosses are where the tags 'popped up'.

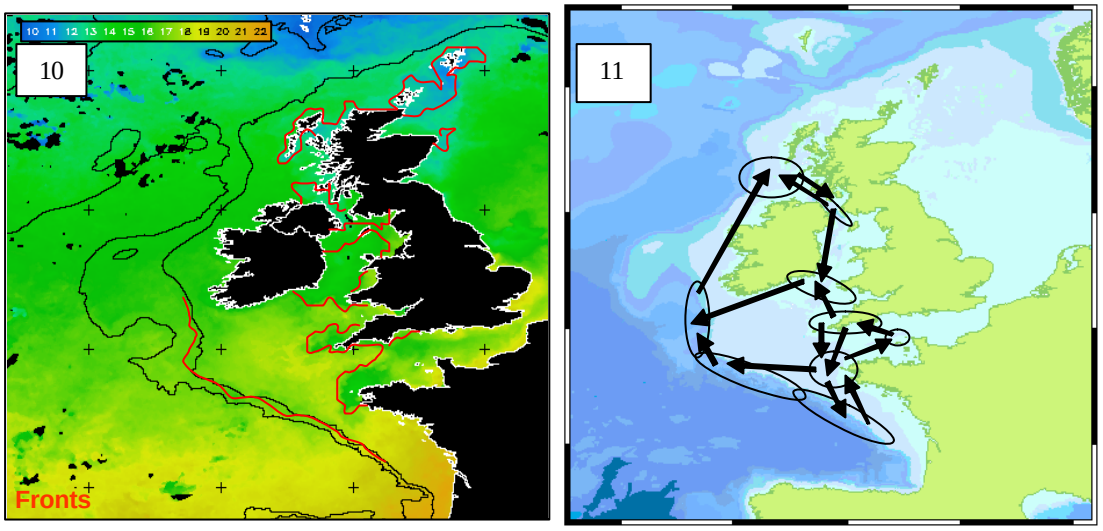


Figure 10&11. Breakdown of location of tidal and shelf break fronts (red lines) on NE Atlantic continental shelf (left), and location of shark hotspots (right) where sharks were observed most frequently from the archival tracking experiment. Remote sensing image (Figure 10) is a monthly composite of sea surface temperature during August 2002 from AVHRR on NOAA satellites. (Data reproduced with permission, Sims *et al*., 2005).

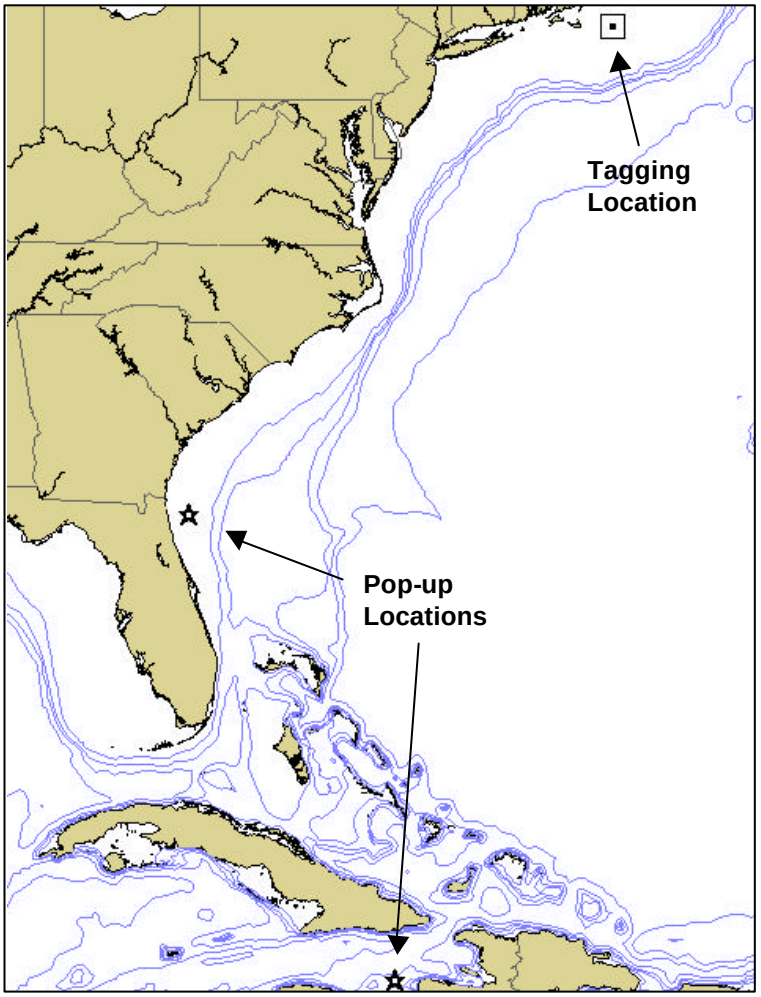


Figure 12. Tagging and pop-up locations of basking sharks tracked on the eastern US seaboard between October 2004 and January 2005 (source: Skomal, 2005).

A basking shark tracking study in the USA, using the same technology, tagged two basking sharks with Popup Archival Tags 40 miles off Nantucket Island in November 2004 (Figure 12) (Skomal, 2005). Three months later (January 2005), one shark had migrated 870 nm SW to waters off Florida, and the other 1,400km SSE between Haiti and Jamaica, above the eastern point of the Cayman Trench. The latter is one of the first records of a basking shark occurring in the Caribbean. It spent most of its time at depths of around 500m, and the movement of this shark was correlated with areas of sea where the water temperature remained between 55-60^{0}F.

2.5 Movement between international borders

Basking sharks tagged in the UK make considerable horizontal migrations up to a recorded 3000 km, moving between the waters of England, France, Eire and Scotland (Sims *et al*., 2005). They also move outside the 200 nm EEZ into international waters (Table 3). Basking sharks that occur in US Atlantic state waters are now known to move in winter south into deep waters of the Caribbean (Skomal 2005), and may also move north to Canadian shelf waters during the summer months (Fowler, pers comm.). Similar tagging study results are not available from other parts of the world, but it seems likely that sharks make extensive latitudinal migrations up and down the coastal margins of the Southwest Atlantic, Northeast and Northwest Pacific in order to locate food.

Basking sharks in NE Atlantic waters have been recorded diving to a depth of up to 850m at the edge of the continental shelf off the Goban Spur where they forage actively for food during the winter months, moving considerable horizontal distances over different vertical depth zones in order to find concentrations of food (Figure 2). Previous suggestions that basking sharks hibernated over-winter now seem most unlikely (Francis & Duffy, 2002; Sims *et al*., 2005). Basking sharks are caught from near to well beyond the edge of the continental shelf off the west coast of New Zealand in winter, both in mid water and on or near the bottom (Francis and Duffy, 2002). When they are caught in winter months, their stomachs have been shown to contain food, and their gill-rakers remained intact.

Sims *et al*. (2005) found that the largest migration observed in the UK shark tagging project was from the Plymouth area, south into waters off north west Brittany, west through the Western Approaches to southern Ireland, around the Atlantic coast of Ireland, and eventually into the sea of the Hebrides in under three months of tracking (Figure 2). This single shark roamed through the inshore territorial waters and EEZ of several States. Three other sharks tagged spent most of the time that they were tagged (67–87%) in international waters, outside the 200 nm EEZ (Table 3). Figure 11 illustrates those areas where sharks tagged in UK waters were most commonly recorded. In summer, basking sharks tended to move north between centres of high zooplankton abundance associated with thermal fronts (Figure 10). In winter, there was a tendency for the sharks to remain in deeper water, generally in the southern region of the shelf (Figure 11). These results suggest it unlikely that there are separate populations of basking sharks inhabiting northern or southern UK waters, but, rather that individuals move freely between these areas and the waters of adjacent states and probably form a single population in this part of the Northeast Atlantic.

Similarly, the new tracking evidence from the eastern seaboard of the Americas shows basking shark movement between waters adjacent to the north eastern states of the USA down into the heart of the Caribbean (Skomal, 2005).

3 Threat data

3.1 Direct threats to the population

The main threat to basking shark populations is from fishing operations – both targeted on basking sharks and incidental or by-catch in other fisheries – which often supply the international demand for basking shark products. However, because these fish congregate in bays and shallow water, they are also at risk from collisions with vessels and may be harassed by shark, cetacean and marine wildlife watchers. Collisions seem to be relatively frequent – large areas of scarring are often observed on the head and dorsal surfaces of UK sharks.

Compagno (1984) considers the basking shark "*to be extremely vulnerable to overfishing, perhaps more so than most sharks ... ascribed to its slow growth rate, lengthy maturation time, long gestation period, probably low fecundity and probable small size of existing populations (belied by the immense size of individuals in their small schools).*"

Targeted basking shark fisheries use nets to deliberately entangle the fish or harpoon guns to take basking sharks swimming or feeding on the surface. Targeted fisheries have been recorded from Norway, Ireland, Scotland, Iceland, California, China, Japan, Peru, Ecuador (Compagno 1984) and Northern Spain (Evaristo Alfaya, pers. comm.). Some of these are described in detail (see Annex 1 and 2). All the available evidence suggests that basking shark populations are extremely vulnerable to targeted fisheries. Where targeted fisheries have occurred, populations rapidly decline within decades, and there is no evidence from any fishery of recovery since closure (Annex 1). Well-documented declines in catches by directed fisheries for the basking shark suggest that reductions in numbers caught of at least 50% to over 90% have occurred in some areas over a very short period (usually ten years or less, Fowler in press; Annex 1; Table 2). Individual basking shark populations naturally occur over a much larger area than each individual fishery, so the reduction in numbers as a result of a localised fishery may denude a much wider geographical area of basking sharks. Target fisheries for basking sharks have resulted in severe and long-term population depletions in several regions and there is likely potential for similar population declines to occur in the future from directed and bycatch fisheries, driven at least in part by the demand for fins in international trade. Basking sharks are now legally protected in some territorial waters because of their vulnerability to exploitation (see section 4.1).

The life-history-strategy of basking sharks (as with many other large marine megafauna) makes them extremely vulnerable to targeted fisheries. Table 1 shows that with a minimal population doubling time of 14 years, low fecundity, late age of sexual maturity and long gestation period, basking shark populations are vulnerable to collapse, and cannot support any sustainable fishery.

An additional explanation for the rapid collapse of target fisheries for a widely distributed and apparently seasonally migratory species, is that basking sharks (like many other large sharks – e.g. Walker 1996, Hueter 1998) are site-faithful and tend to return to the same area on a seasonal basis related to favourable local food conditions. Recent tagging studies have shown that populations can be regarded as 'local' within a regional seas context (Sims et al., 2005; Skomal, 2005). For example, there appears to be a contiguous population, which occupies the waters of NW Europe including Norway, the UK, Ireland and France (Sims *et al*. 2005). Similarly, there is a contiguous population that migrates through the waters of NW Atlantic from Canada through the eastern seaboard of the United States, and into the waters of the Caribbean (Skomal, 2005 and 2002). Site fidelity makes the shark particularly vulnerable to targeted and local fisheries (Fowler, 1996 and in press), although repetitive movement patterns may not apply to all individuals within a population (Sims *et al.*, 2002).

Table 2. Catch trends for the basking shark from seven targeted fisheries over the past 60 years. (data source Anon, 2002).

Location	Timescale	Catch trend
California, USA	1946-1950s	30% decline in a few years followed by fishery closure
Northeast Atlantic	1946-1950s	90% decline from peak catches in the late 1960s
Achill Island, Ireland	1947-1975	95% decline in 25 years, followed by fishery closure
Firth of Clyde, Scotland	1982-1994	90% decline in a 12 year fishery
Canadian Pacific	1950s-1990s	50% decline following a brief eradication program
China	1960-1990	No data. Reportedly common in 1960s, rare today
Japan	1967-1980s	95% decline during a 15 year fishery

The impact of bycatch or incidental capture from fishing operations targeting other species is unknown but may be significant where populations have formerly been depleted by target fisheries. Calculations of natural mortality (M = 0.06) and fisheries mortality derived from north-west European landings (Pauly, 1978 and 2002) strongly suggest this species is unable to withstand targeted exploitation for long, and confirm that stock depletion is likely to be a major factor affecting fisheries yields.

Take by incidental fisheries is mainly recorded in set nets and trawls, and is most common in coastal waters. There is evidence from Newfoundland (Lien and Fawcett, 1986) that some incidental fisheries may become target fisheries as markets for the products develop. Take from incidental catch (Annex 2) may be significant and either contribute to declines from targeted catch or prevent the recovery of over-fished populations. Some range states (e.g. New Zealand and USA) have ensured that the increasing value of bycatch does not stimulate a target fishery, thereby posing a threat to populations, by respectively prohibiting target fisheries and legally protecting the species. This protection should be spread to other states where the shark occurs such that legislation in one range state of the species is not made academic by the shark being completely unprotected in adjacent state waters.

Basking sharks caught incidentally during fishing operations for other species are often sufficiently resilient to be released, apparently unharmed in many cases, possibly even after up to three hours on the deck of a fishing boat (Lien pers. comm. and Watterson in lit.). The survival of sharks returned in this way is not monitored. However, the high value of their fins (and to a lesser extent liver oil, flesh and cartilage) is a strong incentive for fishermen to kill and utilise rather than release this species.

Entanglement in set and trawl nets, lobster and crab pot lines is a threat (Berrow, 1994; Anthony O'Conner, pers comm.). Berrow (1994) received 28 records from fishermen of sharks entangled in fishing gear (mostly surface gill-nets) around the Irish coast during 1993, representing nearly 20% of all records of the species that year. Valeiras (2001) reported that of 12 reported basking sharks that were incidentally caught in fixed entanglement nets in Spanish waters between 1988 and 1998, three sharks were sold on at landing markets, three live sharks were released, and three dead sharks were discarded at sea. The situation of the other four sharks remains unaccounted for.

Increased tourism related to wildlife watching at sea may be disrupting natural basking shark behaviour. Whilst there is legislation in the UK to counter this disturbance, there is no such equivalent in other States.

3.2 Habitat destruction

There is potential for global warming to affect the timing and species assemblages of phytoplankton and zooplankton blooms (Sims and Reid, 2002), and there is evidence that plankton blooms / fish recruitment coupling events that occur in the North Sea may have already been permanently disrupted by warming of this relatively enclosed water body (Beaugrand *et al*., 2002; Beaugrand *et al*., 2003). This is likely to have knock-on consequences to many species that rely on high productivity waters, including the basking shark, which lies at the end of a very short food chain, ie. Phytoplankton – zooplankton – basking shark.

Acidification of the oceans is also likely to affect densities and species assemblages of phytoplankton, which may, in turn, have global consequences for food abundance for basking sharks (Caldeira and Wickett, 2003).

3.3 Indirect threat

Wildlife watching and recreational boat traffic (jet ski use), and interaction with ferries have all resulted in collisions, and some confirmed basking shark mortalities (Doyle *et al*., in press).

3.4 Threat connected especially with migrations

Many basking shark harpoon and net fisheries have taken advantage of seasonal coastal surface feeding, breeding or migrating aggregations of basking sharks in inshore waters (e.g. in Ireland, Scotland, Japan and California). Unsustainable exploitation and depletion of shared migratory stocks can rapidly take place under such circumstances. Evidence from tracking studies in European waters shows that sharks spend a considerable proportion of their time in different State waters, and the majority of their time in waters outside the current scope of inshore protection afforded by different state legislation (Table 3 and Figure 13).

Table 3. Movements of nine tracked basking sharks with respect to UK territorial waters (Sims *et al*., 2005). [Land is erroneous data with sharks geolocated in terrestrial areas; UK territorial is within 12nm of the UK coast; IE territorial is within 12nm of the Irish coast; FR territorial is within 12nm of the French coast; EEZ is between 12nm and 200nm of the UK Exclusive Economic Zone; International is waters outside 200nm from the UK coast. All sharks were tagged either in southwest England or northwest Scotland].

Zone/shark#	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9**
Land	0.0	0.0	2.2	3.8	1.8	5.6	0.9	3.7
UK Territorial	3.9	2.5	6.6	40.3	37.3	17.9	23.0	47.6
IE Territorial	12.2	0.0	0.5	0.0	6.5	8.0	0.0	0.9
FR Territorial	0.1	16.0	2.3	0.6	0.0	0.0	0.0	0.0
EEZ	83.7	81.4	88.5	55.3	54.4	68.5	76.1	47.9
International	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

It is clear that the northwest Atlantic basking shark population at the moment suffers from inadequate legislative protection given its occurrence for long periods in offshore (>12nm) waters. There is a clear need for shark populations to be managed in offshore waters which would require international cooperation through protection and monitoring at a regional seas scale (Figure 13).

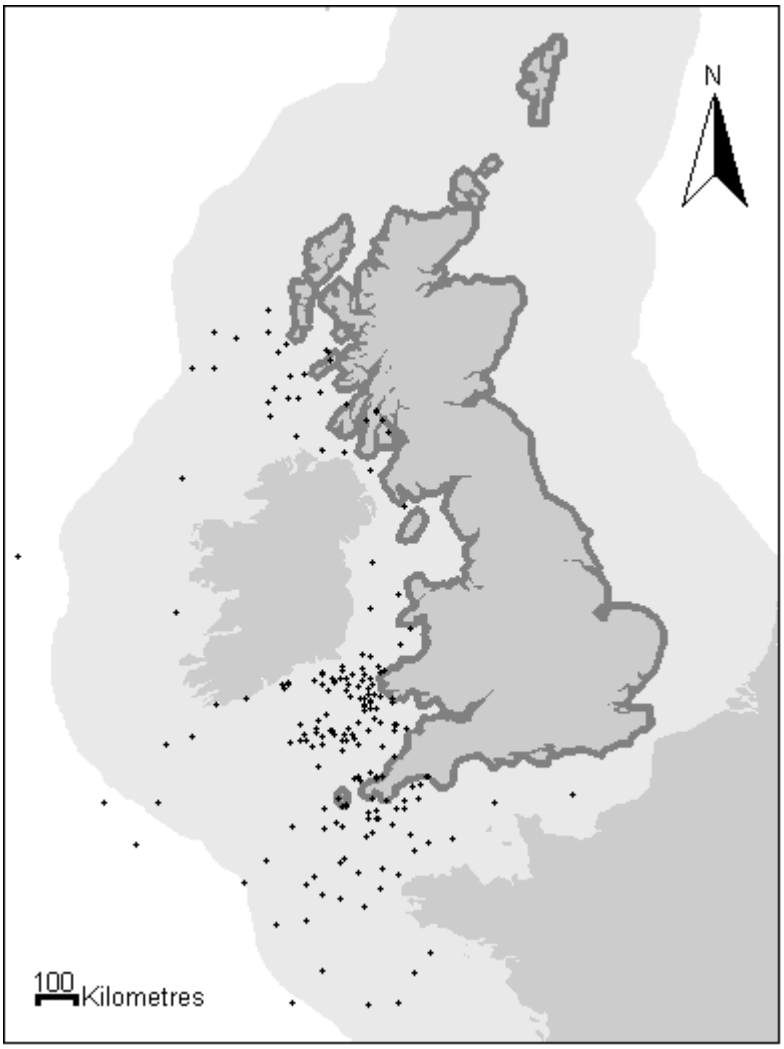


Figure 13. Satellite-tag (shark) geolocations (black dots) shown in relation to the 12nm limit of UK territorial waters (dark grey infill) the 200nm European Exclusion Zone (pale grey infill). (Data supplied by D. Sims, Marine Biological Association of the UK).

3.5 National and international utilization

Basking sharks were historically fished because of their liver oil and meat. Cartilage is another important product. Fisheries are now likely to target the basking shark in order to supply the Asian shark fin market given the increased demand for shark fins over the last ten years.

The paucity of ecological information for basking sharks severely limits the accuracy of population trend analysis for the species. However, a small number of reasonably well-documented fisheries records are useful for providing data on stock declines and population recovery. Fifty to 90% reductions in basking shark catches have been documented in some fisheries over short periods of time, and these declines appear to have led to the long-term loss or reduction in some local populations (Anon, 2002; Fowler, in press). For example, the Achill Island shark fishery declined by 95% in 25 years (Annex 1). Variations in catches in this area may have been affected by broad-scale changes in oceanic conditions influenced by factors such as summer stratification, the North Atlantic Oscillation (NAO) or climate (Sims & Reid, 2002), resulting in altered basking shark distribution and subsequent lower fishing effort. However, this climate change is unlikely to have been as significant an impact as the fishery on local shark populations, given the fact that most targeted fisheries for large k-selected species are unsustainable, which has been emphasised by the collapse of many shark and predatory fish populations around the world from targeted long-line fishing (Baum *et al*, 2003; Myres and Worm, 2003).

As identified in the UK proposal to list the basking shark under Appendix II of CITES, past fisheries records indicate that documented annual catches from targeted basking shark fisheries have only ever been in the order of hundreds to low thousands (Annex 2). Between 1952 and 2004, 81,639 basking sharks were removed from the Northeast Atlantic (Figure 14). Global landings and Northeast Atlantic landings have fluctuated but have continuously declined over the past few decades.

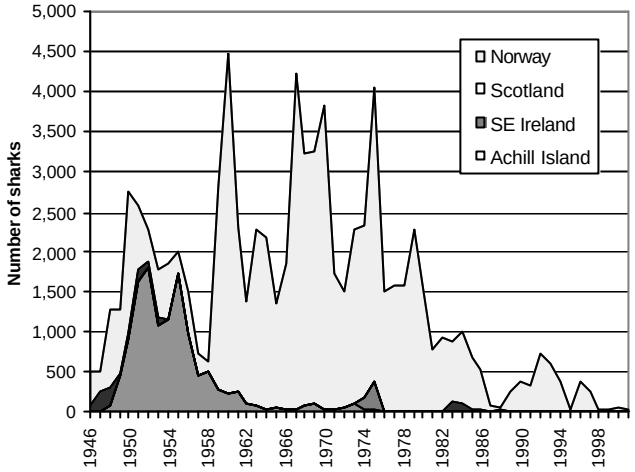


Figure 14. Capture rates of the basking shark in the NE Atlantic since the end of WWII (FAO fishery statistics, 2004).

The lack of detailed fisheries landings records and trade data at species level, and for specific shark products (even where these are easy to identify, as is the case for basking shark fins), presents a major obstacle to determining precisely which products and what quantity are utilised nationally by fishing nations, and which enter international trade (Rose 1996). Anon (2002) presents information from literature, personal communications from researchers and fin traders, and TRAFFIC reports on international trade in shark products, which is reproduced here.

Four basking shark products are known to be utilised locally and to enter the international trade in significant (albeit largely unrecorded) quantities; liver oil, fins, cartilage and meat. Customs data is gathered on quantities of shark fin, cartilage or oil imports and exports by individual species, while most countries which keep any records of trade in sharks separately from other fish, combine all shark products into a single category. It is therefore impossible to determine precisely world landings of basking sharks or the utilisation of their products, or the populations from which these products originate.

The value of international trade is likely having a significant impact on mortality from incidental fisheries, since the high value of international trade in basking shark fins encourages the finning of basking sharks caught incidentally in other fisheries, which might otherwise often be released alive. These considerations have led to the introduction of management measures under nature conservation or fisheries legislation in the UK, USA and New Zealand.

Liver oil: This was, until recently, the main product utilised from the basking shark. Indeed, some fisheries formerly removed the livers from the fish at sea and discarded the remainder of the fish. The liver comprises about 17-25% of the total body weight (of up to 7 t (metric tonnes)), and yields 60-75% oil (Phillips 1947, McNally 1976). Although a large shark can provide about 0.7 t of oil, the average is considered to be about 0.4 to 0.5 t per fish. This oil has a very high squalene content (up to 55%), characteristic of deep water sharks, and is therefore primarily of industrial rather than medicinal value. It traditionally supplied domestic oil markets, including the cosmetic and health supplement markets in Norway (Fleming and Papageorgiou, 1996). The large amount of oil derived from a single shark has made these fisheries viable in the past, but the liver oil market has suffered from competition from the gulper shark *Centrophorus granulosus* and kitefin shark *Dalatias licha* fisheries (ICES, 1995). It is uncertain how much of the liver oil landed in most countries is

utilised nationally today, but all or most oil landed in the UK in 1980s-90s appears to have entered international trade, mainly through export to Norway.

The value of the oil has declined in recent decades. Fleming and Papageorgiou (1996) give values of £600/t for liver oil landed in Scotland in the early 1980s, but this had fallen to £230/t in the late 1980s. Fairfax (1998) reports liver prices of £250/t (US$375/t) in the early 1990s, and notes that the liver was no longer landed in the last years of the recent Firth of Clyde fishery in Scotland because the high costs of exporting oil to Norway made exports uneconomic. The Norwegian fishery reportedly no longer lands basking shark oil either, although Norway has imported large quantities of shark oil (of various species) in past decades. Norway is the only country that reports information to Food & Agriculture Organisation (FAO) on shark oil trade.

Fins: Fins landed in Europe and other fishing nations outside southeast Asia are mainly thought to be directed into the international trade, and are not utilised nationally to any significant extent. Fins landed in China and Japan may be used by domestic markets, or exported for processing. The fins have a very high value in oriental markets. Prices paid to UK fishermen for fins were £3,000/t in the 1970s, but had climbed to £20,000 (US$30,000)/t by 1994 (Fairfax 1998). Fleming and Papageorgiou (1996) record that fins were exported from Scotland to Norway for US$6/kg (£4/kg) in 1983. Prices then rose, with a particularly rapid increase in the early 1990s, and fins for export were US$26.25/kg (£17.50/kg) in 1994, an increase of over 300% in nine years (Anon 1991). Fairfax (1998) reported that the largest quantity of fins yielded by a single large female in the Firth of Clyde fishery in recent years was 92 kg, which would be worth well over US $1,500 (£1,000), and up to US$2,400 (£1,600) to the fisherman. Norway exported 0.096 t of fins to Japan in 1992, 7.218 t in 1993, and 26.859 t in 1994 (Anon. 2002). A Japanese fin trader personally imported 3 t of basking shark fins from Norway in 1995, at US $ 14/kg, and 16 t in 1996 at $ 23/kg. These prices are warranted by the top quality ranking of basking shark fins in Kwang Tong Cuisine (one of the four major Chinese cuisines) and by the demand for their use as 'sign boards' at the entrance to Chinese restaurants (Figure 15). (They are considered to be a fin of second-rank in other cuisines because of their calcified or partly calcified nature.)

Figure 15. Basking shark fins as 'sign boards' in Bangkok (© Sarah Fowler, 2002).

Prices for fins dried for processing are, of course, much higher. A Norwegian fin processor reported that the April 1996 price for dried basking shark fins was about US$130/kg (£90/kg) (Fleming and Papageorgiou 1996). Lum (1996) reports that basking shark fins imported from Norway are the most expensive available in Singapore, at Sg.$400 (£200 or >US$300) per kilogram (dried), or Sg.$88 (£44) per bowl in restaurants.

Parry-Jones (in Phipps 1996) quotes retail prices supplied by an experienced Hong Kong trader of US$25/kg, US$256/kg and US$330/kg respectively for frozen, dried and processed sets of basking shark fins (a fin set usually comprises two pectoral, dorsal and lower caudal fins). Another trader quoted a price of US$846/kg for a single (dried) fin weighing 7.3 kg (US$6,176 for the whole fin), presumed to be from either a basking shark or whale shark. Anon. (2002) reports single basking shark fins on sale in recent years for prices

between US$10,000 and 16,600. Triveldi (2002) reported that individual large basking shark fins could fetch up to between US$10,000-20,000 in the US shark-fin soup market.

Flesh: The meat of basking sharks has been used both for fishmeal and, dried or fresh, for human consumption, but is low value and often discarded, although an individual shark was on display for sale at a French supermarket in Bordeaux for human consumption. There are anecdotal reports that Spanish by-caught basking sharks, as well as being sold at fishmarkets, are processed into fishmeal (Valeiras, 2001).

Cartilage, skin and other products: Basking shark cartilage is probably only used domestically in small quantities. It may be exported in 'raw' form before possible re-importation as a processed product for use in its country of origin. The large size of the basking shark will likely make the processing of its cartilage more cost-effective and desirable than that from smaller sharks. Fleming and Papageorgiou (1996) report that cartilage capsules manufactured and on sale in pharmacies, homeopathic shops and health practitioners in Belgium are labelled as *'ex Ceatarinus maximus pulvis*', which must have been imported to Belgium since there is no fishery in this country. This product is also exported from Belgium to France, Portugal, Germany and Switzerland. No information was obtained on utilisation of basking shark skin for leather, or on uses of other products.

4 Protection status and needs

4.1 National protection status

United Kingdom
The intentional killing, capture or disturbance of basking sharks is prohibited in English, Scottish and Welsh waters (to 12 miles offshore) and they are protected from sale, offering for sale, or possessing for the purpose of sale under a 1998 listing on the Wildlife and Countryside Act (1981), Schedule 5. They are still unprotected within the coastal waters of Northern Ireland at the time of writing. Disturbance of basking sharks is an offence under the Countryside and Rights of Way Act, 2000 within the waters of England and Wales. It is an offense to intentionally disturb or harass basking sharks under the Nature Conservation (Scotland) Act 2004 in Scottish waters (Which amended part 1 of the Wildlife and Countryside Act, 1981).

Isle of Man (UK Crown dependency)
The basking shark is protected within a radius of twelve miles around the Isle of Man. Despite protection here since 1990, numbers of basking sharks recorded around the Island in recent years have been falling.

Guernsey, Channel Islands (UK Crown dependency)
The basking shark is strictly protected under fisheries legislation around Guernsey.

Australia
As a Party to the Convention on International Trade in Endangered Species (CITES), trade in basking sharks and its derivatives into and out of Australia, must be in accordance with CITES regulations and thus the Environment Protection and Biodiversity Conservation Act 1999.

Malta
The basking shark was protected under domestic legislation in September 1999.

Florida state waters, USA
The basking shark, which is on the southern edge of its range in Florida, is fully protected in State waters (out to the three mile limit on the east coast, and nine miles on the Gulf coast).

Atlantic and Gulf federal waters (3-200 miles), USA
The basking shark is strictly protected under the US Fishery Management Plan. Directed commercial fishing and landing or sale (either by commercial or recreational fishermen) of the species is prohibited. This

prohibition recognises the biological vulnerability (limited reproductive potential and slow surface movements) of the species and was enacted in order to prevent targeted fisheries from developing.

New Zealand
The basking shark is one of several fish species (including some teleosts) which have received partial protection through fisheries legislation (the Fisheries Act 1983). Commercial target fishing for the species has been banned since 1991, although they are allowed to be taken as by-catch.

4.2 International protection status

The Basking Shark is listed on Annex I, Highly Migratory Species, of the UN Convention on the Law of the Sea (UNCLOS). UNCLOS requires coastal States and other States whose nationals' fish in the region for the highly migratory species listed in Annex I to "cooperate directly or through appropriate international organizations with a view to ensuring conservation and promoting the objective of optimum utilization of such species throughout the region, both within and beyond the exclusive economic zone. In regions for which no appropriate international organization exists, the coastal State and other States whose nationals harvest these species in the region shall cooperate to establish such an organization and participate in its work". Although the UN Fish Stocks Agreement (established to implement the provisions of UNCLOS relating to the conservation and management of straddling fish stocks and highly migratory fish stocks) was ratified in 2001, there is still no apparent progress with the management and cooperation envisaged under UNCLOS.

Management and monitoring of species of sharks taken in bycatch and directed fisheries is required under the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks), adopted by the UN Food and Agriculture Organization (FAO) Committee on Fisheries (COFI) in 1999. The IPOA aims to ensure the conservation and management of sharks and their long-term sustainable use, requiring States that voluntarily adopt the Plan to identify and pay special attention, in particular, to vulnerable or threatened species. Progress with the implementation of the IPOA-Sharks has been very limited since its agreement, with few significant new shark management measures being delivered as a result, and none that have improved the management of basking shark populations. This disappointing progress suggests that it is most unlikely to deliver sustainable shark fisheries management or conservation in the foreseeable future.

Mediterranean (Barcelona Convention)
The Barcelona Convention for the Protection of the Mediterranean Sea (1976) Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean was signed in Barcelona on 10 June 1995. The basking shark *Cetorhinus maximus* is listed on Annex II to the Protocol 'Endangered or Threatened Species' and will therefore receive full protection in the Mediterranean once the Convention is ratified and appropriate legislation in place. The basking shark (Mediterranean population only) was also added to Appendix II (strictly protected species) of the Bern Convention on Conservation of European Wildlife and Natural Habitats in December 1997. This listing has a European Union Reservation, pending progress on the management of other protected species already listed on European legislation.

Trade (CITES Appendix II)
The basking shark was successfully listed on Appendix II of the CITES convention in 2002 by the United Kingdom. All trade between nation states in basking sharks, or basking shark parts has to be reported between signatory states, and trade is regulated by the Convention such that the population is sustainably managed. The United Kingdom, Australia and China have complied with CITES regulations by reporting trade in basking sharks and its derivatives since listing. Iceland, Indonesia, Japan, Norway and the Republic of Korea have taken out reservations to the Appendix II listing. Trade is controlled within the European Union under the provisions of EC Regulations Nos. 338/97 and 1808/2001.

OSPAR (Protection of the marine environment of the North East Atlantic)
The basking shark was listed on the OSPAR (The Convention on the protection of the marine environment of the north-east Atlantic) list of threatened and / or declining species in 2004. OSPAR states that the species is under threat in 'All regions of the North-East Atlantic where it occurs' (OSPAR Commission, 2005).

4.3 Additional protection needs

The population status of the basking shark is unknown in many parts of its range, particularly where populations have suffered serious depletion through fisheries. This species has such a slow intrinsic rate of population increase following depletion (1–2 % per annum) that population recovery will be very slow and could be prevented by even small quantities of target or bycatch fisheries mortality.

CITES Appendix II listing only requires the regulation of fisheries supplying international trade, not fisheries for domestic consumption, and as such, some states are still landing basking sharks in some range States.

Species conservation programmes in State waters may be nullified by continued exploitation in the waters of neighbouring States and on the high seas. There are no international or regional agreements for cooperation over the conservation and management of basking sharks, and the UN Fish Stocks Agreement remains largely un-ratified. No regional fisheries organizations are monitoring or managing basking shark populations. Very few range States have implemented the UN FAO International Plan of Action for the Conservation and Management of Sharks by undertaking shark assessment reports or developing and implementing Shark Management Plans. A CMS listing for the basking shark (particularly on Appendix II) will contribute towards the implementation of the UN FAO IPOA-Sharks with country co-operation at a regional level. This could provide homogenisation of methods of data collection regarding shark catch and by-catch rates, allowing better management of the basking shark across international borders.

Effective conservation for migratory species, including the basking shark, requires a consistent and coordinated approach to the development and application of conservation measures throughout the full range of the species' habitat, regardless of which jurisdiction within which they fall. This includes important feeding, mating and pupping sites, and the migration routes between them.

Inclusion of the basking shark in both Appendices of the Convention on the Conservation of Migratory Species of Wild Animals would provide a framework within which to coordinate measures that may be adopted by range states to improve the conservation of the species and to promote protection of this vulnerable species.

4.3.3. Summary**:**

- To propose effective protection measures one must, firstly, fully determine basking shark presence and status between neighbouring range states. Agreements between adjacent member states through listing the basking shark on Appendix II would facilitate research and monitoring of contiguous basking shark populations between contracting parties.
- Identify and offer protection in hotspots in the summer season when sharks are closer inshore, and generally found feeding at surface waters by using seasonal MPAs and fishing gear restrictions, designed specifically for shark protection. Listing on the CMS would better facilitate management measures across international waters for the protection of the species.
- Record data on by-catch and entanglements from nets and pots, as well as on deliberate captures for consumption, and for commercial purposes, so as to have estimates of mortality and fishing trends. Effective reporting of basking shark by-catch between member states using the same methodology (and implementing the IPOA for sharks) can be developed through agreements as a result of listing the species on the convention.
- Carry out education programmes, for coastal populations, on the conservation status of the species, its ecological importance, its habitat and the laws that protect it.

5. Range States[2]

ALBANIA; Algeria; ARGENTINA; AUSTRALIA; BELGIUM; Brazil; Canada; Cape Verde; CHILE; China; CROATIA; Cuba; Democratic People's Republic of Korea, DENMARK; ECUADOR; FRANCE; GERMANY; GREECE; Haiti; Iceland; IRELAND; ITALY; Jamaica; Japan; Republic of Korea, LIBYAN ARAB JAMAHIRIYA; MALTA; Mexico; MONACO; MOROCCO; Namibia; NETHERLANDS; NEW ZEALAND; NORWAY; PERU; PORTUGAL; Russian Federation; SENEGAL; SLOVENIA; SOUTH AFRICA; SPAIN; SWEDEN; TUNISIA; Turkey; UNITED KINGDOM ON GREAT BRITAIN AND NORTHERN IRELAND (and Overseas Territories of the Falkland Islands (Malvinas) and Gibraltar); United States; URUGUAY; Yugoslavia.

6. Comments from Range States

A selection of range states were approached for views on this proposal. Those range states were: Belgium, Denmark, Germany, Ireland, New Zealand, Peru, Portugal, Senegal and Spain. None expressed objections to the proposal.

7. Additional remarks

8. References

Anon (2002). Convention on International Trade in Endangered Species (CITES), 2002. Inclusion of Basking Shark *Cetorhinus maxiumus* in Appendix II. Proponent: United Kingdom (on behalf of the Member States of the European Community). 12th Meeting of the Conference of Parties Proposal 36.

Anon. (1991). Shark fins – facts and fallacies. *New Zealand Professional Fisherman* 5(9): 12-14.

Baum, JK, Myres, RA, Kehler, DG, Worm, B, Harley, SJ and PA Doherty (2003). Collapse and conservation of shark populations in the northwest Atlantic. *Science* 299: 389-392.

Beaugrand, G, Reid, PC, Ibanez, F, Lindley, JA, Edwards, M (2002). Reorganisation of North Atlantic Marine Copepod Biodiversity and Climate. *Science* **296**. 1692-1694.

Beaugrand, G, Branger, KM, Lindley, JA, Souissi, S, Reid, PC (2003). Plankton effect on cod recruitment in the North Sea. *Nature* **426**. 661-664.

Berrow SD (1994). Incidental capture of elasmobranchs in the bottom set gill-net fishery off the south coast of Ireland. *Journal of Marine Biological Association UK* **74**. 837-847.

Berrow, SD and Heardman, C (1984). The basking shark *Cetorhinus maximus* (Gunnerus) in Irish waters-patterns of distribution and abundance. *Proceedings of the Royal Irish Academy* 94B, 2. 101-107.

Bonfil R (1994). Overview of world elasmobranch fisheries. *FAO fisheries technical paper 341*. FAO, Rome.

Caldeira, K and Wickett, ME (2003). Oceanography: Anthropogenic carbon and ocean PH. *Nature* 425: 365.

Compagno, LJV (1984). FAO Species Catalogue Vol. 4.Part 1 and 2: Sharks of the world: An annotated and illustrated catalogue of shark species known to date. *FAO Fisheries Synopsis* **125**. FAO, Rome, Italy.

Darling JD and Keogh KE (1994). Observations of basking sharks (*Cetorhinus maximus* in Clayoquot Sound, Bristish Columbia. *Canadian Field Naturalist* **108**, 199-210.

Doyle, JI, Solandt, J-L, Fanshawe, S, Richardson, P (in press). Marine Conservation Society Basking Shark Report 1987-2004. Marine Conservation Society, Ross on Wye, UK.

Earll, RC (1990). The basking shark: its fishery and conservation. *British Wildlife*. 121-129.

Fairfax, D (1998). The basking shark in Scotland: natural history, fishery and conservation. *Tuckwell Press, East Linton, Scotland*. 206 pp.

Fleming, EH and Papageorgiou, P (1996.). European regional overview of elasmobranch fisheries and trade in selected Atlantic and Mediterranean countries. *TRAFFIC Europe.*

Fowler, SL (in press). Status of the basking shark Cetorhinus maximus. In : Fowler, S.L., Camhi, M. Burgess, G., Fordham, S., and Musick, J. (In press). Sharks, rays and chimaeras: the status of the Chondrichthyan fishes.

[2] CMS Parties in capitals.

Francis, MP and Duffy, C (2002). Distribution, seasonal abundance and bycatch composition of basking sharks *Cetorhinus maximus* in New Zealand, with observations on their winter habitat. *Marine Biology* 140(4): 831-842.

Hoelzel, AR (2001). Shark fishing in fin soup. *Conservation Genetics* 2: 69-72.

Hueter, RE (1998). Philopatry, natal homing and localised stock depletion in sharks. *Shark News* 12, 1-2. Newsletter of the IUCN Shark Specialist Group.

ICES (1995). Report of the Study Group on Elasmobranch Fishes. *ICES CM 1995/G:3*. International Council for the Exploration of the Sea. Denmark.

Kunzlik, PA (1988). The Basking Shark. *Scottish Fisheries. Information Pamphlet No. 14*. Department of Agriculture and Fisheries for Scotland. Aberdeen.

Lien, J and Fawcett, L (1986). Distribution of basking sharks *Cetorhinus maximus* incidentally caught in inshore fishing gear in Newfoundland. *Canadian Field-Naturalist*, 100, 246-252.

Lum, M (1996). Every mouthful of shark's fin in high demand. *Singapore Sunday Times, (Straits Times)* May 19 1996, Leisure page.

McNally, K (1976). *The Sun-Fish Hunt*. Blackstaff Press, Belfast.

Musick, JA., MM Harbin, SA Berkeley, G.H. Burgess, A.M. Eklund, L. Findley, R.G. Gilmore, J.T. Golden, D.S. Ha, G.R. Huntsman, J.C. McGovern, S.J. Parker, S.G. Poss, E. Sala, T.W. Schmidt, G.R. Sedberry, H. Weeks and S.G. Wright, 2000. Marine, estuarine, and diadromous fish stocks at risk of extinction in North America (exclusive of Pacific salmonids). *Fisheries* 25(11):6-30.

Myers, RA and Worm, B (2003). Rapid worldwide depletion of predatory fish communities. *Nature* 423: 280-283.

OSPAR (2005). Case Reports for the Initial List of Threatened and/or Declining Species and Habitats in the OSPAR Maritime Area. ISBN 1-904426-57-3.

Owen, RE (1984). Distribution and ecology of the basking shark *Cetorhinus maximus* (Gunnerus 1765). A Thesis submitted in partial fulfillment of the requirements for the Degree of Master of Science in Oceanography. Univers*ity of Rhode Island*.

Parker, HW and Stott, FC (1965). Age, size and vertebral calcification in the basking shark *Cetorhinus maximus* (Gunnerus). *Zoologische Mededelingen*, 40; 305-319.

Parry-Jones, R (1996). TRAFFIC report on shark fisheries and trade in the People's Republic of China. In: Phipps, M.J. TRAFFIC report on shark fisheries and trade in the East Asian Region. *TRAFFIC International, Cambridge, UK*.

Pauly D (2002). Growth and mortality of the basking shark *Cetorhinus maximus* and their implications for the management of whalesharks Rhincodon typus. In: Fowler, S.L. Reed, T.M. and Dipper, F.A. (eds). 2002. Elasmobranch Biodiversity, Conservation and Management. Proceedings of the International Seminar and Workshop, Sabah, Malaysia, July 1997. IUCN SSC Shark Specialist Group. *IUCN, Gland, Switzerland and Cambridge, UK*. xv + 258 pp.

Pauly, D (1978). A critique of some literature data on the growth, reproduction and mortality of the lamnid shark *Cetorhinus maximus* (Gunnerus). *International Council for the Exploration of the Sea* Council Meeting 1978/H:17 Pelagic Fish Committee, 10 pp.

Phipps, MJ (1996). TRAFFIC report on shark fisheries and trade in the East Asian Region. *TRAFFIC International, Cambridge, UK*.

Siccardi, EM (1971). *Cetorhinus* in el Atlantico sur (Elasmobranchii: Cetorhinidae). *Rev. Mus. Argent. Cienc. Nat. Bernardino Rivadavia Inst. Nac. Invest. Cienc. Nat*. 6(2):61-101.

Siccardi, EM (1960). *Cetorhinus* in el Atlantico sur. *In*: Actas y trabajos del Primer Congreso Sudamericano de Zoologia, La Plata, 1959. Vol. 4:251-63.

Sims DW, Southall EJ, Metcalfe JD, and M.G. Pawson (2005). Basking Shark Population Assessment. *Report to Global Wildlife Division, Defra, UK*.

Sims, D, Southall, E, and Metcalfe, J (2002). Basking shark population assessment. First Annual Report (including literature review) for Global Wildlife Division of DEFRA. *CEFAS Contract report C1310. CEFAS, Lowestoft, UK*.

Sims, DW and Reid PC (2002). Congruent trends in long-term zooplankton decline in the Northeast Atlantic and basking shark (Cetorhinus maximus) fishery catches off west Ireland. *Fisheries Oceanography* 11:1, 59-63.

Sims, DW and Quayle VA (1998). Selective foraging behaviour of basking sharks on zooplankton in a small-scale front. *Nature* 393: 460-464.

Sims, DW, Fox, AM, and Merrett, DA (1997). Basking shark occurrence off south-west England in relation to zooplankton abundance. *Journal Fishery. Biology*. 51: 436-440.

Skomal, G (2005). 'Basking shark tagging update'. *In* DMF News bulletin Vol. 25. www..mass.gov/marinefisheries.

Skomal, G and Caloyianis N (2002). The first results of archival tagging of a basking shark, Cetorhinus maximus, in the western north Atlantic. *American Elasmobranch Society annual meeting, Kansas, USA 2002*.

Springer, S and Gilbert PW (1976). The basking shark *Cetorhinus maximus*, from Florida and California, with comments on its biology and systematics. *Copeia*, *1976*, 47-54.

Squire, JL (1967). Observations of basking sharks and great white sharks in Monterey Bay 1948-1950. *Copeia* 1:247-250.

Speedie, C (1998). Basking shark report – Cornwall 1998. *Shark focus* No. 3, p.6.

Triveldi, BP (2002). Shark soup boom spurs conservationist DNA study. *National Geographic* magazine.

Uchida, S (1995). Basking shark. In "*Basic data for the Japanese rare wild animals II* (eds. by Japan Fisheries Resource Conservation Association)", p. 159-167. (In Japanese.).

Valeiras J, Lopez, A and M Garcia (2001). Geographical, seasonal occurrence, and incidental fishing capture of the basking shark *Cetorhinus maximus* (Chonricthyes: Cetorhinidae). *JMBA* 80: 3712/1-3.

Walker, T (1996). Localised stock depletion: does it occur for sharks? *Shark News* 6:1-2. Newsletter of the IUCN Shark Specialist Group.

Watkins, A (1958). *The Sea My Hunting Ground*. London, Heinemann, 250pp.

Yano, K [Ken-ichi] (1976). *World of sharks.* Shincho-sha, Tokyo, 230 pp. (in Japanese).

Yano, K [Ken-ichi] (1979). *Sharks.* Hosei University Press, Tokyo, 267 + 10 pp. (in Japanese).

Annex 1. Trends in fisheries yields or sightings for the basking shark.

Geographical area and description of records.	**Time scale**	**Average catches or sightings per year**	**Overall (decline) or increase in catches**	**Average (decline) or increase per decade**
Achill Island, Ireland. A targeted coastal basking shark fishery	1947-1975	360/year in 1947-1950, 1,475/year in 1951-1955, 489/year in 1956-1960, 107/year in 1961-1965, 64/year in 1966-1970, 50/year in 1971-1975. Rarely seen in 1990s	(>95% decline in 25 years)	1940s: increase as fishery develops (1950s: 65% decline) (1960s: 30% decline) (1970s: 20% decline and closure)
West coast of Scotland	1946-1953	121/year throughout fishery. 142/year in 1946-1949, 100/year in 1950-1953.	(~30% in 7 years, but trend unclear)	(~30%, but trend unclear)
Firth of Clyde, Scotland	1982-1994	58.6/yr in first 5 years, 4.8/yr in last 5 years.	(>90% in 12 years)	(~90%)
Norwegian catches	1946-1996	837/year in 1946-1950 554/year in 1951-1955, 1,541/year in 1956-1960, 1,792/year in 1961-1965, 3,213/year in 1966-1970, 2,236/year in 1971-1975. 1,706/year in 1976-1980 797/year in 1981-1985 343/year in 1986-1990 491/year in 1991-1995 132/year in 1996 – 2000	(90% decline from peak landings in late 1960s to levels in the early 1990s)	~200% increase, 1950s ~100% increase, 1960s (1970s: 47% decrease) (1980s: 80% decrease) (1990s: 60% overall)
Northeast Atlantic (all catches combined)	1946-1996	1,254/year in 1946-1950 2,094/year in 1951-1955, 2,030/year in 1956-1960, 1,899/year in 1961-1965, 3,277/year in 1966-1970, 2,385/year in 1971-1975. 1,706/year in 1976-1980 848/year in 1981-1985 355/year in 1986-1990 494/year in 1991-1995 132/year in 1996 – 2000	(>90% decline from the main period of peak landings in the late 1960s to landings in the 1990s) This followed 20 years of fluctuating but rising catches.	~40% increase, 1950s ~20% increase, 1960s (1970s: 40% decrease) (1980s: 65% decrease) (1990s: 80% overall)
Canadian Pacific	1956-1990s	50-60/year killed in 1950s <25/year sighted in 1990s	(50% decline)	Data unclear, but a few years of catches resulted in an approximately 50% decline in sightings over 40 years.
California	1946-1950s	300/yr in 1946 200/yr in late 1940s Fishery closed, early 1950s	(30% decline in first few years, then fishery closed)	Data unclear, but a few years of high catches were followed by closure of the fishery.
Japan	1967-1990s	127/yr average, 1967-1974 150 sharks in 1975 20 sharks in 1976 9 sharks in 1977 6 sharks in 1978 Fishery closed, early 1980s 0-2/year sighted in 1990s	(>95% decline in 10 years)	Data summarised for first 8 years of the fishery, so early trends unclear, but decline rapid in the 2nd half of the fishery and has persisted to present.
China	1960-1990	No quantitative data. Reported to be common in the 1960s, occasionally caught in the 1970s, and rare in 1980s and 1990s.	(No quantitative data, but decline to very low levels reported.)	(No quantitative data, but significant decline indicated in the 1960s and 1970s.)
Isle of Man sightings	1985-1998	Data available suggest a decrease in sightings/effort.	(Average sightings declined by ~90%)	(Average sightings declined by ~90%)

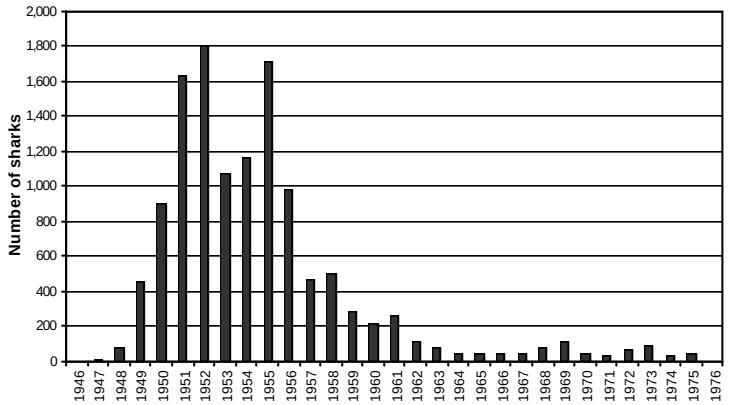
Annex 2: Review of additional fisheries information

Irish fisheries

The apparent collapse of two historical fisheries off the Irish west coast are well documented: the 18th to 19th Century Sunfish Bank fishery, and the mid-20th Century Achill Island fishery (McNally 1976, Parker & Stott 1965). Large numbers of basking sharks were taken in these areas at the end of the 18th and first quarter of the 19th Century. Records from this period suggest that this fishery was active for several decades between 1770 and 1830. The season only lasted for a few weeks in April and May, but at least 1,000 fish seem likely to have been taken each year at the height of the fishery. In the early 1830s, sharks became very scarce. Despite continued high prices for 'sunfish' (basking shark) oil (indicating that the decline in the fishery was not due to market factors), the fishery collapsed in the second half of the 19th Century. This scarcity of sharks lasted for several decades.

Basking sharks were next recorded in abundance around Achill Island in 1941 (McNally 1976). This was some 50 years after the previous fishery in the area had ceased, and more than 100 years since large numbers of shark had been taken off this coast. A new fishery started in 1947. Between 1,000 and 1,800 sharks were taken each year from 1951 to 1955 (an average of 1,475/year), but a significant decline in catch records occurred from 1956, the last year in which shark catchers were employed. From 1957 onwards, continued declining sightings and catches made the fishery less profitable for the free-lance fishermen who took over from them. Average annual catches were 489 in 1956-1960, 107 in 1961-65, and then about 50-60 *per annum* for the remaining years of the fishery (Figure 1).

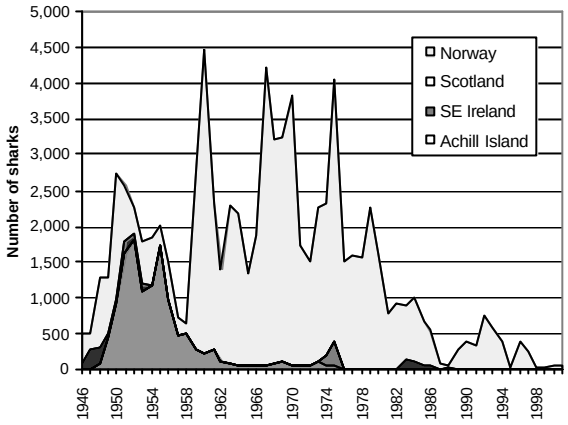
Figure 1. Number of basking sharks landed at Achill Island, 1947-75.



There is no evidence that the continued decline in catches from the late 1950s onwards was the result solely of a significant decline in fishing effort from this shore-based fishing station. Rather, it is considered to reflect decreasing catch per unit effort. Indeed, effort increased significantly again in the early 1970s, as a result of increasing oil prices and re-investment, and catches rose elsewhere (see below). Regardless, the fishery was unable to increase landings and closed in 1975 (Kunzlik 1988). A total of 12,360 fish had been taken in 29 years at this one site, with 10,676 of these caught from 1949-58 (Figure 1).

Sims and Reid (2002) note that the decline in the Achill Island fishery is correlated with a decline in copepod abundance (a major component of basking shark diet) off the west coast of Ireland. The subsequent recovery in copepod populations (Chris Reid pers. comm.) has not, however, been matched by increased sightings of sharks in this area (Berrow and Heardman 1994). The copepod decline obviously did not affect landings in the Norwegian basking shark fishery (see Figure 2), which may have accelerated the decline of the Achill fishery by taking basking sharks in west Irish waters and off the Scottish west coast (S. Myklevoll pers. comm., quoted in Kunzlik 1988). Total Norwegian landings for the whole northeast Atlantic (including Norwegian and Scottish coastal waters) were still relatively low during the initial period of decline at Achill Island (Figure 2). It seems likely that, as in later years, the majority of their catches were taken off the Norwegian coast at this time, and that the basking shark population decline off western Ireland was at least partly due to over-exploitation at Achill Island.

Figure 2. Targeted Northeast Atlantic basking shark catches, 1946-2001.



Fowler (1996, in press) suggests that the percentage decline in basking sharks which occurred off the west coast of Ireland during both Irish fisheries was greater than 50%. Indeed, the most recent Achill Island fishery appears to have caused a local population decline of over 80% in less than ten years, which still persists 40 years later. The fishery collapse therefore seems unlikely to be wholly due to a decline in zooplankton abundance during the 1960s and 1970s, as suggested by Anon (2000), but could be in part due to this trophic influence (Sims & Reid, 2002).

Northeast Atlantic Norwegian fishery

A very wide-ranging Norwegian fleet, whose geographical and temporal distribution changes markedly from year to year (Stott 1982), has undertaken the major basking shark fishery in the Northeast Atlantic. Landings have been made from local fisheries from the Barents Sea to the Kattegat, across the North Sea to the south and west of Ireland, west coast of Scotland, Iceland and Faeroe (Pawson and Vince 1998), and have fluctuated widely (see Figure 2).

Catches were at their highest (>1,000 and up to >4,000 in some years) between 1959 and 1980, when over 30 vessels were active for all or part of the season (ICES 1995, Figure 2). Shark oil prices were particularly high from the mid-1970s to the early 1980s, and fishing effort is therefore thought to have remained fairly constant over this period. The subsequent decline in this fishery has been attributed (ICES 1995) to the ageing inshore whaling fleet, a proportion of which targets basking sharks, and a decline in value of basking shark liver oil in the late 1980s. This trend would, however, appear to have been offset by the greatly increased value of the fins in international trade in the 1990s (with fins from an individual shark now worth over US$2,000). Indeed, Norwegian catches have been reported as weight of fins since at least 1992 (previously they were reported as weight of liver) (Norwegian Directorate for Nature Management in lit., 2002).

Since the precise locations in which the Norwegian fleet fished for basking sharks are uncertain for the first 27 years of the fishery, it is difficult to detect and evaluate trends in catches, effort, and hence population. Figure 3 presents all landings data combined from the Northeast Atlantic since fisheries restarted in the 1940s, with running means added to smooth the fluctuations that may (as discussed above) be the result of climatic or oceanographic factors. This clearly shows a persistent decline in average landings from the early 1970s to the early 1990s. The period of decline includes a period of peak demand and high value for basking shark oil from the mid 1970s to mid 1980s, which encouraged the establishment of new fisheries in southern Ireland and the Firth of Clyde, Scotland. According to ICES (1995), the Norwegian fleet only declined significantly after 1980. Effort has largely been concentrated off the Norwegian coast since 1984.

Although no effort data are available, it is inferred that the declining catches from 1970 to 1980 represent falling yields from declining stocks (possibly despite increased fishing effort), rather than declining fishing effort. This pattern of steeply declining catches is certainly a familiar pattern in other fisheries for large sharks, where much better records, including catch per unit effort data, are available (Camhi *et al*, 1998).

Landings increased slightly in the early 1990s (Figures 2 and 3), when the fishery was being sustained by the high value of the fins (ICES 1995, quoting Dr S Myklevoll). The main market for Norwegian fins appears to be Japan, and exports to this market were also increasing steadily in the early 1990s (Directorate for Nature Management 1995 (quoted in Castro *et al*. 1999), and personal communication from Mr Kuniaki Takahshi 2000). This coincided with the onset of a North Sea regime shift and increased abundance and landings of other species in the NE Atlantic (e.g. horse mackerel, Reid pers. comm.). Despite the combination of high values and an apparent increased availability of sharks, however, the highest catches in the early 1990s still represented only 10-20% of peak catches in the 1960s and increased landings were short-lived. Norwegian basking shark landings have since declined to a new low, despite the continued increasing value of these products and demand in international markets, and an increase in the numbers of vessels fishing for basking sharks. In 1999, fewer than ten vessels were reported by the Norwegian delegation to the 11th CITES CoP (verbal intervention in Committee I, April 2000) to be fishing for sharks, while the Norwegian Directorate for Nature Management (in lit. 2002) reported that in 2000 and 2001 respectively 30 and 13 Norwegian vessels participated in the basking shark fishery.

Figure 3. Total and mean Northeast Atlantic basking shark landings.

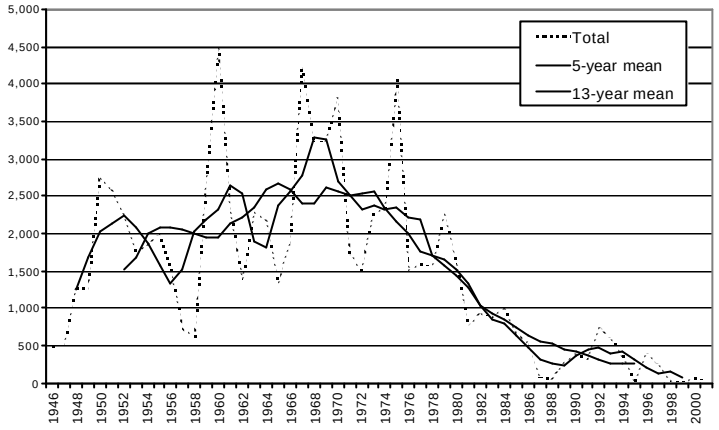


Table 1. Norwegian basking shark catches from 1992-2001 (Directorate for Nature Management)

Year	Fins (kg)	Estimated catch weight (tons)	Estimated no. of sharks	Notes:
1992	37,145	3,715	675	**Column 3**: Estimated catch weight calculated by DNM as 100 x fin weight (although a fin:body ratio of 1% is much lower than other estimates of 2-4%). **Column 4**: Estimated number of sharks calculated using an average 55 kg of fin per shark.
1993	34,360	3,436	625	
1994	26,922	2,692	489	
1995	15,571	1,557	283	
1996	19,789	1,979	360	
1997	11,520	1,152	209	
1998	1,366	137	25	
1999	770	77	14	
2000	2,926	293	53	
2001	1,997	200	36	

Japanese fishery

The main targeted Japanese basking shark fishery took place from March (the peak month) to May, the main basking shark mating and migration period near Nakiri (Shima Peninsula, Mie Prefecture). Basking shark hunting had been a traditional activity here since the Edo era (1772), but became more intensive in 1967 when oil prices rose and Nakiri fishermen began harpooning larger numbers of sharks. Fishing vessels of under 3 tons with a crew of two (one harpooner and one skipper) usually worked in pairs, one as the catcher and the other towing the sharks. The main use for the sharks during this period was the valuable squalene-rich liver oils. Shark fin was also important and considered to be a middle ranked shark fin in Taiwan. Shark meat was sold for human consumption, or processed into fishmeal for animal feed.

During the 12 years from 1967 to 1978, an estimated 1,200 individual basking sharks were harpooned (an average of about 100 per year). During the last few years of the fishery, from 1975 to 1978, catches gradually decreased, from about 150 sharks in 1975, to about 20 in 1976, nine in 1977, and six in 1978. The fishery ceased completely in the early 1980s as a result of falling oil prices and the declining numbers of sharks sighted (Annex 4). In the 1990s, only 0-2 basking sharks were sighted each year off Nakiri during the migration season, compared with a peak year in 1972 when more than 60 basking sharks were processed for sale in Nakiri market in one day. (Yano 1976 and 1979, Uchida 1995.)

California, USA

Basking sharks were only taken occasionally during the winter in Californian waters before a directed fishery commenced. Harpooning was initially only for sport, with carcasses incidentally being processed for oil and fish meal. However, the value of these products increased until the fishery became profitable and was operated from two centres: Monterey Bay and the San Luis Obispo Bay to Morro Bay area, 100 miles to the south. These two small areas are the two most important locations for winter concentrations of basking sharks along the central and northwestern southern Californian coast (Squire, 1967). An average of 25 sharks *per annum* was landed during each season (September to May) from 1924 and 1938, with a maximum of about 100 in a single year. The fishery was inactive for several years then was revived in autumn 1946 to develop new uses for the valuable liver oil. It was also intended to process the carcasses for their very thick leather and for animal feed meal, and dry the fins for export to China. Three hundred basking sharks were taken in the first season, with 12 vessels operating in Monterey Bay and about six in the San Luis Obispo Bay area. Some vessels were directed to basking sharks on or near the surface by a spotter plane (Phillips, 1947). This fishery continued until the early 1950s with about 200 sharks taken annually (Roedel and Ripley 1950, Annex 1). Squire (1967) reports that the fishery was suspended in California in 1950, because of the low prices paid for the oil and the low availability of basking sharks. Lea (pers. comm.) reports that basking shark sightings off central California over the past 20 years are not as numerous in the past. It has been suggested that the early 1940s and 1950s fisheries reduced the populations substantially, and that the species has never fully recovered.

Canadian Pacific

Basking sharks are common in the traditional knowledge of the Hesquiat and Ahousat people along the central west coast of Vancouver Island. In the 1940s, salmon fishermen complained about the problems with these fish being caught in their nets in Barkley Sound, Vancouver Island. The Department of Fisheries and Oceans therefore ran a shark eradication programme in the 1950s. A large blade was placed on the bow of Fisheries vessels and the sharks were rammed and killed. Information on the numbers of fish killed in this manner varies. Newspaper articles report a maximum of 31 being killed in one day and 50 in the first month of operation in 1956, and a total of 59 sharks killed in 1955 and 51-56 in 1956. Clemens and Wilby (1961) state that 'several hundred' were killed in Barkley Sound up to 1959. Presumably the programme ceased when numbers had been depleted to the extent where basking sharks were no longer posing a significant problem to the salmon fishermen. Darling and Keogh (1994) state 'Basking sharks are rarely sighted in Barkley Sound today, suggesting that the majority of the population in that area were killed.' It seems that a single vessel managed to deplete significantly the Barkley Sound stock of basking sharks over a period of just a few years. This occurred between 35 and 40 years ago, but the population has not recovered (Annex 1).

China

Parry-Jones (1996a in Phipps 1996) reports that basking sharks used to be landed by a harpoon fishery in Fujian Province and Guangxi Zhuang Autonomous Region up to the 1970s. The species was commonly caught in the 1960s, but is seldom landed now. The report concludes that catches and landings of this species had decreased over the last 40 years, and recommended prohibition of catches of basking sharks (and whale sharks *Rhincodon typus*) in near-shore waters as a precautionary measure until their status is ascertained.

Scotland

Fairfax (1998) summarises the limited information available on the earlier 18th and 19th century fisheries in Scotland. These appear, like the Irish fishery, to have ceased by the mid 1830s, with large numbers of sharks not being reported again until the 1930s. Fairfax (1998) and Kunzlik (1984) present data on landings from the 20th century Scottish basking shark fisheries, which concentrated on the Firth of Clyde and West coast (see Annex I). Several such fisheries started up in the 1940s, some targeted full time at the basking shark during the summer season, while others were more opportunistic. Regardless, all appear to have ceased after only a few years of good catches (Figure 3, Annex 1). It is unclear whether this fishery was short-lived because of stock depletion (by the Scottish fishermen themselves, or Norwegian shark catchers operating close to the west coast of Scotland), or because of falling oil prices in the 1950s.

Oil prices rose again in the mid 1970s, Norwegian catchers took several hundred sharks in 1975, some Clyde basking shark by-catch was processed in the late 1970s, and a small target harpoon fishery started again in the Clyde in 1982. Initial yields from this fishery were good, but these were extremely short-lived and the fishery ceased at the end of 1994 after several poor years of catches (Fairfax, 1998).

New Zealand

Between 1986 and 1999 about 203 basking sharks were reported caught by observers on commercial trawlers off the coast of New Zealand. Catches were obtained in midwater and on or near the seabed, and multiple catches were common, including 14 in one tow (Francis and Duffy, 2002). These authors also reported that, in the 1980s, Japanese bottom trawlers frequently caught and sometimes targeted basking sharks on the seabed. Catch data are also available from returns made by fishermen (provided by S Black, Ministry of Fisheries, NZ) and Licensed Fish Receivers (fish wholesalers, provided by M Francis, National Institute of Water and Atmospheric Research, NZ). The latter do not include discards and the former may only report processed weights (e.g. fins), not whole weights, resulting in obvious discrepancies. Both sets of data indicate a marked increase in landings in recent years, most likely due to an increased awareness of the value of fins for export to international markets (Malcolm Francis, NIWA, pers. comm.).

Fishing Year (Oct-Sept)	Greenweight reported by fishers (t)	Licensed Fish Receiver records (t)
1988/89	N/a	10.00
1989/90	N/a	3.81
1990/91	90.67	1.05
1991/92	21.22	0.00
1992/93	0.02	0.80
1993/94	42.67	32.93
1994/95	22.65	90.92
1995/96	20.09	11.50
1996/97	21.94	20.60
1997/98	72.82	49.33
1998/99	64.44	33.36
1999/00	172.80	142.80
2000/01	228.18	121.97

Incidental fisheries

There are reports of finned basking sharks being washed up dead in areas where no directed fisheries are known to exist (e.g. Monterey Bay, van Sommeran pers. comm.). Berrow (1994) extrapolated from very limited observer data to suggest that 77-120 sharks may be taken annually in the bottom set gill net fishery in the Celtic Sea (south of Ireland), though the reliability of this estimate has been questioned (P. Kunzlik in litt.). Berrow and Heardman (1994) received 28 records from fishermen of sharks entangled in fishing gear (mostly surface gill-nets) around the Irish coast during 1993, representing nearly 20% of all records of the species that year. At least 22% of basking shark by-catch in fishing nets died. By-catch in the Isle of Man herring fishery in the past has amounted to 10-15 sharks annually, and a further by-catch source here is entanglement in pot fishermen's ropes, amounting to some 4-5 fish annually (Watterson in litt.), although in recent years, the reduction in the Manx herring fishery has aliminated bycatch of the species in this fishery.

Lien and Fawcett (1986) record that at least 410 basking sharks were caught between 1980 and 1983 in salmon gill nets and cod-traps in the coastal waters of Newfoundland. Some basking sharks were also taken in deepwater trawls nearby during the winter months. Fairfax (1998) also reports that basking sharks are sometimes brought up from deep water trawls near the Scottish coast during winter. In contrast to these relatively large coastal by-catches, extrapolation of observer data from oceanic gill net fleets suggests that only about 50 basking sharks were among the several million sharks taken annually offshore in the Pacific Ocean (Bonfil 1994).