Summary of Information for the Consideration of Non-Detriment Findings for Scalloped, Great and Smooth Hammerhead and Giant and Reef Manta Rays

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1 Background

In April 2013, the Convention on Trade in Endangered Species (CITES) Conference of the Parties listed seven species of sharks and rays on Appendix II: Oceanic Whitetip Shark *Carcharhinus longimanus*, Porbeagle Shark *Lamna nasus*, Scalloped Hammerhead *Sphyrna lewini*, Great Hammerhead *Sphyrna mokarran*, Smooth Hammerhead *Sphyrna zygaena*, Giant Manta Ray *Manta birostris* and Reef Manta Ray *Manta alfredi*. These listings came into effect on 14 September 2014.

Appendix II listing is for species not necessarily threatened with extinction, but in which trade must be controlled to avoid utilisation incompatible with their survival (https://cites.org/eng/disc/how.php). Trade in species listed on CITES Appendix II requires that:

- the CITES Management Authority of the exporting country (or a designated competent authority in countries that are not Parties to CITES) must verify that the species was legally obtained, and
- the CITES Scientific Authority of the exporting country must advise that export will not be detrimental to the survival of the species (a non-detriment finding-NDF).

There are also requirements for export of CITES Appendix II species taken on the high seas (i.e. marine areas beyond national jurisdiction and outside the 200 nautical mile jurisdiction of any country). The Scientific Authority (generally from the country where the species will be landed, although this can vary depending on chartering arrangements) must issue an NDF before the species is taken at sea.

An NDF for trade in CITES Appendix II sharks and rays therefore requires an NDF to be issued by a country in three cases:

- before the export of the species that was obtained within the country's Exclusive Economic Zone (EEZ).
- before the take of the species that was obtained on the high seas by the country's vessel and landed at the country's port.
- before the take of the species on the high seas by the country's vessel and landed at a foreign port.

Among the tropical Pacific CITES members, an NDF is likely not required for:

- Oceanic Whitetip Shark as there is a current WCPFC ban on their retention, transshipping, storing or landing.
- Porbeagle Shark as it is a temperate species and rarely occurs in tropical waters.

There is no defined process for how an NDF is undertaken, thus to assist the NDF process for the shark and ray Appendix II listings, a Guidance for CITES Non-detriment findings for shark species was produced (Shark NDF Guidance) (Mundy-Taylor *et al.* 2014). There was also recognition of a lack of capacity within some countries to make NDFs. As sharks are a significant by-product of the Pacific fisheries, especially tuna and billfish, a CITES project to build capacity within the Oceania region was funded. This was to assist Oceania countries to implement the NDF processes if they wish to trade in CITES Appendix II sharks and rays.

Shark and ray stocks are shared across Pacific countries, which is an issue that needs to be considered in NDF development. A regional approach with the use of a common NDF template that would provide consistent format, language and terminology was considered beneficial. The format and content of a template for NDFs was agreed upon at the Pacific CITES project Workshop held on the 11-13 April, 2016 in Nadi, Fiji. This template was essentially the worksheets from the Shark NDF Guidance. The template follows a logical process with a format that clearly sets out the steps in the NDF process and is well supported by the Shark NDF Guidance through detailed explanations on the required information. When NDFs are reviewed, or more information becomes available, the NDF template format can be easily updated in the relevant field(s), and the style of the format (questions and answers) makes it easier for those new to NDFs to become familiar with, and undertake, the process.

To assist Oceania Parties undertake NDFs, this template was pre-populated with information common to the Pacific region for Appendix II shark and ray species, that is, Scalloped Hammerhead, Great Hammerhead, Smooth Hammerhead, Giant Manta Ray and Reef Manta Ray. This summary of published information document provides the detailed common background information that was used to pre-populate the NDF templates, for example, the global catches, conservation status, biological parameters and regional management measures. For ease of use, this document generally follows the format of the NDF template.

2 Available Information on Management Context of Hammerheads and Manta Rays

2.1 Global level information

2.1.1 Reported global catch

The reported average global annual catch was 222 tonnes (t) of Scalloped Hammerhead, 238 t of Smooth Hammerhead, 19 t of Great Hammerhead and 5403 t of Hammerhead Shark (general) for 2010–2014 (FAO 2016) (Table 2.1). These catches are considered to be significant under-estimates as the FAO catch data is compromised by under-reporting of hammerhead sharks, with substantial discrepancies evident when compared to trade statistics. Shark fin trade data from 1996–2000 suggested that 49,000–90,000 t of hammerhead sharks were taken for the fin trade each year (Clarke *et al.* 2006; CITES 2013a). For the same period (1996-2000) the average annual global catch of hammerhead sharks was reported as 3508 t (FAO 2016). Many countries have only recently begun reporting hammerhead shark catch data with most of the catch reported at family level. It is likely that substantial quantities of Scalloped Hammerhead are included in the FAO catch data Hammerhead Sharks (general) category (CITES 2013a; Lack *et al.* 2014).

The FAO Global Capture Production Statistics reported Giant Manta Ray catches in 2012–2014 as an average of 812 t taken (FAO 2016). Reef Manta Ray is not listed as a separate species in the FAO global capture production database (FAO 2016). Catches were reported for Manta rays and devil rays (Mobulidae) with an average of 4210 t taken over 2010–2014 (Table 2.1). The landings of manta and devil rays have increased by more than ten-fold over the last 15 years from less than 200 t in 1998 to a peak of over 5000 t in 2012 and 2013 (Ward-Paige *et al.* 2013; FAO 2016). It is unknown how well these catch figures represent the true catch.

Table 2.1. FAO global capture production statistics for 2010–2014 (tonnes). Source: (FAO 2016).

Shark and rays	2010	2011	2012	2013	2014	Average (2010-2014)
Scalloped Hammerhead	336	212	265	240	55	222
Smooth Hammerhead	65	167	296	483	176	238
Great Hammerhead	0	0	0	18	20	19
Hammerhead Shark (general)	6090	5969	3951	4117	6886	5403
Giant Manta	0	0	744	669	1023	812
Manta rays, devil rays	2447	3731	5191	5649	4033	4210

2.1.2 Species distribution

Global

2.1.2.1 Scalloped Hammerhead

The Scalloped Hammerhead occurs in tropical and warm temperate seas worldwide (Figure 2.1). It is commonly found in continental shelf waters but also regularly enters estuaries and the open ocean, occurring from the surface to at least 275 m depth (Last and Stevens 2009). Significant catches of this species in pelagic longline fisheries (e.g. (Beerkircher *et al.* 2002) suggests it spends more time in the open ocean compared to other hammerhead sharks. Some adult populations form large aggregations at seamounts (Baum *et al.* 2007; CITES 2013a). There appears to be an ontogenetic change in distribution, with juveniles living in coastal nursery areas (Clarke 1971; Simpfendorfer and Milward 1993; Duncan and Holland 2006) and then moving offshore as they grow (Harry *et al.* 2011). Both juvenile and adults appear to range more widely at night which is thought to be associated with increased foraging activity (Speed *et al.* 2010). Populations also exhibit high levels of sexual segregation. For example, in Australia there are few records of pregnant females (Stevens and Lyle 1989; Noriega *et al.* 2011) while in Indonesia, pregnant females are commonly reported (White *et al.* 2008). Observations from the Queensland coast, Australia also suggest that males remain in inshore areas longer than females (Harry *et al.* 2011).

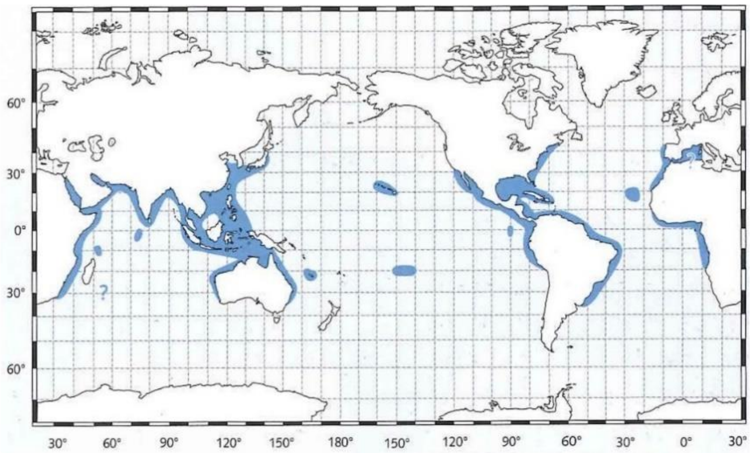

Figure 2.1. Distribution of the Scalloped Hammerhead. Reproduced from Last and Stevens (2009).

Pacific

In the Western Pacific, the Scalloped Hammerhead occurs in Thailand, Viet Nam, Indonesia, China (including Chinese Taipei), Japan, Philippines, Australia and New Caledonia (Compagno 1984; Baum *et al.* 2007). Data collation (Section 2.3) indicated that Scalloped Hammerheads have been recorded in the EEZs of a considerable number of additional countries across the Pacific, that is: Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Palau, Papua New Guinea, Solomon Islands, Tonga and Vanuatu.

2.1.2.2 Great Hammerhead

Global

The Great Hammerhead occurs in tropical and warm temperate seas worldwide (Figure 2.2). This species tends to occur on the continental shelf, rarely enter estuaries and occur in the open ocean. It is present from the surface, and in very shallow water, to at least 80 m depth (Last and Stevens 2009). There is limited published data on movement of this species from tagging and tracking studies, but some information online demonstrates that this species spends significant amounts of time in coastal habitats with occasional long distance movements along coast lines or into open ocean areas (Simpfendorfer 2014). Unlike Scalloped Hammerheads, neonates have not been reported from nearshore habitats which suggest the Great Hammerhead pupping may occur further offshore (Harry *et al.* 2011). This species exhibits some degree of sexual segregation, with juveniles of both sexes and adult females more common in inshore tropical areas, and adult males potentially more common in temperate waters (Harry *et al.* 2011).

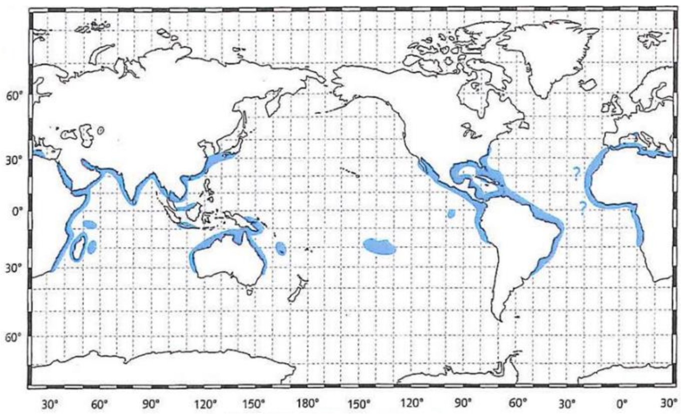

Figure 2.2. Distribution of the Great Hammerhead. Reproduced from Last and Stevens (2009).

Pacific

In the Western Pacific, the Great Hammerhead has been reported from Australia, Indonesia, Thailand, Viet Nam, China (including Chinese Taipei), Riu Kyu Islands, Palau, New Caledonia, Federated States of Micronesia and French Polynesia (Compagno 1984; Denham *et al.* 2007). Data collation (Section 2.3) indicated that Great Hammerheads have been recorded in the EEZs of a number of additional countries across the Pacific, that is: Cook Islands, Fiji, Kiribati, Marshall Islands, Nauru, Papua New Guinea, Solomon Islands, Tonga, Tuvalu and Vanuatu.

2.1.2.3 Smooth Hammerhead

Global

The Smooth Hammerhead occurs subtropical and temperate oceans worldwide and is found inshore and on continental shelves from the surface to 200 m but is most common to depths of 20 m (Ebert 2003; CITES 2013a)(Figure 2.3). This species has been observed in freshwater in Florida and Uruguay and have been reported from open ocean areas as bycatch in pelagic fisheries (Beerkircher *et al.* 2002; CITES 2013a). It generally has a more temperate distribution than the Scalloped and Great Hammerhead that limits the degree of overlap with these other two species. The Smooth Hammerhead has been reported from the tropics in some areas, however these reports are patchy, probably due to confusion with the more abundant Scalloped Hammerhead (Compagno 1984; Casper *et al.* 2005; Last and Stevens 2009); the tropical distribution of the Smooth Hammerhead needs to be clarified. The Smooth Hammerhead occasionally form large schools, particularly as juveniles (Compagno 1984; Last and Stevens 2009).

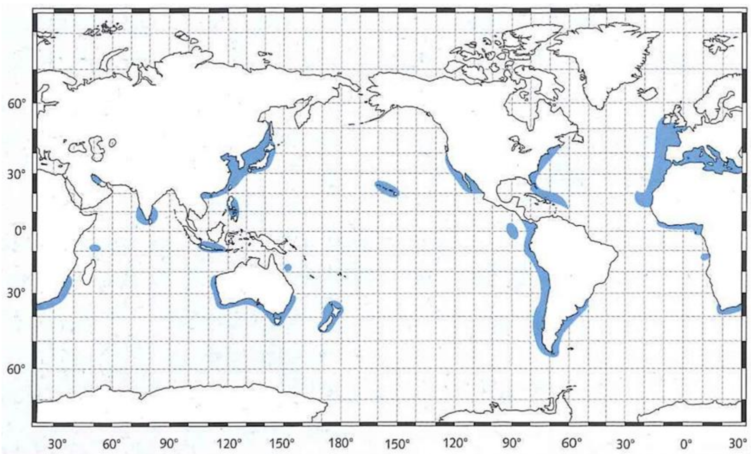

Figure 2.3. Distribution of the Smooth Hammerhead. Reproduced from Last and Stevens (2009).

Pacific

In the Western Pacific, the Smooth Hammerhead has been reported from Australia, New Zealand, Indonesia, Viet Nam, China and southern Japan (Compagno 1984; Last and Stevens 2009). Data collation (Section 2.3) indicated that Smooth Hammerheads have been recorded in the EEZs of additional countries across the Pacific, that is: Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Kiribati, New Caledonia, Papua New Guinea, Solomon Islands, Tonga, Tuvalu and Vanuatu.

2.1.2.4 Giant Manta Ray

The Giant Manta Ray occurs in tropical, sub-tropical and temperate waters worldwide (Figure 2.4), although populations appear to be sparsely distributed and highly fragmented (Marshall *et al.* 2009; Marshall *et al.* 2011a). This species is common in a few locations while sporadic or regularly seasonal in other areas (Marshall *et al.* 2011a). The Giant Manta Ray has been observed as far north as Rhode Island (United States), Aomori (Japan), Sinai Peninsula (Egypt) and as far south as Uruguay, South Africa and New Zealand (Marshall *et al.* 2009). It occurs along productive coastlines where upwelling occurs, and at oceanic island groups, particularly offshore pinnacles and seamounts. The Giant Manta Ray is also present on shallow reefs while being cleaned and feeds at the surface inshore and offshore. The Giant Manta Ray undertake deep dives to at least 1000 m depth. While the species can be solitary they do aggregate to clean, mate and feed. This species tend to be encountered with less frequency than the smaller Reef Manta Ray, even though it has a broader distribution worldwide (Marshall *et al.* 2011a).

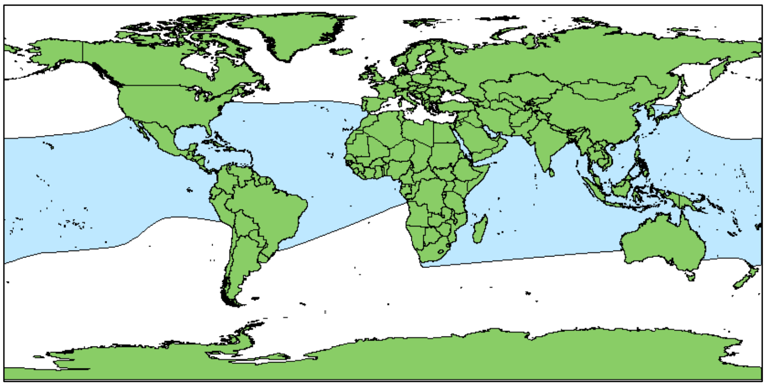

Figure 2.4. Distribution of the Giant Manta Ray (IUCN (International Union for Conservation of Nature) 2016).

Pacific

In the Western Pacific, the Giant Manta Ray has been reported from Australia, Indonesia, Thailand, Malaysia, Chinese Taipei, China, Philippines and New Zealand (Marshall *et al.* 2011a). Data collation (Section 2.3) indicated that Giant Manta Rays have been recorded in the EEZs of a considerable number of additional countries across the Pacific, that is: Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tuvalua and Vanuatu.

2.1.2.5 Reef Manta Ray

The Reef Manta Ray occurs in tropical and sub-tropical waters worldwide (Figure 2.5), however populations appear to be fragmented and sparsely distributed (Marshall *et al.* 2009; Marshall *et al.* 2011b). This species is commonly seen inshore in resident aggregations, but also observed around coral and rocky reefs. Similar to the Giant Manta Ray, it occurs along productive coastlines where upwelling occurs and at oceanic island groups (Marshall *et al.* 2011b). The Reef Manta Ray appears to be more resident to tropical waters and has relatively smaller home ranges and movements than the Giant Manta Ray (Marshall *et al.* 2011b; Couturier *et al.* 2012). Seasonal migrations of the Reef Manta Ray of up to 650 km between known aggregations sites and dives down to depths of 300 m have been observed

(Marshall *et al.* 2011b; Couturier *et al.* 2012; Couturier *et al.* 2014). Acoustic tracking studies indicate that the Reef Manta Ray do not commonly venture from coastal waters (Marshall *et al.* 2011b; CITES 2013b).

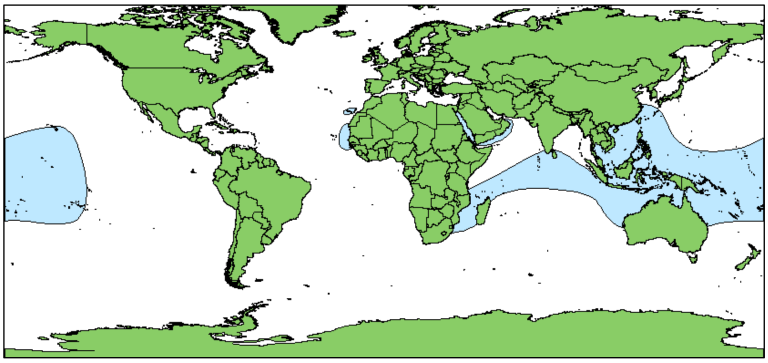

Figure 2.5. Distribution of the Reef Manta Ray (IUCN (International Union for Conservation of Nature) 2016).

Pacific

In the Western Pacific, the Reef Manta Ray has been reported from Australia, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Indonesia, Malaysia, Marshall Islands, New Caledonia, Palau, Papua New Guinea, Philippines and Thailand (Marshall *et al.* 2011b). Data collation of observer data was only available for Giant Manta Ray, and it is unknown whether these records include the Reef Manta Ray. This data collation (Section 2.3) indicated that Giant Manta Rays, and possibly Reef Manta Rays, have been recorded in the additional EEZs across the Pacific of: Kiribati, Nauru, Samoa, Solomon Islands, Tokelau, Tuvalu and Vanuatu.

2.1.3 Known stocks/populations

2.1.3.1 Scalloped Hammerhead

The global pattern of stock structure of the Scalloped Hammerhead varies between males and females, reflecting the strong sexual segregation. Genetic studies of females indicate there are at least four genetically distinct populations: Northwest Atlantic, Southwest Atlantic, Eastern Atlantic and Indo-West Pacific (Duncan *et al.* 2006; Baum *et al.* 2007; NOAA 2013). In contrast, males do not show these distinct genetic population differences, with no large genetic differences between and within ocean basins. This suggests that males move over larger distances and have less population structure than females (Daly-Engel *et al.* 2012).

There may also be further female genetic stock segregation within the Pacific, with possible segregation between Indo-West Pacific, Central and Eastern Pacific populations (NOAA 2013). Within the Indo-West Pacific, populations of Scalloped Hammerheads in Australia and Indonesia cannot be differentiated genetically, suggesting they are the same stock (Ovenden *et al.* 2009; Ovenden *et al.* 2011). Tagging and telemetry studies of male and female Scalloped Hammerheads suggested adults will travel long distances, including across open oceans (Ketchum *et al.* 2014). This suggests that the Australian-Indonesian stock may also be shared with other island nations in the Indo-West Pacific (NOAA 2013; Heupel *et al.* 2015).

This possible connectivity will have implications for the estimation of sustainable levels of take for NDFs in the Oceania region. However, stocks in the region may be more limited in movement to the margins of continental shelves, or divided by land bridges (Figure 2.6) and there may be potential differences between males and female stock structure (Heupel *et al.* 2015). Further work to resolve the nature of the regional stock structure, and the rate of exchange between nations in the Oceania region, will be essential to allow more detailed assessment and hence NDFs.

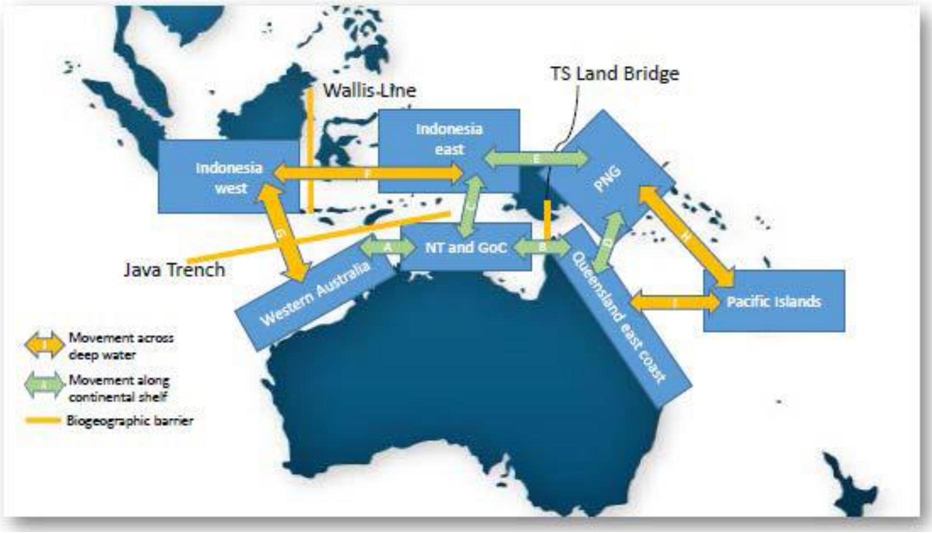

Figure 2.6. Conceptual population model of Scalloped Hammerhead in the Indo-Pacific Ocean. Reproduced from Heupel *et al*. 2015.

2.1.3.2 Great Hammerhead

Global scale phylogeography indicates there are at least two genetically distinct stocks of Great Hammerhead: Atlantic and Indo-Pacific (Simpfendorfer 2014). The scale of movements indicated from satellite tagging suggests that it is likely that the population of this species in northern Australia is connected to other countries within the Oceania region. Genetic data suggest limited stock differences between Australia and south Asia. Further work to resolve the stock structure of the Great Hammerhead within the Indo-Pacific region is required. However, based on the available information, it is assumed there is a single Indo-Pacific stock (Simpfendorfer 2014).

2.1.3.3 Smooth Hammerhead

Genetic investigation of global phylogeography demonstrates a significant difference in stocks between the Atlantic and Indo-Pacific Oceans (Simpfendorfer 2014). There is also evidence of population structuring within ocean basins (Testerman 2014). This limited dispersal within ocean basins is supported by tagging data that indicates mostly relative short movements that are restricted to the continental shelf, although there are also some longer movements (>1000 km). On the basis of the limited genetic and movement data, is it most likely that the Oceania stock may be isolated from the Australian stock (Simpfendorfer 2014). However, further work is required to resolve this possibility.

2.1.3.4 Giant Manta Ray

Preliminary satellite tracking and international photo-identification works suggest a high degree of fragmentation between regional populations of this species, and movements across ocean basins may be rare (Marshall *et al.* 2011a). They are capable of large migrations (>1000 km) though these tend to all been along coastlines rather than across ocean basins (Marshall *et al.* 2011a). All identified regional populations are estimated to be small (100—1,000 individuals) (CITES 2013b). These regional populations have not yet been verified through genetic analysis as subpopulations, but distances between them and photo identification work strongly suggests they may be distinct groups with limited genetic exchange (CITES 2013b). It is unknown if the Giant Manta Rays observed in Australia mix with those observed in the Pacific Island countries.

2.1.3.5 Reef Manta Ray

This species appears to exhibit high levels of separation between regional populations (Marshall *et al.* 2011b). All identified regional populations are estimated to be small (100—1,500 individuals) with one exceptional regional population in the Maldives estimated at 5000 individuals (CITES 2013b). These regional populations have not yet been verified through genetic analysis as subpopulations, but distances between them and photo identification work strongly suggests they may be distinct groups with limited genetic exchange (CITES 2013b). It is unknown if the eastern Australian regional population mixes with the populations in the Oceania region.

2.1.4 Main catching countries

The countries reported as taking the majority of the Scalloped Hammerhead reported global catch (by the FAO Global Capture Production database (FAO 2016)) for the five years 2010–2014 were (in order of decreasing catch and with an annual average catch greater than 20 tonne (t)): Mauritania (104 t), Brazil (65 t) and Ecuador (35 t). However, the reliability of the FAO catch data to accurately identify the main catching countries is hindered by the inclusion of much of the Scalloped Hammerhead catch data in the general 'Hammerhead Sharks' catch category (Lack *et al.* 2014).

The only country reported as taking Great Hammerhead over the last five years is the United States of America that reported 18 t in 2013 and 20 t in 2014 (Table 2.1; FAO 2016).

The countries reported as taking the majority of Smooth Hammerhead reported global catch (FAO 2016) for 2010–2014 were (in order of decreasing catch and with an annual average catch greater than 20 t (t)): Morocco (99 t), Ecuador (68 t) and Iran (48 t).

Under the general 'Hammerhead Sharks' catches in the FAO Capture Production database (FAO 2016), the main catching countries for 2010–2014 (in order of decreasing catch and with an annual average catch greater than 100 t) were: Indonesia (2,608 t), Senegal (1017 t), Congo (546 t), Mexico (474 t), Ghana (229 t) and Benin (144 t). Indonesia was responsible for 100% of the reported Hammerhead Sharks (general) catches in the Western Central Pacific fishing area for that period. Indonesia is included in the Asian countries, not the Oceania countries in the FAO Capture Production Database. Among the Oceania countries, there are no catches in the FAO Capture Production database for Scalloped Hammerhead or 'Hammerhead Shark' (general) reported during 2010–2014, although there are catches of Smooth Hammerhead reported as an average of 10 t from New Zealand (FAO 2016).

In previous years of FAO Hammerhead global catch, Brazil, followed by Spain and Mauritania were the main catching countries of Scalloped Hammerhead during 2002–2011 (Mundy-Taylor and Crook 2013). In that same period, the main catching countries of Smooth Hammerhead were Spain, Ecuador and Portugal. For 2002–2011 the top three main catching countries of Hammerhead Shark (general) were those same countries as for 2010–2014 (Mundy-Taylor and Crook 2013).

For Giant Manta Rays, the only reported global catch (by the FAO Global Capture Production database (FAO 2016) for the five years 2010–2014 was from Sri Lanka with an average of 812 t (Table 2.1). For Manta rays and devil rays only two catching countries were reported with average catches for 2010–2014: Indonesia (4195t) and Mauritania (15t) (FAO 2016). Consequently, among the Oceania countries there are no reported catches of Giant Manta Rays or Manta rays and devil rays in the FAO Capture Production for 2010–2014 (FAO 2016).

2.1.5 Main gear types

The Scalloped, Great and Smooth Hammerhead are taken as target and bycatch by trawls, purse seines, gillnets, fixed bottom longlines, hook and line, pelagic longlines and inshore artisanal fisheries (Casper *et al.* 2005; Baum *et al.* 2007; Denham *et al.* 2007). The artisanal fisheries catch large numbers of juvenile Scalloped Hammerheads in some regions. The aggregating behaviour of the Scalloped Hammerhead makes them vulnerable to capture in large schools (Baum *et al.* 2007).

The Giant and Reef Manta Rays are taken as target and bycatch by trawls, gillnets, harpoons, hand spears, gaff hooks, pelagic longlines, purse seines and other inshore artisanal fisheries methods (Marshall *et al.* 2011a; Marshall *et al.* 2011b; Lewis *et al.* 2015). While the Giant Manta Ray has been reported in both tuna longline and purse seine fisheries (see Section 2.3), the Reef Manta Ray is not believed to interact with the tuna pelagic longline fisheries (Clarke *et al.* 2014b) but is possibly taken in the tuna purse seine fisheries (Hall and Roman 2013).

2.1.6 Global conservation status

2.1.6.1 Scalloped Hammerhead

The IUCN Red List of Threatened species status is Globally Endangered (Baum *et al.* 2007). A suggested draft status in Oceania is Endangered (Heupel *et al.* 2015). A number of subpopulation assessments report the status and year of assessment as:

- Eastern Central and Southeast Pacific: Endangered (2007)
- Eastern Central Atlantic: Vulnerable (2007)
- Northwest and Western Central Atlantic: Endangered (2007)
- Southwest Atlantic: Vulnerable (2007)
- Western Indian Ocean: Endangered (2007).

A European regional assessment in 2015 found this species to be Data Deficient.

2.1.6.2 Great Hammerhead

The IUCN Red List of Threatened species status is Globally Endangered (Denham *et al.* 2007). A suggested draft status in Oceania is Vulnerable (Heupel *et al.* 2015). No official IUCN Assessments for different areas report status and year as:

- Eastern Atlantic: Critically Endangered (2007)
- Northwest Atlantic and Gulf of Mexico: Endangered (2007)
- Southwest Indian Ocean: Endangered (2007)
- Australia: Data Deficient (2007).

A European regional assessment in 2015 found this species to be Data Deficient.

2.1.6.3 Smooth Hammerhead

The IUCN Red List of Threatened species status is Globally Vulnerable (Casper *et al.* 2005). A suggested draft status in Australia is Least Concern (Heupel *et al.* 2015). No subpopulation or area assessments have been undertaken. Similar to the other two hammerhead species, a European regional assessment in 2015 found this species to be Data Deficient.

2.1.6.4 Giant Manta Ray

The IUCN Red List of Threatened species status is Globally Vulnerable (Marshall *et al.* 2011a). No subpopulation or regional assessments have been undertaken.

2.1.6.5 Reef Manta Ray

The IUCN Red List of Threatened species status is Globally Vulnerable (Marshall et al. 2011b). No subpopulation or regional assessments have been undertaken.

2.1.7 Multilateral Environmental Agreements

CITES (Convention on International Trade in Endangered Species)

The Scalloped Hammerhead, Great Hammerhead, Smooth Hammerhead and *Manta* spp. are listed under Appendix II of CITES (https://cites.org/eng/prog/shark/index.php). Appendix II listing is for species in which trade must be controlled to avoid utilisation incompatible with their survival (https://cites.org/eng/disc/how.php). None of the main catching countries have taken out a reservation. A reservation results in the CITES party being treated as a non-party with regard to trade in the species (CITES Articles XXIII) (Clarke *et al.* 2014a). Japan, that is a party to CITES and a WCPFC Member, has reservations for Scalloped Hammerhead, Great Hammerhead and Smooth Hammerhead; all in effect from 12/06/2013 (https://cites.org/eng/app/reserve.php). Guyana and Yemen also have reservations for these three species of hammerheads. The reservation by Japan was accompanied by a declaration that Japan would '*voluntarily, conduct procedures related to export permits that are required under CITES, in accordance with relevant laws and regulations*' regardless of whether trading with a party or non-party to CITES (Clarke *et al.* 2014a). Guyana has a reservation for *Manta* spp. in effect from 12/06/2013.

CMS (Convention on Conservation of Migratory Species of Wild Animals)

The Scalloped Hammerhead, Great Hammerhead, Giant Manta Ray and Reef Manta Ray are listed on Appendix II of CMS (http://www.cms.int/en/species). Appendix II listing is for migratory species that would benefit from international cooperation through international agreements. The Giant Manta Ray and Reef Manta Ray are also listed on Appendix I of CMS. Appendix I listing is for species considered in danger of extinction throughout all or a significant part of their range (http://www.cms.int/en/page/appendix-i-ii-cms). The international agreements may vary from legally binding treaties to less formal instruments, such as Memorandums of Understanding, Action Plans or Species Initiatives.

The Oceania Parties to the CMS (as of 1 October 2015) are: Australia, Cook Islands, Fiji, New Zealand, Palau, Philippines, and Samoa. None of these are the main catching countries for Scalloped Hammerhead, Great Hammerhead, Smooth Hammerhead, Hammerhead Shark (general) or *Manta* spp. Australia entered a reservation for Scalloped Hammerhead and Great Hammerhead on 11 December 2014. Several countries, although not Party to the Convention, are Party to one or more of the Agreements and/or have signed one or more of the MOUs; these include the other Oceania CITES Parties, that is, Papua New Guinea, Solomon Islands and Vanuatu.

The main catching countries for Scalloped Hammerhead (Mauritania, Brazil and Ecuador), and Smooth Hammerhead (Morocco, Ecuador and Iran) are all Parties to the CMS. Of the Hammerhead Shark (general) main catching countries, most are CMS Parties, that is: Senegal, Congo, Benin and Sri Lanka. Both Indonesia and Mexico are Non–Party Range States (Range states are countries that exercise jurisdiction over any part of the range of migratory species).

Some Oceania countries not Party to CMS are Range States: Kiribati, Marshall Islands, Micronesia, Nauru, Niue, Papua New Guinea, Solomon Islands, Timor-Leste, Tonga, Tuvalu and Vanuatu.

A Memorandum of Understanding on the Conservation of Migratory Sharks (Sharks MoU) commenced on 1 March 2010 (http://www.cms.int/sharks/). It aims to achieve and maintain a favourable conservation status for migratory sharks. The Scalloped Hammerhead, Great Hammerhead, Giant Manta Ray and Reef Manta Ray (along with all other mobulids) are listed on Annex 1 of Sharks MoU as of 20 February 2016 (http://www.cms.int/sharks/en/mos2). There is a Conservation Plan (Annex 3) for sharks listed on Annex 1 that aims to complement, develop and promote the objectives and actions described in the Shark MoU. The Shark MOU signatories in Oceania are: Australia, Nauru, New Zealand, Palau, Philippines, Samoa, Tuvalu and Vanuatu (note: Range states Nauru, Tuvalu and Vanuatu have signed the Sharks MoU which is encouraged under the CMS Convention (http://www.cms.int/en/node/3916)).

Other Regional Agreements

The Scalloped Hammerhead was listed in Annex II of the Barcelona Contention in 2012 which is consistent with ICCAT (International Commission for the Conservation of Atlantic

Tuna) management measures and requires that the species are not to be captured or sold and that plans for its recovery are to be developed (Lack *et al.* 2014)

The IATTC (Inter-American Tropical Tuna Commission) have prohibited the retention, transhipment and trade, and promoted live release where possible, of mobulid rays (which includes manta rays and devil rays) as of 3 July 2015 (Resolution C-15-04) (https://www.iattc.org/ResolutionsActiveENG.htm).

2.2 Stock/context-specific information for Hammerheads and Manta Rays

2.2.1 Main management bodies

The main management body relevant to the Oceania and Pacific region is the WCPFC (Western and Central Pacific Fisheries Commission). The WCPFC is responsible for managing and conserving sharks and rays in the Western and Central Pacific Ocean (WCPO). Management bodies for other areas are:

- IATTC (Inter-American Tropical Tuna Commission) (Eastern Central and Southeast Pacific)
- ICCAT (International Commission for the Conservation of Atlantic Tunas) (Eastern and Western Central and Southeast and Southwest Atlantic)
- IOTC (Indian Ocean Tuna Commission) (Western Indian Ocean)
- NAFO (Northwest Atlantic Fisheries Organisation) Northwest and Western Central Atlantic).

Additional management bodies for the Smooth Hammerhead are:

- CCSBT (Commission of the Conservation of Southern Bluefin Tuna)
- GFCM (General Fisheries Commission for the Mediterranean)
- SEAFO (South Atlantic Fisheries Organisation).

Gaps in management are likely to occur in the Areas Beyond National Jurisdiction (ABNJ), such as high seas areas, where the marine areas do not fall under the responsibility of any one country or Regional Fisheries Management Organisation (RFMO). To address management issues in these areas, a five-year project is underway that includes sustainable management of tuna fisheries and biodiversity conservation: Areas Beyond National Jurisdiction (ABNJ or Common Oceans) Tuna Project (http://www.commonoceans.org/home/en/). A component of the ABNJ Tuna Project specifically addresses the take of sharks.

2.2.2 Stock assessment

The stock status of each of the Scalloped Hammerhead, Great Hammerhead and Smooth Hammerhead in the WCPO is unknown. Species-specific catch records of these hammerhead sharks from the WCPO are extremely sparse. The hammerhead sharks appear to be distributed patchily both temporally and spatially (Brouwer and Harley 2015; Rice *et al.* 2015). The tuna longline and purse seine log sheet catch data for hammerhead sharks is poor (see Section 2.3). The observer data for the purse seine fishery is minimal (33 Hammerhead Shark (general) observed across all Flag or EEZs over 4 years; Table 5). Larger numbers have been observed in the longline fishery (2089 Hammerhead Shark (general) observed over 4 years; Table 5). However, these observations are not representative of all areas of the WCPO (Rice *et al.* 2015). The number of species-specific observations are even fewer for both fisheries (Table 5). Given the current data, stock assessments in the WCPO region for the Scalloped, Great and Smooth Hammerhead are not feasible (Rice *et al.* 2015). A catch-per-unit-effort analyses on the hammerhead species complex was undertaken in 2015 (See Section 2.3.4), however the lack of data on which it was based precludes inferences being made from the analyses (Rice *et al.* 2015).

The Research Plan for WCPFC Key sharks: 2016–2020 (Brouwer and Harley 2015) outlines the need for work on hammerhead sharks to focus on improving the data, particularly by quantifying the species-specific catch. Under this Research Plan, no stock assessments are planned for the hammerhead shark species. There are suggested work projects that include improving data collection by observers and the species composition of the catch, updating the catch history, and using this information to determine stock links and boundaries for WCPO hammerhead sharks (Brouwer and Harley 2015).

The status and stock assessments for the Scalloped Hammerhead of the other international management bodies are (Lack *et al.* 2014):

- IATTC: Status- unknown, no stock assessment. No statement on likely trends in the stock status.
- ICCAT: Status-unknown, no stock assessment by International Council for Exploration of the Sea (ICES) Working Group on Elasmobranch Fishes due to insufficient data (ICES 2012, Chapter 12).
- IOTC: Status- uncertain, IOTC Scientific Committee concluded that status was uncertain (IOTC Scientific Committee 2012, Appendix XXVI).
- NAFO: Status-overfished and overfishing occurring. The stock assessment indicated a 95% probability that the stock was overfished and 73% that overfishing was occurring.

The status and stock assessments for the Smooth Hammerhead of the other international management bodies are (Lack *et al.* 2014):

- CCSBT: Status-unknown, no stock assessment.
- IATTC: Status-uncertain, a 2009 Ecological Risk Assessment (ERA) ranked Smooth Hammerhead as 8th out of 10th in terms of vulnerability to ICCAT longline fisheries.
- IOTC: Status-uncertain, 2012 ERA of longline fishery reported this species has high productivity but high susceptibility.
- GFCM- status- unknown, no stock assessment.

No stock assessments have been done for *Manta birostris* or *Manta alfredi* in the WCPO or any other region of the world (Marshall *et al.* 2011a; Marshall *et al.* 2011b; CITES 2013b).

2.2.3 Cooperative management arrangements

The three species of hammerheads are all highly migratory species (UNCLOS Annex 1; http://www.un.org/unlcos/annex1). The Giant Manta Ray and Reef Manta Ray are not listed as highly migratory species under UNCLOS Annex 1. The relevant RFMOs for stocks are:

IACCT, ICCAT, NAFO, IOTC and WCPFC. The WCPFC is responsible for the catches of tuna, sharks and rays in the Western Central Pacific Ocean (WCPO). The IOTC is responsible for those same species in the Indian Ocean. These two RFMOs are relevant to the Indo-West Pacific Stock of Scalloped Hammerhead, Indo-Pacific stocks of Great and Smooth Hammerhead, and stocks of Giant and Reef Manta Rays. There is a Memorandum of Understanding between the two RFMOs to promote cooperation and enhance the conservation and sustainable use of species which occur within both organisations (http://www.iotc.org/about-iotc/cooperation-other-organisations).

Other RFMOs relevant to the Scalloped, Great and Smooth Hammerhead and Giant and Reef Manta Ray take in the Pacific, that may not have a direct management role but are associated with the data management and surveillance and monitoring are: SPC- the Secretariat Pacific Community (SPC) that serves as the WCPFC's Science Services Provider and Data Manager, and the Pacific Islands Forum Fisheries Agency (FFA). The FFA assists Pacific Island countries to sustainably manage their fishery resources and cooperates with the WCPFC and is affiliated with SPC and a number of other regional Pacific organisations through an advisory body known as the Council of Regional Organisations in the Pacific (CROP) (http://www.ffa.int/regional_organisations). Part of the Areas Beyond National Jurisdiction Program aims to improve cooperation between all relevant tuna RFMOs to work in partnership to progress shark monitoring and management (Clarke and Nichols 2015).

2.2.4 Non-membership of RFBs

Indonesia is the main reported catching country of Hammerhead Shark (general) in the Asian region (FAO 2016). Although, Indonesia is not considered as an Oceania country in the FAO Capture Production Database, Indonesia is a member of the main management body for the region, WCPFC. The main catching country of Giant Manta Rays is reported as Sri Lanka which is not a member of IOTC. The main catching country of Manta and devil rays (general) is Indonesia and Mauritania; Mauritania is a member of ICCAT.

2.2.5 Nature of harvest

The three species of hammerheads and two species of manta rays are taken as both target, byproduct (captured incidentally but utilised) and bycatch (taken incidentally and discarded) (Casper *et al.* 2005; Baum *et al.* 2007; Denham *et al.* 2007; Marshall *et al.* 2011a; Marshall *et al.* 2011b). Fishing effort is not spread evenly across Indo-Pacific stocks with the majority of the Hammerhead (general) and manta and devil ray (general) catch reported from Indonesia (FAO 2016). The majority of the Giant Manta Ray catch is reported from Sri Lanka (FAO 2016). Catch by other Oceania/Pacific countries is poorly known (Section 2.3).

2.2.6 Fishery types

The major types of fisheries that capture Scalloped, Great and Smooth Hammerhead and Giant Manta Ray are the industrial tuna and billfish fisheries where the hammerheads and Giant Manta Rays are taken as secondary catch. The longline fisheries target albacore tuna (*Thunnus alalunga*), adult bigeye tuna (*Thunnus obesus),* yellowfin tuna (*Thunnus albacores*) and swordfish (*Xiphias gladius*) but also catch skipjack tuna (*Katsuwonus pelamis*), Pacific bluefin tuna (*Thunnus orientalis*), striped marlin (*Tetrapturus audax*), black marlin (*Makaira indica*) and blue marlin (*Makaira nigricans*). Purse seine fisheries target mainly skipjack tuna and also catch bigeye tuna and yellowfin tuna (http://www.spc.int/oceanfish/en/tuna-fisheries). All three species of hammerheads and Giant Manta Rays are taken by both longline and purse seine fisheries, with larger numbers of hammerheads observed to be captured by longlines (Table 2.5). Reef Manta Rays were not included in the SPC Observer information provided and while they are not believed to be taken in the longline fisheries (Clarke *et al.* 2014b), they may be captured in the purse seine fisheries (Hall and Roman 2013).

Small scale domestic and inshore artisanal fisheries also capture hammerheads and manta rays (Section 2.3). These fisheries use gillnets, hand lines, drum lines, possibly seine nets, handspears and spearguns. In addition, gaff hooks and harpoons are used for manta rays (Juncker 2006; Baum *et al.* 2007; Marshall *et al.* 2011a; Glaus *et al.* 2015).

2.2.7 Management units

Management of the Scalloped, Great and Smooth Hammerhead and Giant and Reef Manta Ray catches in the tuna fisheries in the Pacific region is done by WCPFC. Gaps in regional management are the Areas Beyond National Jurisdiction (ABNJs).

At a national level management of the species varies from country to country (Section 6.1). Potential gaps in management at the national level may occur between fisheries and environment authorities in each country, where there is no clarity on the responsibilities of each relevant authority and there where there is a lack of data sharing, communication and common goals.

2.2.8 Products in trade

Hammerheads

The main product from each of the three hammerhead species that is traded internationally is the fins (CITES 2013a). The meat, liver oil, skin, cartilage and jaws may also be used from all three species, though the use of the latter two varies regionally (Lack and Meere 2009; Mundy-Taylor and Crook 2013). In Fiji, surveys revealed some fishers sell teeth and jaws, though it is not known from which species (Glaus *et al.* 2015).

Manta rays

The main product in trade from each of the two manta ray species is the gill filter plates, which have a very high value (Froese and Pauly 2015). The meat, cartilage, liver and skin from both species are also traded (White *et al.* 2006; Marshall *et al.* 2011a; Marshall *et al.* 2011b; Froese and Pauly 2015).

2.3 Data and Data Sharing of Hammerheads and Manta Rays

2.3.1 Reported national catch(es)

The national catches for each country need to be provided by each country. There was insufficient time in this CITES project to request permission from each country to allow SPC to provide the species-specific catch data collected in the Regional Observer Program (Section 2.3.3). Each Pacific CITES member was requested to bring species-specific catch and trade data to the workshop held in Nadi, Fiji, 2016, however, no data was forthcoming.

2.3.2 Are catch and trade data available from other States fishing these stocks?

The pelagic tuna bycatch observer and logsheet data, and coastal fisheries catch data are managed by SPC. Access to the data requires permission from each member country for both the pelagic and coastal catch data.

Trade data is reported to FAO but not at a species level, rather as generic 'shark' in different product forms. The FAO data for the Oceania region is tabled (Table 2.2). Other States outside Oceania fish in the WCPO region, but as the source of the trade product is reported only by State it is not known where it was caught. More detailed information on the import, export and re-export of the different shark products from each country is in Appendix 1 (Section 8). Shark liver oil is a commodity category in the FAO database, but none was reported as traded in Oceania during the years 2009-2013.

Table 2.2. Export of shark products from Oceania countries for 2009–2013 (tonnes). Source: (FAO 2016a).

Country	2009	2010	2011	2012	2013
Australia	627	630	448	532	593
Fiji	4	0	168	720	793
Fed. States Micronesia	0	0	168	115	4
Kiribati	2	1	3	2	0
Marshall Islands	83	38	129	78	63
New Zealand	2269	3107	2381	2236	2687
Papua New Guinea	12	41	45	1	13
Solomon Islands	1	2	6	4	5
Tonga	0	0	0	15	0
Vanuatu	1	0	0	65	128
Total Oceania	**2999**	**3819**	**3348**	**3768**	**4286**

2.3.3 Reported catches by other States

Accurate species-specific catch data for the Scalloped, Great and Smooth Hammerhead, and Giant and Reef Manta Ray for each of the Pacific nations were not available. These species are taken primarily as bycatch in the tuna longline and purse seine fisheries with some coastal fishery catches. Some logsheet and observer data were available.

Pelagic tuna bycatch data

Sharks and rays taken as bycatch in the tuna fisheries within the WCPO are recorded in the tuna fisheries logsheets (longline and purse seine) and by observers. SPC is the Data Manager with the data collated and available to WCPFC member countries through a series of regional tuna fisheries databases (http://www.spc.int/Oceanfish/en/ofpsection/data-management/spc-members/dd). Permission to release the detailed tuna fishery shark and ray bycatch data is a lengthy process that requires authorisation from each of the WCPFC members through the WCPFC Secretariat. The time-frames for the release of authorised data were beyond those of this CITES project. There has been a number of recent reports however, that have assessed the shark bycatch data from the WCPO tuna fisheries, including the hammerhead shark catch data (Clarke *et al.* 2014a; Brouwer and Harley 2015; Rice *et al.* 2015).

Fishery logsheet data

Key shark species annual catch estimates have been required to be provided by WCPFC members since 2008. Initially the key shark species included Blue Shark (*Prionace glauca*), Oceanic Whitetip Shark (*Carcharhinus longimanus*), Mako Sharks (*Isurus* spp.) and Thresher Sharks (*Alopias* spp). Silky sharks (*Carcharhinus falciformis*) were added in 2009, Porbeagles (*Lamna nasus*) and hammerhead sharks (Winghead Shark -*Eusphyra blochii*, Scalloped Hammerhead, Great Hammerhead and Smooth Hammerhead) in 2010 (Clarke *et al.* 2014a; Brouwer and Harley 2015). The SPC/FFA longline logsheet allows for the collection of data for all key shark species, however hammerhead sharks are not separated to species level on the logsheet (Brouwer and Harley 2015). The SPC/FFA purse seine logsheet does not provide for collection of data on key shark species (http://www.spc.int/oceanfish/en/data-collection/241-data-collection-forms). Neither species of manta rays are considered key shark species so no annual catch estimates are available from the logsheets.

The annual catch estimates for each key shark species are available through the WCPFC Data Catalogue (http://www.wcpfc.int/wcpfc-data-catalogue-0). A summary of the hammerhead shark data from the longline fishery is provided in Table 2.3 and Table 2.4. It is not clear whether the logsheet catch estimates include discards, that is, whether they represent the entire catch or just the retained catch (Brouwer and Harley 2015). Some flag States provided the number of catch records for aggregate or operational data (higher spatial resolution) or the number of length samples taken, although they did not provide catch estimates. This suggests these additional flag States also interacted with hammerhead sharks in the WCPO and they are listed in the Table 2.3 caption. There is no data presented for hammerhead sharks from the purse seine fishery in the WCPFC Data Catalogue as none of the flag States provide estimates of annual catch (pers. comm. Peter Williams, SPC, 2016). Only one Great Hammerhead, one Smooth Hammerhead, two Scalloped Hammerhead and two Hammerhead Shark (general) were recorded during 2010–2012 in the purse seine logsheets (Clarke *et al.* 2014a). These were from the flag States or EEZs of: Federated States of Micronesia, Kiribati, Papua New Guinea, Philippines, Solomon Islands and the United States (Clarke *et al.* 2014a).

Only a relatively few countries that fish in the WCPO have reported hammerhead shark catches in the logsheets. Considerably more flag States have been observed to catch hammerhead sharks (Clarke et al. 2014, Brouwer and Harley 2015; Table 2.5), which suggests a significant level of non-reporting on logsheets (Rice *et al.* 2015).

Table 2.3. Annual reported catch estimates in metric tonnes of hammerhead sharks in the longline tuna fishery by flag State. Source: WCPFC Data Catalogue. Note additional flag States that reported

interaction with hammerheads: Cook Islands, China, Federated States of Micronesia, French Polynesia Japan, New Caledonia, Solomon Islands, Spain, Tonga and United States.

Flag	Year	Annual Catch Estimate (Metric Tonnes)	Average Annual Catch (Metric tonnes)
Australia	2009	3	5.3
Australia	2010	3	
Australia	2011	3	
Australia	2012	10	
Australia	2013	9	
Australia	2014	4	
Fiji	2011	13	29.3
Fiji	2012	44	
Fiji	2013	31	
Korea	2012	4	12.7
Korea	2013	21	
Korea	2014	13	
Marshall Islands	2012	1	1
New Zealand	2013	9	8
	2014	7	
Papua New Guinea	2009	4	3.8
	2010	4	
	2011	3	
	2012	4	
	2013	4	
	2014	4	
Chinese Taipei	2010	469	363
	2011	448	
	2012	368	
	2013	292	
	2014	238	

Table 2.4. Annual total reported catch estimates in metric tonnes of hammerhead sharks in the longline tuna fishery by year. Source: WCPFC Data Catalogue.

Year	Catch (metric tonne)
2010	476
2011	467
2012	431
2013	366
2014	266

Observer data

The main source of information on the shark and ray bycatch from the tuna fisheries is the observer data. There is a WCPFC Regional Observer Programme (ROP) and various national observer programmes. Since 2012, 5% ROP observer coverage of the longline fisheries has been required (under WCPFC conservation and management measures CMM 2007-01, CMM 2012-03), but annual average ROP observer values have been <1% in recent years, with most of the observed sets within EEZs (Rice *et al.* 2015). The ROP purse seine coverage is much better with a requirement since 2010 for 100% purse seine observer coverage (CMM 2008-01 now replaced with CMM 2014-01). Rice (et al. 2015) reported an annual average ROP purse seine observer values of 42–56% during 2010-2013 (Rice *et al.* 2015). This is based on the observer reports available to SPC at the time and FFA is confident that the coverage on purse seine vessels operating under the PNA (Parties to Nauru Agreement) VDS (Vessel Day Scheme) is now approaching 100%. There may be some purse seine effort outside the VDS, though this is likely to be minor with respect to total purse seine effort (pers. comm. Ian Freeman, FFA, 2016).

The SPC provided a summary of observer data, that is, the observed number of key shark species and Giant Manta Rays recorded in the longline and purse seine fisheries in WCPO area by flag State and location of catch (EEZ) pooled for the period 2010–2014 (Table 2.5). No data for Reef Manta Rays was provided. Table 2.5 is for observed longline and purse seine catches combined. The longline and purse seine observed catches are summarised separately in Appendix 2 (Section 9). This is observer data only and does not include logsheet data. It cannot be taken to indicate total catches of the species, only what was observed when observers were onboard the vessels. Zero catches do not mean there were no sharks or rays caught by the fishery, just that no sharks or rays were observed when observers were onboard the vessels. This observer data is useful as an indication of which States may be interacting with these species, however there are a number of factors which caution against using it as a definitive guide for the presence or absence of a species in a flag State or EEZ. These have been detailed by Clarke (*et al.* 2014) and Rice *et al.* (2015) and briefly include:

- Flag States may represent a mix of flag States and chartering States.
- Observer coverage is not spatially or temporally uniform across fleets and EEZs.
- Species identifications may not always be reliable.

With these caveats in mind, far greater numbers of hammerhead sharks were observed in the longline fishery than the purse seine fishery (Table 2.5). The observer data suggests that of the CITES Pacific flag States, the greatest number of Hammerhead Shark (general) were observed in the flag and in the EEZ of Papua New Guinea during 2010–2014 (Table 2.5). This is not unexpected, as Papua New Guinea operated a dedicated longline shark fishery from the 1990s till May–June 2014 when it ceased due to the requirement to not land or retain silky sharks (WCPFC CMM 2013-08[1]). The vessels appear likely to move to tuna longlining (http://aciar.gov.au/print/20924) and may still catch hammerhead sharks, though likely in lesser quantities than that of the dedicated shark fishery. After Papua New Guinea, Fiji flag

[1] Implemented on 1 July 2014

and EEZ observers recorded the largest number of each hammerhead shark species followed by Vanuatu then Australia. Australian observers recorded the largest number of Hammerhead Shark (general) (Table 2.5).

The observer data indicates that hammherhead shark stocks are shared among many Pacific flag States and EEZs. Of the Pacific CITES members, it appears the three hammerhead, species, Hammerhead Shark (general) and Giant Manta Rays are shared across all flag States and EEZs with the exceptions of:

- Palau – no recorded observations of Smooth Hammerhead or Hammerhead Shark (general).
- New Zealand – only recorded observations of Smooth Hammerhead.
- Samoa – no recorded observations of any hammerhead sharks (Table 5).

Giant Manta Rays were observed much more frequently in the purse seine fishery than the longline fishery (Table 2.5). The data suggests that of the CITES Pacific members, all flag States encounter Giant Manta Rays, except Palau, with the greatest numbers observed in Papua New Guinea, followed by Australia and Vanuatu. They were fished in all EEZs, except New Zealand, with the largest numbers observed in Papua New Guinea, followed by Australia and Solomon Islands (Table 2.5).

For both longline and purse seine, the total number of each key shark species and Giant Manta Rays recorded by observers is the same for flag and EEZ but the proportions differ between the two (Table 2.5). The difference occurs because flag vessels do not always fish in their own EEZ, and within an EEZ multiple flagged vessels can fish. For example, a flag vessel may fish entirely within its own EEZ, it may fish partly within its own EEZ and partly outside its own EEZ, or it may fish entirely outside its own EEZ. In the latter case a shark may be observed, for example, on a Fiji flag vessel fishing in Vanuatu; the shark would be recorded to flag Fiji and to EEZ Vanuatu. Therefore, the number of sharks observed is the same for flag and EEZ.

The observer data also indicates that hammerhead sharks and Giant Manta Rays are being encountered by a large number of different WCPFC flag States vessels and landed in a large variety of EEZs (Table 2.5), as was the case in 2010–2012 (Clarke *et al.* 2014a). A comparison of the observer data from 2010–2012 (Clarke *et al.* 2014a) to 2010–2014 (Table 2.5), indicated that there has been an improvement in the recording of hammerhead sharks to species level by observers for many of the countries (both flag and EEZ). The 2010–2014 observer data was also used in a summary of pooled longline and purse seine observer and logsheet data by Brouwer and Harley (2015)[2]. Although the Brouwer and Harley (2015) data included logsheet data, the flag states and EEZs in which there were greater numbers of hammerhead sharks were similar to those when just the observer data was examined (Table 2.5). This corroborates the lack of shark catch data available in the logsheets.

[2] The numbers of sharks in Brouwer and Harley (2015) are indicative only as there may be double counting (i.e. the same shark may have been recorded on a logsheet and by an observer).

Table 2.5. Observed catches (by number) for flag States and by location (EEZ or International waters) for 2010-2014 based on SPC data holdings and grouped by CITES membership. The numbers of sharks for each country are the observed longline plus purse seine catches. OCS=Oceanic Whitetip Shark, SPL= Scalloped Hammerhead, SPK = Great Hammerhead, SPZ=Smooth Hammerhead, SPN= Hammerhead Shark (general), POR= Porbeagle Shark, RMB= Giant Manta Ray.

Species	OCS	SPL	SPK	SPZ	SPN	POR	RMB
Longline Flag # recorded	16216	1012	415	182	2089	20519	301
Longline EEZ # recorded	16215	1010	415	182	2089	20519	301
Purse seine Flag # recorded	518	17	24	7	33	0	1149
Purse seine EEZ # recorded	518	17	24	7	33	0	1149
Total # recorded Flag	16734	1029	439	189	2122	20519	1450
Total # recorded EEZ	16733	1027	439	189	2122	20519	1450
The numbers below are total numbers observed for longline and purse seine combined							
Flag (Oceania)							
Fiji	1127	44	74	28	7	0	12
Palau	1	0	0	0	0	0	0
Papua New Guinea	2485	629	269	25	1144	0	236
Samoa	21	0	0	0	0	0	1
Solomon Islands	988	2	1	0	22	0	10
Vanuatu	194	37	33	9	3	0	39
Australia	260	10	3	23	260	51	196
New Zealand	23	0	0	16	0	4302	3
Flag (Competent Authorities in Oceania)							
Cook Islands	55	0	1	1	0	0	2
Fed States Micronesia	222	0	0	0	0	0	15
Kiribati	24	0	1	0	2	0	42
Marshall Islands	29	1	3	0	1	0	9
Tokelau	0	0	0	0	0	0	0
Tonga	639	4	6	9	24	0	0
Tuvalu	4	0	0	0	0	0	13
Flag (External Territories in Oceania)							
French Polynesia (France)	576	0	2	3	0	0	12
New Caledonia (France)	148	1	1	8	4	0	0
United States	4811	37	2	45	38	0	181
Flag (Others)							
China	1298	8	4	0	12	0	84
Ecuador	18	2	2	5	9	0	5
El Salvador	6	0	1	0	4	0	0
European Union	0	0	0	0	0	0	0
Japan	568	0	4	3	97	16163	93

Korea (not a CITES Party)	758	7	4	4	55	3	233
Philippines	14	6	1	0	1	0	82
Chinese Taipei (not a CITES Party)	2449	239	24	10	437	0	176
Indonesia	0	0	0	0	0	0	0
Spain	16	2	3	0	2	0	6
EEZ (Oceania)							
Fiji	1075	43	69	28	8	0	11
Palau	6	1	3	0	0	0	1
Papua New Guinea	3442	867	290	32	1463	0	638
Samoa	11	0	0	0	0	0	1
Solomon Islands	962	8	6	3	133	0	110
Vanuatu	232	37	37	9	0	0	28
Australia	608	10	3	11	332	3129	192
New Zealand	18	0	0	18	0	17298	0
EEZ (Competent Authorities in Oceania)							
Cook Islands	146	0	1	1	0	0	8
Fed States Micronesia	679	1	2	1	14	0	100
Kiribati	1037	5	3	3	33	0	214
Marshall Islands	1007	5	3	0	1	0	11
Tokelau	10	0	0	0	0	0	2
Tonga	727	4	7	11	24	0	0
Tuvalu	114	0	1	1	2	0	19
EEZ (External Territories in Oceania)							
French Polynesia	547	0	2	3	0	0	12
New Caledonia	172	1	1	8	16	0	0
Pitcairn	0	0	0	0	0	0	0
United States	3076	32	0	33	24	0	1
EEZ (Others)							
Commonwealth Northern Mariana Islands	0	0	0	0	0	0	0
International Waters	2816	13	10	27	70	92	35
Japan	0	0	0	0	0	0	0
Nauru	48	0	1	0	2	0	67
Niue	0	0	0	0	0	0	0

Additional findings from observer information on hammerheads in the WCPO not available to this CITES project were detailed by Rice *et al.* (2015). These include:

- The majority of observed hammerhead sharks were immature.

- Juvenile hammerhead sharks were more commonly observed in Papua New Guinea and Solomon Islands than elsewhere, with adult hammerhead sharks rarely observed in these areas.
- The majority of all hammerhead sharks taken on longlines up till 2013 were retained with some finned, except for 2010–2012 when most were discarded. There is no species-specific information on fate of hammerhead sharks on purse seines, only that for sharks in general, observers report that in 2013 and 2014 nearly all sharks were discarded. Prior to that the majority of sharks on purse seine vessels were observed to be finned.

The Areas Beyond National Jurisdiction Project (ABNJ Tuna Project) is addressing one of the main issues of shark bycatch in the tuna fisheries, that is, the need for shark data improvement and harmonisation (Clarke and Nichols 2015). The ABNJ project is contributing to the harmonization of observer longline bycatch data fields and has proposed a tuna RFMOs bycatch data exchange template being trialled by WCPFC. The ABNJ project has also compiled shark life history information for the WCPFC key shark species (Clarke 2015; Clarke *et al.* 2015a; Clarke and Nichols 2015).

Coastal catch data

Sharks and rays are taken in coastal and artisanal fisheries of the Pacific Ocean both as target and bycatch species. SPC is the Coastal Fisheries Data Manager that holds the data on behalf of the SPC member countries. Similar to the pelagic data, permission is required from each member country prior to the release of data. There is almost no SPC held data available on coastal shark catches for the Pacific CITES member countries. Any data is likely to come from the training and implementation of creel survey activities in countries, although the recording of sharks in these surveys is not common, with mostly inshore reef sharks reported. The time-frames for the release of authorised creel survey data were beyond those of this CITES Project. An SPC led large-scale under water visual assessment project examined 63 sites across 17 Pacific Island Countries and Territories from 2002 to 2009 and was targeting finfish with sharks only incidentally noted if present in the vicinity of a transect (Pinca *et al.* 2009). No hammerhead sharks were recorded and only one *Manta birostris* was reported; from Fiji in 2002.

There is very limited information on coastal shark catches across the Pacific countries (Lack and Meere 2009; Glaus *et al.* 2015). Many subsistence and small-scale coastal fisheries for sharks occur across the Pacific countries but the shark catches are very poorly documented; with the few reported catches mostly at the generic level of ‘shark’ (Juncker 2006). Cook island, Fiji, Guam, Hawaii, Palau, Papua New Guinea and Tonga included hammerhead sharks among those caught in their national waters from both artisanal and industrial fisheries. There is no mention of manta rays (Juncker 2006).

A recent study of coastal shark fisheries in Fiji confirmed Scalloped Hammerhead (using DNA barcoding) as among the approximately twelve sharks species being taken in Fiji inshore waters (Glaus *et al.* 2015). Juvenile Scalloped Hammerheads were said to be often sold in local fish markets (Glaus *et al.* 2015). Other hammerhead shark species (*Sphyrna* spp.) were anecdotally noted as being caught. The majority of shark being caught was taken as bycatch and mostly used for domestic consumption, although there were some fishers that did not value shark and discarded them (Glaus *et al.* 2015). A Scalloped Hammerhead nursery area has been reported in the Rewa River estuary, in south-eastern Viti Levu (Brown *et al.* 2016). During a recent study of the nursery area, it was noted that over a four-week period (November to December 2014), approximately 120 juvenile Scalloped Hammerheads were captured by local fishers in gill nets. The largest individual was 1170 mm total length (TL). The captured Scalloped Hammerheads were mostly dead and considered by those fishers to be of no commercial value and were either used for bait or discarded (C. Rico, University of the South Pacific, pers. comm. 2015).

A study in Indonesia from 2001 to 2005 reported approximately 544 t of mobulids (manta and devil rays) were taken annually from drift gillnets, of which Giant Manta Rays comprised 13.7% (White *et al.* 2006). It is not known if these included Reef Manta Rays. In 2013–2014, lower average annual catches of mobulids of 230 t were reported from similar regions of Indonesia (this latter study modified the White *et al.* 2006 catch estimation method to estimate an average of 1094 t of mobulids were taken annually from 2001–2005) (Lewis *et al.* 2015).

There may be some shark and ray catch data obtained during a SPC fisheries development project that ran from approximately 1978 to 1985 across multiple Pacific Island Countries and Territories. The data is predominantly of shallow and deep water reef fishes, although there may be some shark data, however, this data is in hard copy and was not accessible for this CITES Project.

2.3.4 Catch trends and values

The limited observer and longline logsheet catch and effort data has been used by Rice (et al. 2015) to estimate a standardised catch-per-unit-effort (CPUE) for the hammerhead shark complex (*S. lewini, S. mokarran*, *S. zyganea* and *Eusphyra blochii*) taken in the WCPO. This analysis indicated a large increase in CPUE during 1997–2001 with a fluctuating CPUE in the following years with no consistent rise or decline (2002–2013) (Rice *et al.* 2015). However, the lack of data on which the CPUE was based limits the interpretation and application of this information (Brouwer and Harley 2015; Rice *et al.* 2015).

There is no species-specific data on catch trends for *Manta birostris* or *Manta alfredi* in the WCPO. Dramatic declines in Indonesian mobulid (manta and devil rays) catches from 2001–05 to 2013–14 have been reported, with declines of between 64% and 94% in different parts of Indonesia; the largest declines were observed for *Manta* spp. (Lewis *et al.* 2015).

2.3.5 Have RFBs and/or other States fishing this stock been consulted?

SPC was contacted and provided some observer data, and WCPFC have hammerhead shark catches (general) available online (http://www.wcpfc.int/wcpfc-data-catalogue-0). The FFA were also contacted. All the Pacific states fishing the stocks were informed of this CITES project but only the Pacific CITES members were invited to the workshop in Nadi, Fiji 2016 due to budget constraints. Individual scientists and researchers working on Pacific shark conservation and management were contacted to enquire about data availability and quality.

3 Intrinsic Biological Vulnerability of Hammerheads and Manta Rays

Scalloped Hammerhead: All reported data on this species is based on studies from the Pacific Ocean and eastern Indian Ocean (Indonesia).
Great Hammerhead: The reported data on this species is based on studies from the Pacific Ocean (Australia, Mexico) with some additional age data from the Atlantic Ocean.
Smooth Hammerhead: There is limited biological data on this species from the Pacific Ocean; additional age data from the Atlantic Ocean was used.
Giant and Reef Manta Ray: There is limited biological data on this species from the Pacific Ocean, global data was also used.

3.1 Median age at maturity

3.1.1 Scalloped Hammerhead

There is conflicting information on the age of the Scalloped Hammerhead, as some studies base the age on the assumption that two band pairs per year are formed in the vertebrae (Chen *et al.* 1990; Anislado-Telentino *et al.* 2008), while other studies assume one band pair per year are formed (Harry *et al.* 2011; Drew *et al.* 2015). Attempts to verify periodicity of band pair formation have been hampered by small sample sizes in some months of collection (Drew *et al.* 2015), and too short a time at liberty of calcein marked individuals (Harry *et al.* 2011). The median estimated age at maturity:

- Based on two band pairs per year, for animals from Taiwan is 4.1 years for males and 3.8 years for females (Chen *et al.* 1990).
- Based on one band pair year, from the tropical east coast of Australia is 5.7 years for males (too few mature females from east coast of Australia to estimate age at maturity) (Harry *et al.* 2011), and for Indonesian animals 8.9 years for males and 13.2 years for females (Drew *et al.* 2015).

These differing estimates of ages at maturity have important implications for demographic modelling, and research on the validation of the periodicity of band pair formation is required.

3.1.2 Great Hammerhead

Annual band pair deposition was confirmed for this species from eastern Australian through calcein mark and recapture (Harry *et al.* 2011). It was also confirmed for animals from the north-west Atlantic and Gulf of Mexico through marginal increment analysis and concurrent bomb radiocarbon validation (Piercy *et al.* 2010). The median estimated age at maturity for the Great Hammerhead from eastern Australia was similar for males and females and was 8.3 years (range 7.4–9.5 years) (Harry *et al.* 2011).

3.1.3 Smooth Hammerhead

Annual band pair deposition has been assumed but not validated for the Smooth Hammerhead (Coelho *et al.* 2011). The median age at maturity for Smooth Hammerheads is estimated as 11 years (2594 mm TL) for animals from Taiwan (Liu and Tsai 2011). This estimate is assumed to be from vertebral band counts though it is not clear if this if for males or females, or sexes combined as the original paper is in Chinese. Age at maturity was estimated from the Atlantic Ocean as 15 years for males and 22 years for females (Clarke *et al.* 2015a). These estimates were based on using the size at maturity to estimate age at maturity from the von Bertalanffy growth curve that was based on vertebral band counts (Coelho *et al.* 2011; Rosa *et al.* 2015).

3.1.4 Giant Manta Ray

Male age at maturity is unknown but is estimated as 3–6 years for the closest relative *M. alfredi* (Section 3.1.5). Female age at maturity is estimated at 8–10 years (Marshall *et al.* 2011a), but the method of age determination is unknown and estimates of female age at maturity are a subject of debate (Dulvy *et al.* 2014).

3.1.5 Reef Manta Ray

Male age at maturity is estimated as 3–6 years from Hawaii, apparently based on observations of mating by mature males (determined from visual assessment of the claspers) (Couturier *et al.* 2012). Female age at maturity is unknown but likely >8 years, with >15 years observed for females in the Maldives; the method of determination of age of maturity is unknown (Marshall *et al.* 2011b; CITES 2013b).

3.2 Median size at maturity

3.2.1 Scalloped Hammerhead

The male median size at maturity is smaller than that of females and varies slightly among studies from different areas. Male size at maturity ranges from 1471 to 1980 mm stretched total length (L_{ST}):

- 1471 mm L_{ST}, tropical east coast of Australia (Harry *et al.* 2011)
- 1500 mm L_{ST}, northern Australia (Stevens and Lyle 1989)
- 1756 mm L_{ST}, Indonesia (Drew *et al.* 2015)
- 1980 mm L_{ST}, Taiwan (Chen *et al.* 1990).

Female estimated median size at maturity is also variable and prior to the Drew *et al.* (2015) Indonesian study, was based on a limited number of mature females. It ranges from 2000–2285 mm L_{ST}:

- 2000 mm $L_{ST,}$ northern Australia (Stevens and Lyle 1989)
- 2100 mm L_{ST}, Taiwan (Chen *et al.* 1990)
- 2285 mm L_{ST}, Indonesia (Drew *et al.* 2015).

3.2.2 Great Hammerhead

The median estimated size at maturity for the Great Hammerhead from eastern Australia was similar for males and females and was 2279 mm L_{ST} (range 2149–2429 mm L_{ST}) (Harry *et al.* 2011).

3.2.3 Smooth Hammerhead

The median estimated size at maturity for Smooth Hammerhead from the subtropical-temperate east coast of Australia was 2500–2600 mm TL for males and 2650 mm TL for females (Stevens 1984).

3.2.4 Giant Manta Ray

All males > 3800 mm Disc Width (DW) from Indonesia were mature (based on visual assessment of claspers) with the median estimated size at maturity for males estimated as 3752 mm (DW_{50}). Fewer mature females were encountered in the Indonesian study with the smallest mature female at 4126 mm DW (based on visual inspection of gonads) (White *et al.* 2006). These data were prior to the split of genus *Manta* into two species and may include *M. alfredi*. Since the taxonomic split, it appears size at maturity for the Giant Manta Ray may vary slightly across its range from 3750–4000 mm DW for males and 4100–4300 mm DW for females (Marshall *et al.* 2011a).

3.2.5 Reef Manta Ray

Size at maturity appears to vary regionally and ranges from 2500–3000 mm DW for males and 3000–3900 mm DW for females (Marshall *et al.* 2011b). In Mozambique, males mature at >3000 mm DW and females at approximately 3900 mm DW (Marshall and Bennett 2010). In eastern Australia, males mature at 3000–3500 mm DW; female size at maturity could not be determined (Couturier *et al.* 2014). In Hawaii, males are estimated to mature at 2800 mm DW and females at 3370 mm DW (Deakos 2012). In the Republic of Maldives, males mature at 2500 mm DW and females at 3000 mm DW (Marshall *et al.* 2011b).

3.3 Maximum age/longevity in an unfished population

3.3.1 Scalloped Hammerhead

The maximum estimated observed age is 19 years (2399 mm L_{ST}) for males and 35 years (2773 mm L_{ST}) for females from Indonesia (Drew *et al.* 2015), and 21 years (2617 mm L_{ST}) for males from tropical east coast of Australia (Harry *et al.* 2011). These are both based on an assumption of vertebral deposition of one band pair per year.

Maximum observed ages based on two band pairs per year were 10.6 years (3010 mm L_{ST}) for males and 14.0 years (3310 mm L_{ST}) for females from Taiwan (Chen *et al.* 1990), and 11 years (2810 mm L_{ST}) for males and 18.6 years (3356 mm L_{ST}) for females from Mexico (Anislado-Telentino and Robinson-Mendoza 2001; Anislado-Telentino *et al.* 2008).

3.3.2 Great Hammerhead

The maximum estimated observed age from animals in eastern Australia was 31.7 years (3691 mm L_{ST}) for males and 39.1 years (4391 mm L_{ST}) for females (Harry *et al.* 2011).

However, a larger male from south Atlantic was aged to 42 years (3795 mm L_{ST}) (Passerotti *et al.* 2010; Piercy *et al.* 2010). A slightly smaller female from Central Mexican Pacific was aged to 45 years (4240 mm L_{ST}) (Tovar-Avila and Gallegos-Camacho 2014).

3.3.3 Smooth Hammerhead

There is no estimate of maximum age for Smooth Hammerheads from the Pacific Ocean. Maximum age was estimated from the Atlantic Ocean (using vertebral band counts) as 24 years (2860 mm TL) for males and 25 years (2840 mm TL) for females (Rosa *et al.* 2015). As these are smaller than maximum size animals it is likely the maximum age is higher than these estimates.

3.3.4 Giant Manta Ray

The maximum age is unknown, however it is suggested to be > 25 years, as photographic databases have re-sighted individuals up to 20 years (Marshall *et al.* 2011a). Maximum age has been estimated to be at least 40 years for *Manta* spp. (Marshall *et al.* 2011a).

3.3.5 Reef Manta Ray

The maximum age is unknown, however is inferred as 31 years based on photographic re-sightings (Dulvy *et al.* 2014). The maximum age for *Manta* spp. has been estimated to be at least 40 years (Marshall *et al.* 2011b).

3.4 Maximum size

3.4.1 Scalloped Hammerhead

The maximum observed size among the Pacific studies is 3010 mm L_{ST} for males and 3460 mm L_{ST} for females (Stevens and Lyle 1989). The maximum theoretical size from growth models, based on one band pair per year, is 3050 mm L_{ST} for males and 3075 L_{ST} mm for females (Drew *et al.* 2015). Based on two band pairs per year, the theoretical maximum size is 3210 L_{ST} mm for males and 3200 mm L_{ST} for females (Chen *et al.* 1990).

3.4.2 Great Hammerhead

The maximum observed size in the WCPO is 4450 mm L_{ST} for males (from northern Australian fishery data) (Stevens and Lyle 1989) and 4391 mm L_{ST} for females from eastern Australia (Harry *et al.* 2011). The maximum eastern Australian theoretical size is estimated to be 4027 mm L_{ST} (range 3638–4545 mm L_{ST}) for males and females combined (estimated as L_{∞} from von Bertalanffy growth model) (Harry *et al.* 2011). The Great Hammerhead is reported to reach 6000 mm TL, though to rarely exceed 4500 mm TL (Last and Stevens 2009).

3.4.3 Smooth Hammerhead

The maximum observed size is reported as 3700–4000 mm TL (Compagno 1984), however it has also been estimated as approximately 3500 mm TL in Australia (Last and Stevens 2009). In Taiwan, the maximum size has been estimated from growth models as 3588 mm TL for males and 3752 mm TL for females (Liu and Tsai 2011).

3.4.4 Giant Manta Ray

The maximum size is reported as 7100 mm DW, although there are anecdotal reports of over 9000 mm DW from the Philippines (Alava *et al.* 2002; Marshall *et al.* 2011a).

3.4.5 Reef Manta Ray

The maximum size varies among regions. It has been reported as approximately 5500 mm DW from Mozambique (Marshall *et al.* 2009), 4200 mm DW from Japan, 4100 mm DW from Western Australia and 3620 mm DW from Hawaii (Marshall *et al.* 2011b).

3.5 Natural Mortality rate (M)

3.5.1 Scalloped Hammerhead

The natural mortality for eastern Australian Scalloped Hammerheads was estimated as 0.123 year$^{-1.}$ This was based on the method of Jensen (1996) using the formulae: M= 1.6k, where M is the natural mortality and k is the von Bertalanffy growth completion rate (Harry 2011). The natural mortality has been calculated for the Gulf of Mexico Scalloped Hammerhead population using growth model parameters that assumed one band pair per year (Branstetter 1987); it was estimated to be 0.107 year^{-1} (Chen and Yuan 2006). The growth model parameters were similar to those from other Pacific and Indian Ocean studies that assumed one band per year (Harry *et al.* 2011; Drew *et al.* 2015).

3.5.2 Great Hammerhead

The natural mortality for eastern Australian Great Hammerheads was estimated as 0.126 year$^{-1.}$ This was based on the method of Jensen (1996) (Harry 2011).

3.5.3 Smooth Hammerhead

There are no estimates of natural mortality for Smooth Hammerheads for the Pacific or Atlantic Oceans.

3.5.4 Giant Manta Ray

The natural mortality is thought to be low, however there is some predation from large sharks (Marshall *et al.* 2011a). Mortality for juveniles of *Manta* spp. is expected to be low due to their extremely large size compared to other sharks and rays (Dulvy *et al.* 2014). Mortality has been estimated for *Manta* spp. using life history parameters of large tropical batoids and planktivourous whale sharks; it was estimated as 0.012–0.04 year^{-1} (Dulvy *et al.* 2014).

3.5.5 Reef Manta Ray

The natural mortality is thought to be low although there is no data. Limited predation from large sharks and Orcas occurs (Marshall *et al.* 2011b) . Mortality for juveniles of *Manta* spp. is expected to be low due to their extremely large size compared to other sharks and rays (Dulvy *et al.* 2014). Mortality has been estimated for *Manta* spp. using life history parameters of large tropical batoids and planktivourous whale sharks; it was estimated as 0.012–0.04 year^{-1} (Dulvy *et al.* 2014).

3.6 Maximum annual pup production (per mature female)

3.6.1 Scalloped Hammerhead

The maximum estimated annual pup production is reported as 14 to 41 with a mean of 25.3 for females from Indonesia (White *et al.* 2008), and as 12 to 38 with a mean of 25.8 for females from Taiwan (Chen *et al.* 1988). Gestation is 8–10 months in the Pacific region (Chen *et al.* 1988; Stevens and Lyle 1989; White *et al.* 2008). These annual estimates assume that females pup annually. However, the reports are contradictory as to whether they give birth annually (Baum *et al.* 2007) or only once every two years (biennially) (Liu and Chen 1999). Consequently, the length of the female Scalloped Hammerhead reproductive cycle is not clear (Clarke *et al.* 2015a).

3.6.2 Great Hammerhead

The estimated litter size is 6 to 33 (mean 15.4) for females from northern Australia with an estimated 11 month gestation (Stevens and Lyle 1989). However, it is likely that females breed biennially (Stevens and Lyle 1989), hence the estimated annual pup production is 3 to 17 (average 10).

3.6.3 Smooth Hammerhead

Litter sizes from eastern Australia were 20–49 (mean 32), although it was noted these are minimum values as pups were often aborted during capture (Stevens 1984). A similar mean litter size of 33.5 was reported from west Africa (Casper *et al.* 2005). Gestation is about 10–11 months (Stevens 1984), yet the periodicity of the female reproductive cycle is not known, that is, whether they breed annually or biennially (Clarke *et al.* 2015a).

3.6.4 Giant Manta Ray

The litter size is generally 1 pup per litter and gestation period is unknown. The reproductive cycle is suggested to be at least annual, which has been observed in an aquarium and in the wild for the closest relative *M. alfredi* (Couturier *et al.* 2012). For *Manta* spp., biennial reproductive cycles may occur and the cycles may even be longer, up to five years, although this may be an artefact of poor sightings (Dulvy *et al.* 2014). Annual reproductive output for the Giant Manta Ray may therefore vary from 1 to 0.2 (1 pup every five years), although a more plausible range is 1–0.5 pups per year.

3.6.5 Reef Manta Ray

The litter size is generally one pup (occasionally 2) with the reproductive cycle most commonly biennial, although annual cycles have been observed (Marshall and Bennett 2010; Marshall *et al.* 2011b). A gestation period of one year in an aquarium and in the wild have been observed for the Reef Manta Ray (Marshall and Bennett 2010; Couturier *et al.* 2012). For *Manta* spp., reproductive cycles may be longer, up to five years, although this may be an artefact of poor sightings (Dulvy *et al.* 2014). Annual reproductive output for the Reef Manta Ray may therefore vary from 0.5 to 0.2 (1 pup every five years) pups per year.

3.7 Intrinsic rate of population increase (r)

3.7.1 Scalloped Hammerhead

The intrinsic rate of population increase for the Scalloped Hammerhead was calculated for the Gulf of Mexico population using growth model parameters that assumed one band pair per year; it was 0.086 year^{-1} (Chen and Yuan 2006). Life history parameters from Taiwan based on two bands per year yielded a higher intrinsic rate of population increase of 0.205 year^{-1} (Liu and Chen 1999).

3.7.2 Great Hammerhead

The intrinsic rate of population increase is not known for the Great Hammerhead. It is assumed to be very low, similar to the one band per year value of 0.086 year^{-1} for Scalloped Hammerhead (Chen and Yuan 2006). The intrinsic rebound potential of the Great Hammerhead in eastern Australia was estimated as 0.043 year^{-1} (calculated with no fecundity increase, 1.00*b* where *b* is average fecundity) (Harry 2011). The intrinsic rebound potential (r_{2M}) is similar to intrinsic rate of population increase but allows for density-dependent compensation.

3.7.3 Smooth Hammerhead

There are no estimates of rate of population increase from the Pacific or Atlantic Oceans.

3.7.4 Giant Manta Ray

The intrinsic rate of population increase based on life history traits has been estimated as 0.042 year^{-1} (Ward-Paige *et al.* 2013). The maximum population growth rate (r_{max}) has been estimated for manta rays (general) using a generic manta ray life history and a life history model and estimated as a median of 0.116 year^{-1} (0.089–0.139) (Dulvy *et al.* 2014). This is one of the lowest known r_{max} of the 106 sharks and rays for which this has been estimated (Dulvy *et al.* 2014).

3.7.5 Reef Manta Ray

The intrinsic rate of population (*r*) increase based on life history traits has been estimated as 0.050 year^{-1} (Ward-Paige *et al.* 2013). The maximum population growth rate (r_{max}) has been estimated for manta rays (general) using a generic manta ray life history and a life history model and estimated as a median of 0.116 year^{-1} (0.089–0.139) (Dulvy *et al.* 2014). The difference in *r* and r_{max} were suggested to be due to differences in the methodology and estimates of natural mortality (Dulvy *et al.* 2014).

3.8 Geographic distribution of stock

3.8.1 Scalloped Hammerhead

The Scalloped Hammerhead is circumglobal, coastal-pelagic to semi-oceanic in warm temperate to tropical seas. However, there are at least four genetically distinct female populations, one of which is an Indo-West Pacific population, and even possibly female stock segregation within the Pacific. In contrast, males appear to have one global population (see Section 2.1.3.1). This has implications for estimations of sustainable take from the Oceania region.

3.8.2 Great Hammerhead

The Great Hammerhead is circumglobal, in coastal and shelf waters, and occasionally in the open ocean in sub-tropical to tropical seas; it is often solitary (Denham *et al.* 2007). There are at least two genetically distinct stocks: Atlantic and Indo-Pacific (Simpfendorfer 2014) (see Section 2.1.3.2).

3.8.3 Smooth Hammerhead

The Smooth Hammerhead is circumglobal, in coastal and shelf waters, and occasionally in the open ocean in temperate to subtropical seas. It is reported from the tropics but only patchily. There are at least two genetically distinct stocks: Atlantic and Indo-Pacific (Simpfendorfer 2014) (see Section 2.1.3.3).

3.8.4 Giant Manta Ray

The Giant Manta Ray is circumglobal in tropical, subtropical and temperate waters. The stock distribution is unknown; however, populations are likely fragmented as it is unknown if they cross ocean basins (See Section 2.1.3.4).

3.8.5 Reef Manta Ray

The Reef Manta Ray is circumglobal in tropical and subtropical waters. The stock distribution is unknown; however, populations appear to be sparsely distributed with a high degree of separation (See Section 2.1.3.5).

3.9 Current stock size relative to historic abundance

3.9.1 Scalloped Hammerhead

It has been estimated from long-time series studies on multiple areas that globally, the Scalloped Hammerhead has declined to at least 15–20% of the baseline abundance (CITES 2013a). There are reported large declines in abundance (based on catch rate data) of 60–99% over recent decades of the Scalloped Hammerhead and the hammerhead complex of Scalloped, Great and Smooth Hammerhead in the Atlantic and Indo-Pacific Oceans (Baum *et al.* 2007; CITES 2013a). In the Indo-West Pacific there is limited analyses of catch data trends on the Scalloped Hammerhead or hammerheads in general. Catch rates of all hammerheads in the northern Queensland Shark Control Program declined to between 16.5 % and 33.4% of original levels by the early 1990s (Simpfendorfer *et al.* 2011), although some of this decline may be also due to fisheries catches. In the Western Australian North Coast Shark Fishery there was a 58–76% decline in all hammerheads from 1998–1999 to 2005–2006 (Heupel and McAuley 2007). In the shark nets deployed off South Africa in the southwestern Indian Ocean catch rates of Scalloped Hammerheads declined by approximately 64% from 1978–2003 (Dudley and Simpfendorfer 2006).

3.9.2 Great Hammerhead

The current and historic stock sizes of Great Hammerheads are unknown due to the lack of data. Global populations of Great Hammerheads have been estimated to have declined by at least >50% (Denham *et al.* 2007). For the hammerhead complex: declines of 60–99% are reported from the Atlantic and Indo-Pacific Oceans; catch rates in the Queensland Shark Control Program are between 16.5–33.4% of original levels; and declines of 58–76% are reported from the Western Australian North Coast Shark Fishery (see Section Scalloped Hammerhead 3.9.1).

3.9.3 Smooth Hammerhead

The current and historic stock sizes of Smooth Hammerheads are unknown due to the lack of data. For the hammerhead complex: declines of 60–99% are reported from the Atlantic and Indo-Pacific Oceans; catch rates in the Queensland Shark Control Program are between 16.5–33.4% of original levels; and declines of 58–76% are reported from the Western Australian North Coast Shark Fishery (see Section Scalloped Hammerhead 3.9.1).

3.9.4 Giant Manta Ray

The Giant Manta Ray is estimated to have exhibited high rates of population decline in several regions, up to as high as 85% over the last approximately 75 years (Marshall *et al.* 2011a). A global decline of >30% is strongly suspected (Marshall *et al.* 2011a). Dramatic declines in Indonesian mobulid catches from 2001–2005 to 2013–2014 have been reported, with declines of between 64% and 94% in different parts of Indonesia; the largest declines were observed for *Manta* spp. (Lewis *et al.* 2015).

3.9.5 Reef Manta Ray

Dramatic declines in Indonesian mobulid (manta and devil rays) catches from 2001–2005 to 2013–2014 have been reported, with declines of between 64% and 94% in different parts of Indonesia; the largest declines were observed for *Manta* spp. (Lewis *et al.* 2015). Elsewhere high population reductions of Reef Manta Rays of up to 80% over the last 75 years are estimated for several regions, and globally a decline of 30% is suspected (Marshall *et al.* 2011b).

3.10 Behavioural factors

3.10.1 Scalloped Hammerhead

The Scalloped Hammerhead displays a number of behaviours that increase its vulnerability to anthropogenic factors. They include: inshore nursery areas, high natural predation on the young, aggregating behaviour, and high at-vessel fishing mortality rates.

There are naturally high levels of predation on Scalloped Hammerhead pups and juveniles, mostly by other carcharhinids and by adult Scalloped Hammerheads (Baum *et al.* 2007). Neonates are born in shallow intertidal habitats and in the tropics, where juveniles of both sexes remain in the shallow inshore waters of less than 25 m for the first few years of life (Harry *et al.* 2011). This exposes them to fishing pressure, with large numbers of pups and juveniles reported as captured in some regions of the world (Baum *et al.* 2007). A recent study of a Scalloped Hammerhead nursery area in Fiji reported inshore net fishers catching 120 juveniles over a 4-week period with all animals discarded, mostly dead (C. Rico, University of the South Pacific pers. comm. 2015). The heavy fishing pressure on this size class adds a cumulative pressure to the already high natural mortality, which could increase the vulnerability of the population. The aggregating behaviour of some populations at seamounts increases their vulnerability to capture (Baum *et al.* 2007).

Scalloped Hammerheads exhibit very high at-vessel fishing mortality rates; that is, they are mostly deceased when brought on board the vessel (Morgan and Burgess 2007). A study of bottom longlining in the northwest Atlantic and Gulf of Mexico of six species of sharks indicated the hammerheads had the highest at-vessel mortality. For the Scalloped Hammerheads, 91.4% of all animals landed were deceased with juveniles showing the highest mortality (95.2%), followed by the adults (90.9%) and the young (70%). Hammerheads are active obligate ram ventilators and when hooked on a longline must increase swimming speed or mouth gape to increase oxygen availability. When unable to do so, it is likely rapid asphyxiation occurs following hooking (Morgan and Burgess 2007).

3.10.2 Great Hammerhead

The Great Hammerhead is generally solitary and hence unlikely to be abundant in areas of occurrence (Denham *et al.* 2007). They also have very high at-vessel fishing mortality rates (Morgan and Burgess 2007). A bottom longline study found that of all Great Hammerheads landed, 93.8% were deceased with juveniles having the highest mortality (90.5%), followed by adults (87.3%) and the young (86.4%) (Morgan and Burgess 2007).

3.10.3 Smooth Hammerhead

The nursery areas of this species are smooth sandy substrates in shallow waters of depths down to 10 m, with very large schools of juveniles reported in coastal waters (Casper *et al.* 2005). Although at-vessel mortality has not been published, the Smooth Hammerhead is likely to have a very high mortality similar to that of the Scalloped and Great Hammerheads, as it is also an active obligate ram ventilator.

3.10.4 Giant Manta Ray

This species is generally solitary but tends to aggregate at offshore pinnacles and sea mounts. They also visit cleaning stations in shallow reefs, and are sighted feeding at the surface inshore and offshore. Possible nursery grounds near the continental shelf edge have been identified in Sri Lanka (Heinrichs *et al.* 2011) and Peru (http://www.mantatrust.org).

3.10.5 Reef Manta Ray

The Reef Manta Ray are often resident as aggregations, in or along productive near-shore areas, with smaller home ranges and shorter seasonal migrations than Giant Manta Rays. Predictable aggregations make them vulnerable to targeted fisheries which have increased in several parts of the world in response to the demand for their gill plates that are of high value (Couturier *et al.* 2012; Couturier *et al.* 2014).

3.11 Trophic level

3.11.1 Scalloped Hammerhead

Based on diet studies, the Scalloped Hammerhead has a high trophic level estimated at 4.1 ± 0.5 standard error(s.e.) (Froese and Pauly 2015).

3.11.2 Great Hammerhead

Based on diet studies, the Great Hammerhead has a high trophic level estimated at 4.3 (Froese and Pauly 2015).

3.11.3 Smooth Hammerhead

Based on diet studies, the Smooth Hammerhead has a high trophic level estimated at 4.2-5.4 (Froese and Pauly 2015).

3.11.4 Giant Manta Ray

The tropic level is estimated as 3.5 ± 0.5 s.e. based on food items (Froese and Pauly 2015). Mobulids (manta and devil rays) feed on zooplankton and small fishes (Couturier *et al.* 2012).

3.11.5 Reef Manta Ray

The tropic level is estimated as 3.6 ± 0.5 s.e. based on size and trophic level of closest relatives (Froese and Pauly 2015). Isotope and signature fatty acid analyses suggest Reef Manta Rays feed on zooplankton at both the surface and near the bottom of the sea floor (Couturier *et al.* 2013).

4 Pressures on species

Each country will need to complete the NDF template for this step as the information required is specific to each country and held within countries' government departments. Detailed advice on completion of this step is provided in the guidance notes of the 'CITES Non-detriment findings Guidance for shark species 2nd revised version' (Shark NDF Guidance) (Mundy-Taylor *et al.* 2014).

5 Existing Management Measures

Each country will need to complete the NDF template for the first part of this step for the (Sub-)National management measures. The first part requires details of the in-country generic and species-specific management measures that relate to shark management. Advice on completion of this step is provided in the guidance notes of the 'CITES Non-detriment findings Guidance for shark species 2nd revised version' (Shark NDF Guidance) (Mundy-Taylor *et al.* 2014).

A general description of the fisheries management and effectiveness is provided for each Pacific CITES member country below (Section 5.1). This is followed by the Regional and International management measures required for the second part of this step (Section 5.2). There is also a brief discussion of the effectiveness of the implementation of the regional management measures (Section 5.2.3).

5.1 National

Coastal regions

5.1.1 Country-specific fisheries management and effectiveness

Coastal fisheries management among the Pacific CITES members is legislated, however their currency and effective implementation is highly variable, but generally poor. Enforcement capacity and compliance resourcing is also generally poor, as is the level of knowledge of coastal fisheries regulations (Govan *et al.* 2013). Each country has national fisheries departments responsible for fisheries management functions. Traditionally, community-based management of coastal fisheries has been embedded in cultural norms, and although this has eroded through time, there has been a more recent move to reinstate community based management and recognise it in national legislation.

5.1.1.1 Fiji

The current Fiji *Fisheries Act* dates back to 1942. The coastal fisheries management in Fiji has been described as outdated and poorly implemented and enforced, largely due to inadequate resourcing and poor governance (Gillett *et al.* 2014). Attempts to change this are occurring as Fiji is currently in the process of developing a National Fisheries Policy (the first stake holder meeting was held in February 2016) that will focus on raising the profile of coastal fisheries to ensure adequate resourcing and good governance.

A recent study across Fiji found that most (~81 %) local artisanal fishers catch sharks in coastal fisheries. Species catch composition was diverse and, despite poor identification skills, hammerhead species were a significant portion of the total catch. Genetic analyses verified that Scalloped Hammerhead were present in the catch. Overall, the study found that the fishery is quite small however there is the potential for it to greatly expand (Glaus *et al.* 2015).

Generally coastal fisheries are considered over-exploited. Further, there are no shark-specific measures in place for coastal fisheries in Fiji. Some work has been done by the Wildlife Conservation Society on trying to maintain or increase populations of Whitetip Reef Shark (*Triaenodon obesus*) (Gillett *et al.* 2014). However, it is not clear how effective this has been. In some parts of Fiji, shark diving operations represent an important local eco-tourism industry, and in 2014 one of the popular dive areas (Beqa Lagoon) was declared a Shark Reef National Marine Park. A National Plan of Action for Sharks has been completed, however it appears to only apply to oceanic fisheries.

5.1.1.2 Palau

The Palau Shark Sanctuary announced in 2009 prohibits all commercial shark fishing within the Palau EEZ (http://sharksmou.org/shark-sanctuaries). As of 2015, it has become part of the Micronesia Regional Shark Sanctuary that includes an additional three countries (Federated States of Micronesia, Mariana Islands and Marshal Islands (Micronesia regional shark sanctuary).

Information on coastal fisheries management systems in Palau is scant, however recently two of the northern states of the Republic of Palau, in partnership with multiple Non-Government Organisation (NGO's), signed the *Ngarchelong Coastal Fisheries Management Act 2015* (http://pacificvoyagers.org/palau-northern-reef-states-pass-coastal-fisheries-management-bill/). This Act introduces a combination of species-specific management measures and strengthens governance structures and capacity, however most of the fisheries regulations are still in the consultation phase of development. A copy of the legislation could not be located to assess specific measures related to coastal shark fishing.

A recent audit report of the tuna fishery in Palau's EEZ was critical in regard to all aspects of the development of adequate regulations, effective implementation of existing regulations, and enforcement. The report cited poor governance and a lack of adequate resourcing as key reasons for ineffective management (Republic of Palau 2013).

5.1.1.3 Papua New Guinea

Coastal fisheries management in Papua New Guinea is generally considered to be poor through a lack of adequate resourcing for management and enforcement. Most coastal fisheries are considered to be over-exploited and some local fisheries have been driven to near collapse, such as beche-de-mer (Govan *et al.* 2013). This has resulted in shifts in targeting through time, including increased artisanal shark fishing for fins by coastal fishers (Gillett 2009; Govan *et al.* 2013). In coastal fisheries, although regulations exist for numerous coral reef species, there are no regulations specific to sharks.

Papua New Guinea had a domestic target shark longline fishery with a management plan (Kumoru 2003), which operated from the 1990s until 2014, when it ceased due to the requirement to not land or retain silky sharks (WCPFC CMM 2013-08). Hammerheads or manta rays were not listed in the main families harvested by the shark longline fishery, however national observer data showed a reasonable level of hammerhead catch. Included in the management plan were measures such as a Total Allowable catch (2000 t dressed weight) and a stated intention to decrease capacity through time. The effectiveness of management on this fishery was unclear, although there was a requirement for 20% national observer coverage for the fishery. A Papua New Guinea national tuna management plan also placed limits on retained shark bycatch by the tuna longline fishery (Kumoru 2003). Currently, SPC and FFA are in the process of developing a National Plan of Action for Sharks (NPOA Sharks), that will include archipelagic waters and small commercial fisheries. The first meeting on NPOA Sharks was held in February 2016 where the Shark Assessment Report was completed with follow-up consultation planned for May 2016 (pers. comm. Ian Freeman, FFA 2016).

5.1.1.4 Samoa

Samoa has relied on traditional village-based governance of coastal resources since 1995, which operates in over 90 villages (Secretariat Pacific Community 2013). One of the most common measures used has been marine protected areas (King *et al.* 2001). Despite this, several target coastal fishery resources have reportedly declined significantly and the local clam, *Hippopus hippopus*, has become extinct (Secretariat Pacific Community 2013). Recently, in conjunction with the Samoa Ministry for Agriculture and Fisheries, SPC developed a tool to provide a policy framework and strategic directions for sustainable development of coastal fisheries (Secretariat Pacific Community 2013). Although there are few formal coastal fisheries regulatory arrangements in place, and it is unclear what traditional management measures have been and are currently used, this at least provides a clear strategy for coastal fisheries management in the future, something lacking in many Pacific Island Countries and Territories (PICTs). It is not known if there have been any shark-specific measures historically, however it appears unlikely. Samoa is currently in the process of developing a National Plan of Action for Sharks. Neighbouring American Samoa has a shark sanctuary that prohibits shark fishing within three nautical miles of the coastline (http://www.mpatlas.org/mpa/sites/9322/).

5.1.1.5 Solomon Islands

Improvements in management of inshore fisheries are evident in recent years, with some good local NGO partnerships. However, Government commitment to coastal fisheries is neglected relative to offshore fisheries. This has resulted in a lack of resources and technical capacity. In addition, there is increasing evidence of overfishing occurring on coastal fish stocks, particularly where there is access to local markets (Govan *et al.* 2013). More recently, the use of nearshore Fish Aggregation Devices has increased to provide an alternative fishery for coastal fishers that is also aimed at reducing pressure on coral reef fishery stocks (Albert *et al.* 2015). Historically, sharks have been harvested for their fins by coastal fishers for export markets with an estimated value of SBD$70,000 and SBD$90,000 for 2006 and 2007 (Gillett 2009). The species composition of this catch is unknown and there are no regulations specific to sharks. Solomon Islands are currently in the process of developing a National Plan of Action for Sharks.

5.1.1.6 Vanuatu

Similar to other PICT's, Vanuatu fisheries governance appears to lack a clear strategy for coastal fisheries management activities and the Fisheries Department has very little in the way of operating costs (Govan *et al.* 2013). Despite this, national level fishery regulations do exist, and, although traditional management has been eroded in Vanuatu, coastal subsistence fisheries are generally managed locally by traditional owners (Govan *et al.* 2013). However, lack of knowledge and internal conflict is likely to compromise effective local management, although with the help of NGO's, Vanuatu now has several coastal marine protected areas or tabu areas. Shark fins represented a very small proportion of exports over a decade ago (Gillett 2009), however the current extent of coastal shark catch is unknown. There are no local regulations specific to shark in Vanuatu, although there is provision within the *Vanuatu Fisheries Act 2014* for regulation of the taking of shark, confiscation of shark fins and for a Vanuatu Observer Programme to record sharks. A Vanuatu National Plan of Action on Sharks (2015–2018) was implemented in August 2014 (http://www.fao.org/3/a-az639e.pdf).

5.2 Regional

Oceanic regions (EEZ's and High seas)

5.2.1 Shark-specific measures

Conservation and Management Measures (CMM's) describe management adopted by the WCPFC which are binding to member countries and WCPFC cooperating non-members. There are currently no WCPFC CMM's in place specific to hammerhead sharks and manta rays, however, there are six CMM's in place pertinent to sharks. There is an opportunity to review each measure annually at WCPFC meetings, and some CMM's include provisions for periodic review, sometimes at fixed intervals.

CMM2010-07 describes a general shark management measure that has evolved since first introduction in 2006 (Brouwer and Harley 2015; WCPFC 2016), and revolves around the need for WCPFC members, cooperating non-members and participating Territories to implement the FAO International Plan of Action for the Conservation and Management of Sharks (IPOA Sharks) and actions consistent with this IPOA. These actions include: development of National Plans of Action for sharks as appropriate that include relevant mitigation measures, accurate data recording and reporting, encouragement of live release, and a fin to carcass ratio of ≤ 5% to address the issue of finning (Brouwer and Harley 2015; WCPFC 2016).

CMM2013-05 is a general shark management measure for catches on the high seas that requires daily catch and effort reporting, including sharks.

Other more specific CMM's have been developed for WCPFC key shark species (WCPFC 2016):

- CMM2011-04 for Oceanic Whitetip Sharks that prohibits their retention, transhipping, storing or landing and calls for release with as little harm as possible.
- CMM2012-04 for Whale Sharks that prohibits purse seine setting on a Whale Shark if it is sighted prior to the set and calls for safe release of the Whale Shark if it is inadvertently encircled in the net.
- CMM2013-08 for Silky Sharks that prohibits their retention, transhipping, storing or landing and calls for release with as little harm as possible.

Two more CMM's have been introduced to limit impacts on sharks in general in the WCPO. CMM2014-05 was developed to reduce the use of wire traces and shark lines in longline fisheries targeting tuna and billfish. It also requires that where there exists a fishery that targets shark in association with WCPFC fisheries, a management plan is required to be developed for review, no later than 1 December, 2015 (WCPFC 2016). This management plan is required to include appropriate authorisations to operate, as well as mechanisms that limit catch to 'acceptable levels'.

CMM2015-07 establishes a WCPFC Compliance Monitoring Scheme (CMS) whereby compliance with obligations and CMM's adopted by the WCPFC is assessed. The CMS is meant to annually assess levels of compliance of WCPFC members, cooperating non-members and participating Territories against particular criteria (e.g. catch/effort limits, catch/effort reporting, spatial/temporal/gear restrictions, annual reporting obligations, etc.). CMM2015-07 details procedural elements of this assessment and the determination of appropriate responses to resolve non-compliance issues, such as capacity building or the application of penalties. This measure is only effective for 2016 and 2017 pending a review in 2017 (WCPFC 2016).

Eastern Central and Southeast Pacific

A measure specific to manta ray and devil rays has been introduced by IATTC (C-15-04) that prohibits their retention and trade and promotes live release where possible. This measure applies to all manta and devil rays caught within the IATTC Convention Area which covers the Eastern Central and Southeast Pacific.

Indonesia

In response to the CITES listings, the Indonesian Government issued a regulation in 2014 through the Ministry of Marine Affairs and Fisheries that prohibits the export of products of *Sphyrna* spp. for one year to 31 November 2015 (Regulation No. 59/2014) (Chodrijah and Setyadji 2015; Dharmadi *et al.* 2015).

Regarding Manta rays, the Indonesian Government issued a regulation in 2014 through the Ministry of Marine Affairs and Fisheries conferring full protected status to both species of Manta rays (Regulation No. 4/KEPMEN-KP/2014) (Dharmadi *et al.* 2015).

5.2.2 Tuna-specific (generic) measures

Most of the management measures for the WCPF are aimed at controlling catch and effort of the target species, tuna and billfish, many of which may help in limiting shark catch. The effectiveness of many of these are limited due to the multitude of exceptions within the CMMS, that mean many of the WCPFC CNMs (cooperating non-members) do not have to abide by the CMMs. The full range of management measures are best outlined in WCPFC (2016) and those which are fundamental to legal fishing operations in the WCPFC Convention are summarised in Clarke *et al.* (2014a). Some of the more general measures that are more likely to influence shark catches are described below.

In 2008, a raft of measures was introduced by the WCPFC to reduce fishing mortality principally on bigeye tuna, to sustainable levels (CMM2008-01). This package of measures included reductions in longline catch, limits on purse seine effort, closure of two high seas pockets, an annual three-month prohibition of purse seine sets on FADs, and catch limits imposed on other fisheries. In 2015, in recognition that a number of CMM's and resolutions prior to and after CMM2008-01 had not been successful in reducing fishing mortality of bigeye and yellowfin tuna, further fishing restrictions were introduced (CMM2015-01; WCPFC, 2016). These are currently in force until December 31, 2017 and include: an additional two month prohibition on purse seine sets around FADs or limits on FAD sets during 2015 and 2016; prohibitions on setting on FAD's in the high seas during 2017; effort restrictions on coastal and high seas purse seines (e.g. Vessel Day Scheme); stricter monitoring and control measures (e.g. increased Vessel Monitoring Scheme polling during FAD closures), including more observer coverage; longline catch limits of bigeye and yellowfin tuna; controls on increased fishing capacity; and data provision requirements (see CMM2015-01 for details). Large-scale driftnets are also prohibited gear in the WCPFC high seas area and daily catch and effort reporting, including sharks, is required when operating in the high seas (CMM2008-04 and CMM2013-05 respectively; WCPFC, 2016). Another WCPFC measure is a ban on transshipments at sea by foreign purse seiners (CMM2009-06). In addition, most PICT's do not allow transshipments at sea within their EEZ's (Norris 2015).

Spatial restrictions
Due to increasing concerns of Illegal, Unreported and Unregulated (IUU) fishing, to increase vigilance through CMM2010-02, the WCPFC has placed strict conditions for access of the Eastern High Seas pocket, an area bounded by the EEZ's of Cook Islands, French Polynesia and Kiribati. These measures include strict reporting requirements by vessels entering and exiting the area and continuous Vessel Monitoring Scheme polling to better facilitate compliance and enforcement activities (WCPFC 2016). A total of four Highs Seas Pockets in the WCPFC region were declared no-fishing zones for purse seiners in 2010 (Pala 2009; Sibert *et al.* 2012). This was implemented under the PNA (Parties to the Nauru Agreement) 3rd Implementing agreement. Under this agreement, technically, if a purse seiner wishes to fish the high seas they can do so, provided they do not access any of the PNA EEZs. However, as around 80% of the skipjack tuna catch is taken in PNA waters, the purse seiners tend not to fish the High Seas Pockets.

5.2.3 Implementation of measures and likely effectiveness
There are no management measures in place specific to hammerhead sharks and manta rays. Despite numerous measures specific to both shark and tuna having been implemented in recent years by the WCPFC, assessing their effectiveness is challenging. Clarke *et al.* (2013) reported very little evidence of a decline in longline shark finning after fin-to-carcass ratio restrictions were first implemented in 2007, however more recently Rice *et al.* (2015) reported a reduction in finning from observer data for both purse seine and longline fisheries.

Enforcement efforts appear to be limited with very few boardings reported each year (Norris 2015). Compliance with CMM measures is reported to be very low, particularly by foreign fishing vessels, thereby undermining their effectiveness (Norris 2015). Observer coverage has been approaching the required 100% for purse seine vessels since 2010 (particularly for those purse seine vessels operating under the PNA VDS) (see Section 2.3.3) but is still very poor for longline vessels (Section 2.3.3). In addition, misreporting and under-reporting is known to be a longstanding compliance issue across the fisheries (Hanich 2010). Compounding these issues is the scientific view that measures currently in place for reducing bigeye and yellowfin tuna mortality rates are unlikely to be effective (Hanich 2010). It can therefore be assumed that these measures are likely to be ineffective at indirectly reducing shark mortality through a decrease in overall purse seine and fishing longline effort.

Apart from PICT's within their own EEZ's, compliance activities on the high seas falls under the responsibility of WCPFC member states. As Norris (2015) reports, this is extremely difficult for resource-starved Pacific Island nations, and the enforcement burden should be at least proportionately borne by those other nations, particularly ones with a significant fishing presence in the region.

High seas measures, including closures, were implemented specifically to negate IUU fishing. However, non-compliance is still reported to be occurring (Hanich 2010; Norris 2015), and research has demonstrated that even with high levels of compliance these restrictions are unlikely to benefit bigeye tuna stocks (Sibert *et al.* 2012). This is not unexpected, since they are highly migratory species, something they share with hammerhead sharks and manta rays. Hence, these high seas restrictions are also unlikely to benefit key shark stocks. Bans on transshipment at sea by purse seiners is a useful measure for negating IUU fishing and may assist in the reducing any IUU of juvenile silky sharks taken by purse seiners, however this does not apply to longline vessels, which generally catch the majority of sharks. Through a lack of enforcement capacity across the region, illegal transshipments are reported to be continuing (Norris 2015).

6 Conclusion

The compilation of the available information relevant to the production of an NDF for the three hammerhead and two manta ray species highlighted the areas where there are data gaps and issues. These are broadly identified as a lack of the following:

- Species-specific catch data and availability of data.
- Accurate species distribution maps for each of the three hammerhead species.
- Knowledge of stock structure for all five species.
- Stock assessments for all five species.
- Some biological information for the five species.

These issues and their ramifications for the quality of an NDF are discussed below along with existing projects and initiatives that are currently underway which are attempting to address some of these issues. These projects include:

- Global Sharks and Rays Initiative (GSRI) (global_shark_and_ray_initiative).
- Rapid Assessment Toolkit (RAT) (http://wwf.panda.org/wwf_news/).
- Areas Beyond National Jurisdiction (ABNJ) (http://www.commonoceans.org/home/en/).
- WCPFC Research Plan (Brouwer and Harley 2015).
- NESP Hammerheads Project (nespmarine/project-a5/hammerhead-sharks).
- Sustainable management of the shark resources of Papua New Guinea (ACIAR project http://aciar.gov.au/project/fis/2012/102).

6.1 Data

Issues

The lack of species-specific catch data is apparent in the FAO Global Capture Production Statistics where the majority of the hammerhead catch is recorded as hammerhead (general), Great Hammerhead species has only appeared in catches from 2013 onwards, Giant Manta Ray from 2012 onwards, Reef Manta Ray is not a species within the Production Statistics, and the majority of manta ray catches are grouped with devil rays (Section 2.1.1). These issues arise due to a lack of accurate species catch records being available to FAO.

Within the WCPO, the tuna longline logsheets do not currently include capacity to record hammerhead sharks to species level and there is no reporting of hammerheads at all on the tuna purse seine logsheets. Manta rays are not listed as a key species by WCPFC which hinders their recording on logsheets. There is almost no data available on hammerheads and manta rays in the coastal fisheries of the Pacific countries.

The process to obtain species-specific catch data on bycatch from the WCPFC tuna fisheries is extremely lengthy. While the data sensitivity and need to obtain permission from each member country are recognised, the lack of ease of data sharing and time-frames for data release hinder progress on data collation and reporting. This impinges on the ability to make a decision for NDFS, particularly in the Oceania region where the populations of each of the five species occur across multiple Pacific countries. A NDF that involves shared stocks needs to be transparent about the species and quantities being taken in each of the countries.

Data Solutions

Problems with the tuna bycatch data quantity and quality and data sharing have been previously raised among all tuna RFMOs (t-RFMOs) (Clarke 2015). On a global scale, the ABNJ Tuna Project is addressing these issues which has led to a number of initiatives within the WCPO area (Clarke 2015):

- A review of what data longline observers should collect was undertaken to best understand bycatch interactions and mortality rates (Gillman and Hall 2015). Based on this, the WCPFC12 adopted changes to the WCPFC Regional Observer Program to include more detail on hooks, bait, leaders, branchline weighting, shark lines, deep setting and hooking location (WCPFC12 Summary Report, Attachement Q). The effectiveness of these changes to the improved recording of hammerhead and manta ray catches is unknown, because they are not commonly observed species and there is still low observer coverage in the longline fisheries. Electronic monitoring, such as onboard cameras may prove more effective at monitoring catches of hammerhead and manta rays.
- A Bycatch Data Exchange Protocol Template to promote data sharing was designed so that each t-RFMO can populate the template with public domain data (Clarke *et al.* 2015b). It could provide an inventory of bycatch data holdings and is being produced in trial form by WCPFC and the IOTC in 2016.

Other current projects in the WCPO region that will aid improvement in shark and ray data include:

- The WCPFC has a 'Draft Shark Research Plan: 2016-2020' (Brouwer and Harley 2015). With respect to hammerhead sharks, this plan proposes a focus on improving data for the the species through: quantification of the species catch, clarification of the species composition of the tuna bycatch by depth and region, stock discrimination, and a review to identify for which hammerhead species and regions age and growth is most uncertain followed by biological sampling to improve age and growth estimates. Manta rays are not mentioned in the Plan.
- Global Sharks and Rays Initiative (GSRI). The latter initiative is a large, ten-year global scale strategy to conserve sharks and ray (global_shark_and_ray_initiative). This includes a component for managing sharks and ray fisheries sustainably that will encourage new approaches to reporting and monitoring of shark and ray catches. It will also work to build capacity for reporting of species-specific accurate catch data.
- The Rapid Assessment Toolkit (RAT) is a recently funded project that involves a number of organisations (World Wildlife Fund, TRAFFIC, SPC, James Cook University

and FFA). The project aims to improve coastal catch data for Pacific Island countries using existing data collection methods. The data to be collected is that required for the NDF process and in the long-term could enhance NDF production by providing coastal catch data that is currently virtually non-existant.

- A project specific to Papua New Guinea is currently improving information on the species-specific shark catches across a range of fisheries in Papua New Guinea and the distribution of shark species across the country (Sustainable management of the shark resources of Papua New Guinea ACIAR project http://aciar.gov.au/project/fis/2012/102).

Remaining data issues

Some remaining issues for NDF production in the WCPO are the need to:

- Report hammerhead shark by species in the longline and purse seine logsheets. On the longline logsheet, hammerheads are not separated to species level; there is only provision for 'other species' where species information can be captured if the vessel captains can identify the different species and are instructed to fill in this section (Brouwer and Harley 2015).
- Include both species of manta rays as key species in the WCPFC.
- Improve time-frames for release of bycatch species data and the ability to share data at a level sufficent to enable transparency about quantities and locations of catch of each species.

6.2 Accurate species distribution maps

Issue

For the three hammerhead species, the current distribution maps are inadequate. They do not include parts of the Pacific where the species are known to occur. This became evident when it was noted that the current recorded distributions did not include countries where species had been reported in the SPC held observer database records (Section 2.3).

Solution

To address this issue, a minor project commenced in May 2016 which is part of a Masters thesis by Asiem Sanyal studying at the Imperial College London and affiliated with James Cook University (Colin Simpfendorfer). Information will be collated on the presence of each of the three hammerhead species in the EEZs of the Pacific Island countries. A range of sources will be used to collate the information that include the current Red List of Threatened Species maps, observer data collated in this document and information from local dive and charter operators. This will be compiled to construct more accurate maps of known current distributions of each of the three hammerhead species. One of the aims is to have the updated maps available on the CITES Shark and manta rays portal (https://cites.org/eng/prog/shark/index.php).

6.3 Known stocks/populations

Issue

All three species of hammerheads and the two manta ray species have varying degrees of information on stock structure within the Indian and Pacific Oceans. The regional stock structure for all five species requires further work to resolve the rate of exchange between countries in the Oceania region. The degree of connectivity is essential information to enable more accurate assessments of the sustainable levels of take for NDFs of each of the species in the Oceania region.

Solution

An Australian project has commenced to define the connectivity of Australia's hammerhead sharks with Indonesia, Papua New Guinea and Pacific Island countries (NESP Research Project nespmarine/project-a5/hammerhead-sharks). This project will collect tissue samples from Scalloped and Great Hammerheads across these countries to assess genetic connectivity among the countries. This will be combined with identification and satellite tags to track movements of the species. This will provide essential information to inform NDFs for these two species.

Remaining stock issues

As far as can be ascertained, there are no current projects planned to improve information on stock structure of the Great Hammerhead and Giant and Reef Manta Rays in the Oceania region.

6.4 Stock assessments

Issues

There are no stock assessments in the Indo-Pacific region for any of the three hammerhead and two manta ray species. Given the current lack of data, stock assessments in the WCPO region for each of these five species are not feasible.

Solutions

While no stock assessments are currently planned for any of the five species in the Oceania region, improved data collection and stock information for some species is planned through projects that include the RAT, ABNJ, NESP Hammerheads, WCPFC Research Plan and GSRI. An assessment framework for the management risk (M-risk) of a large number of commercially captured sharks (that included the Scalloped and Smooth Hammerhead) was recently developed (Lack *et al.* 2014). A framework to determine appropriate limit reference points (LRPs) has been recommended for WCPFC elasmobranchs (Clarke and Hoyle 2014). In the short-term, these two latter works may enable alternative assessment methods that can be used in the fisheries management of at least some of the three hammerhead and two manta ray species. In the long-term, all of these projects may provide synergistic data to improve alternative stock assessment methods and contribute to more traditional stock assessments.

6.5 Biological Information

Issues

There are issues with validation of age for Scalloped and Smooth Hammerheads where the periodicity of band pair formation has not been confirmed as annual or biennial. Ageing of both species of manta rays is highly uncertain, with no vertebral age and growth studies available and maximum ages only inferred from re-sightings in photographic databases.

Natural mortality and rates of population increase have not been estimated for the Smooth Hammerhead. For all three species of hammerheads, there is uncertainty as to whether the length of the reproductive cycle is annual or biennial. For both species of manta rays, the length of the reproductive cycle is also uncertain with estimates varying from one year to five years.

Data on ageing and the reproductive cycle are particularly important to demographic studies and are needed to enable accurate determination of estimates of sustainability of the species' populations.

Remaining biological issues

Research in the Oceania region is required to:

- Validate band pair periodicity of Scalloped and Smooth Hammerheads.
- Validate age of Giant and Reef Manta Rays.
- Determine reproductive length of female reproductive cycles of all five species.

As far as can be ascertained, there are no projects current planned to gather this biological information.

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9 Appendix 1

Table 1. FAO fishery commodities global production and trade in Oceania countries for 2009-2013 (tonnes). Source: FAO 2016 (nei = not elsewhere included, not identified to species level).

Country	Trade Flow	Commodity	2009	2010	2011	2012	2013
Australia	Export	Sharks nei, fresh or chilled	5	0	0	0	0
		Sharks nei, frozen	61	40	0	0	0
	Sub-total Export		66	40	0	0	0
	Import	Shark fins, dried, unsalted	7	6	16	0	0
		Shark fins, dried, whether or not salted, etc.	0	0	0	27	23
		Sharks nei, fresh or chilled	553	582	432	489	521
		Sharks nei, frozen	1	2	0	16	49
	Sub-total Import		561	590	448	532	593
Total Australia			627	630	448	532	593
Fiji	Export	Shark fins, dried, whether or not salted, etc.	0	0	0	33	11
		Sharks nei, fresh or chilled	0	0	56	0	0
		Sharks nei, frozen	4	0	28	20	0
	Sub-total Export		4	0	84	53	11
	Import	Shark fins, dried, whether or not salted, etc.	0	0	0	25	25
		Sharks nei, fresh or chilled	0	0	0	6	25
		Sharks nei, frozen	0	0	0	355	706
	Sub-total Import					386	756
	Re-export	Shark fins, dried, whether or not salted, etc.	0	0	0	1	2
		Sharks nei, fresh or chilled	0	0	56	219	0
		Sharks nei, frozen	0	0	28	61	24
	Sub-total Re-export		0	0	84	281	26
Total Fiji			4	0	168	720	793
Kiribati	Export	Shark fins, dried, whether or not salted, etc.	2	1	3	2	0
Marshall Islands	Export	Shark fins, dried, whether or not salted, etc.	16	11	24	7	3
		Shark fins, frozen	0	0	0	16	0
		Sharks nei, frozen	67	27	105	55	60
	Sub-total Export		83	38	129	78	63
Total Marshall Islands			83	38	129	78	63
Fed. States of Micronesia	Export	Sharks nei, frozen	0	0	145	68	4
	Import	Sharks nei, frozen	0	0	23	47	0
Total Fed. States of Micronesia			0	0	168	115	4

Country	Trade Flow	Commodity	2009	2010	2011	2012	2013
New Zealand	Export	Shark fillets nei, frozen	819	970	676	448	598
		Shark fillets, fresh or chilled	12	12	23	4	4
		Shark fins, dried, whether or not salted, etc.	0	0	0	61	9
		Sharks nei, fresh or chilled	569	717	565	759	816
		Sharks nei, frozen	435	625	684	794	1084
		Sharks, rays, chimaeras nei, frozen	37	39	32	21	24
		Sharks,rays,chimaeras, nei fillets fresh or chilled	0	0	0	1	0
		Sharks,rays,chimaeras, skates, fillets, frozen, nei	395	743	401	147	152
	Sub-total Export		2267	3106	2381	2235	2687
	Import	Shark fins, dried, whether or not salted, etc.	0	0	0	1	0
		Sharks nei, frozen	0	1	0	0	0
	Sub-total Import		0	1	0	1	0
	Re-export	Sharks nei, fresh or chilled	1	0	0	0	0
		Sharks,rays,chimaeras, skates, fillets, frozen, nei	1	0	0	0	0
	Sub-total Re-export		2	0	0	0	0
Total New Zealand			2269	3107	2381	2236	2687
Papua New Guinea	Export	Shark fins, dried, whether or not salted, etc.	12	17	25	1	8
		Sharks nei, fresh or chilled	0	0	2	0	0
		Sharks nei, frozen	0	24	18	0	0
	Sub-total Export		12	41	45	1	8
	Import	Shark fillets nei, frozen	0	0	0	0	5
	Sub-total Import		0	0	0	0	5
Total Papua New Guinea			12	41	45	1	13
Solomon Islands	Export	Shark fins, dried, whether or not salted, etc.	1	2	6	4	5
Tonga	Export	Sharks nei, fresh or chilled	0	0	0	15	0
Vanuatu	Export	Shark fins, dried, whether or not salted, etc.	0	0	0	1	0
		Shark fins, frozen	0	0	0	1	0
		Sharks nei, frozen	1	0	0	63	128
	Sub-total Export		1	0	0	65	128
Total Vanuatu			1	0	0	65	128
Total Oceania			2999	3819	3348	3768	4286

10 Appendix 2

Table 1: Numbers of sharks observed in Longline catches for 2010-2014 based on SPC data holdings. Listed for each species by CITES Flag states and the location (EEZ or International Waters). OCS=Oceanic Whitetip Shark, SPL= Scalloped Hammerhead, SPK = Great Hammerhead, SPZ=Smooth Hammerhead, SPN= Hammerhead Shark (general), POR= Porbeagle Shark, RMB= Giant Manta Ray.

Species	OCS	SPL	SPK	SPZ	SPN	POR	RMB
Total # recorded Flag	16216	1012	415	182	2089	20519	301
Total # recorded EEZ	16215	1010	415	182	2089	20519	301
Flag							
Fji	1127	44	74	28	7	0	12
Palau	1	0	0	0	0	0	0
Papua New Guinea	2435	625	268	25	1144	0	10
Samoa	21	0	0	0	0	0	1
Solomon Islands	981	2	0	0	22	0	3
Vanuatu	177	37	33	9	0	0	20
Australia	260	10	3	23	260	51	196
New Zealand	19	0	0	16	0	4302	0
Flag (Competent Authorities)							
Cook Islands	55	0	1	1	0	0	2
Fed States Micronesia	202	0	0	0	0	0	1
Kiribati	3	0	0	0	0	0	0
Marshall Islands	10	0	1	0	0	0	0
Tonga	639	4	6	9	24	0	0
Flag (External Territories)							
French Polynesia	576	0	2	3	0	0	12
New Caledonia	148	1	1	8	4	0	0
United States	4644	37	0	45	33	0	0
Flag (Others)							
China	1286	8	2	0	10	0	7
Chinese Taipei	2388	238	23	9	436	0	25
Japan	532	0	0	2	96	16163	1
Korea	712	6	1	4	53	3	11
EEZ							
Fiji	1075	43	69	28	8	0	11
Palau	6	1	1	0	0	0	0
Papua New Guinea	3263	857	284	32	1458	0	13
Samoa	11	0	0	0	0	0	0
Solomon Islands	918	8	4	3	130	0	9
Vanuatu	232	37	37	9	0	0	28

Australia	608	10	3	11	332	3129	192
New Zealand	18	0	0	18	0	17298	0
EEZ (Competent Authorities)							
Cook Islands	145	0	0	1	0	0	8
Fed States Micronesia	639	1	0	0	13	0	5
Kiribati	917	3	0	1	26	0	6
Marshall Islands	996	5	3	0	0	0	1
Tonga	727	4	7	11	24	0	0
Tuvalu	79	0	0	0	2	0	0
EEZ (External Territories)							
French Polynesia	547	0	2	3	0	0	12
New Caledonia	172	1	1	8	16	0	0
United States	3074	32	0	33	24	0	0
EEZ (Others)							
Nauru	21	0	0	0	0	0	0
International Waters	2767	8	4	24	56	92	16

Table 2. Numbers of sharks observed in purse seine catches for 2010-2014 based on SPC data holdings. Listed for each species by CITES Flag states and the location (EEZ or International Waters). OCS=Oceanic Whitetip Shark, SPL= Scalloped Hammerhead, SPK = Great Hammerhead, SPZ=Smooth Hammerhead, SPN= Hammerhead Shark (general), POR= Porbeagle Shark, RMB= Giant Manta Ray.

Species	OCS	SPL	SPK	SPZ	SPL	SPN	POR	RMB
Total # recorded Flag	518	17	24	7	17	33	0	1149
Total # recorded EEZ	518	17	24	7	17	33	0	1149
Flag								
Papua New Guinea	50	4	1	0	4	0	0	226
Solomon Islands	7	0	1	0	0	0	0	7
Vanuatu	17	0	0	0	0	3	0	19
New Zealand	4	0	0	0	0	0	0	3
Flag (Competent Authorities)								
Fed States Micronesia	20	0	0	0	0	0	0	14
Kiribati	21	0	1	0	0	2	0	42
Marshall Islands	19	1	2	0	1	1	0	9
Tuvalu	4	0	0	0	0	0	0	13
Flag (External Territories)								
United States	167	0	2	0	0	5	0	181
Flag (Others)								
China	12	0	2	0	0	2	0	77
Chinese Taipei	61	1	1	1	1	1	0	151
Ecuador	18	2	2	5	2	9	0	5
El Salvador	6	0	1	0	0	4	0	0
Japan	36	0	4	1	0	1	0	92
Korea	46	1	3	0	1	2	0	222
Philippines	14	6	1	0	6	1	0	82
Spain	16	2	3	0	2	2	0	6
EEZ								
Palau	0	0	2	0	0	0	0	1
Papua New Guinea	179	10	6	0	10	5	0	625
Samoa	0	0	0	0	0	0	0	1
Solomon Islands	44	0	2	0	0	3	0	101
EEZ (Competent Authorities)								
Cook Islands	1	0	1	0	0	0	0	0
Fed States Micronesia	40	0	2	1	0	1	0	95
Kiribati	120	2	3	2	2	7	0	208
Marshall Islands	11	0	0	0	0	1	0	10
Tokelau	10	0	0	0	0	0	0	2

Tonga	0	0	0	0	0	0	0	0
Tuvalu	35	0	1	1	0	0	0	19
EEZ (External Territories)								
United States	2	0	0	0	0	0	0	1
EEZ (Others)								
Nauru	27	0	1	0	0	2	0	67
International Waters	49	5	6	3	5	14	0	19